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A THEORETICAL COMPARISON OF BANKING STRUCTURES

Ka Kei Chan
University of Westminster, UK
Alistair Milne
Loughborough University, UK

ABSTRACT:

The objective of this paper is to compare, using a simple theoretical framework, the value created in different banking structures. We construct a model to characterise a banking group that consists two different subsidiary banks. The model distinguishes safe *utility* subsidiary bank from riskier *casino* subsidiary bank. Under these model specifications, three types of banking structures— (1) total separation, (2) ring fencing, and (3) universal banking—are studied. Our proposed model shows that total separation is always a suboptimal banking structure to the economy as a whole, while the choice between ring fencing and universal banking depends on the expected returns to the subsidiary banks.

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Corresponding Author's Email Address: k.chan1@westminster.ac.uk

INTRODUCTION

The objective of this paper is to compare, using a simple theoretical framework, three banking structures—total separation, ring fencing, and universal banking. We attempt to determine which banking structure is the most beneficial to an economy, and what factors could affect this result.

The regulation on banking structure has been a long debated question since Glass-Steagall Act in 1933. Recently, following the 2007-09 global financial crisis, the Independent Commission on Banking (ICB) in the United Kingdom, chaired by Sir John Vickers, was asked to consider structural reforms to promote financial stability and competition in the UK banking sector. And in its final report, released on 12 September 2011, the key suggestion on financial stability was to reduce the taxpayer subsidies to bank risk-taking by the ring fencing of different subsidiary banks and banking activities. In short, the report suggested that, without prohibiting banking groups from providing both commercial and investment banking services, the UK-domestic retail banking subsidiaries should be legally insulated (ring-fenced), but not separated, from other investment banking and global banking activities.

From the ICB final report, it is clear that an important purpose of ring fencing of subsidiary banks is to ensure that capital and liquidity transfers from ring-fenced subsidiaries to non-ring-fenced activities are restricted: *"one case where the ring-fence would constrain capital flows... is when the group did not have sufficient capital to maintain appropriate safeguard levels in the ring-fenced bank... at times of financial distress when the safety and continuity of the retail banking operations could be jeopardised by transferring capital across the ring-fence."* (paragraph 5.52, page 138).

However, restricting liquidity and capital transfer between ring-fenced and non-ring-fenced subsidiary banks does not mean it is forbidden to do so. In fact, one key advantage of ring fencing, according to the ICB final report, is that *"different parts of the group would be able to recapitalise each other subject to meeting regulatory minima – when the transfer of capital is likely to be socially valuable."* (paragraph A3.20, page 274).

It is also obvious from the ICB final report that the UK policy makers are not in favour of total separation of subsidiary banks: *"the Commission does not accept the conclusion that only total separation will work."* (paragraph 2.14, page 26). This is because *"in reality, the ability to transfer excess capital around the group in normal conditions should provide substantial advantages to creditors and capital providers compared to full*

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separation" (paragraph A3.71, page 292).

Therefore, it can be concluded that the reform of the UK banking sector will be focused on the conditional restrictions on universal banking. As numerous research has already shown that universal bank affiliations create positive value (Vennet (2002), Overfelt et al (2009) and Chronopoulos et al (2011)), is it true that ring fencing can retain the benefits of universal banking, while avoiding the spill-over effect from the risky investment activities to the retail banking subsidiaries? This is the core question we aim to answer in this paper.

The model proposed in this paper is a simple one. We characterised a banking group that consists two different subsidiary banks—*utility bank* and *casino bank*, which resembles retail banking and investment banking respectively. The two subsidiary banks are assumed to operate separately and distinguishable regardless of the banking structures. The model further assumes that utility bank is protected by deposit insurance and as a result its risk level is restricted such that it remains default-remote regardless of the economy states; casino bank on the other hand is not protected by deposit insurance, and has no restriction on the risk level of investment, and therefore could suffer from bank failure at some economy states.

Based on the specifications of the two subsidiary banks, we explore three banking structures-- total separation, ring fencing, and universal banking. Inspired by the ICB report, we distinguish these three structures by the restrictions on capital transfer between subsidiary banks. Under total separation it is assumed that subsidiary banks cannot have any capital transfer at all times; Under ring fencing the subsidiary bank with excess capital are allowed to transfer capital to the other, provided that the capital transfer does not affect the promised return to its depositors; Under universal banking the subsidiary banks are committed to transfer capital to each other when there is a shortfall.

TABLE 1: BANK FAILURE UNDER DIFFERENT BANKING STRUCTURES

Banking Structures	Total Separation (TS)		Ring Fencing (RF)		Universal Banking (UB)	
	Utility	*Casino*	*Utility*	*Casino*	*Utility*	*Casino*
Good Economy	√	√	√	√	√	√
Poor Economy	√	*X*	√	√	√	√
Systemic Crisis	√	*X*	√	*X*	*X*	*X*

(√ represents no bank run and *X* represents bank run)

We distinguish three economy states: good economy, poor economy, and systemic crisis, and Table 1 summarises the failures of different bank subsidiaries under different economy states.

Under total separation (two subsidiary banks are two standalone banks and no capital transfer is allowed between them), utility bank survives at all times, while casino bank only survives when the economy is good.

Under ring fencing, utility bank rescuses casino bank at the poor economy state with its excess capital; this is possible because the loss in casino bank at this state is assumed to be mild. However, at systemic crisis when casino bank suffers huge loss, utility bank is uncapable to rescue due to the insufficient capital, and is therefore ring-fenced from the failure of casino bank. The outcome is utility bank survives while casino bank fails.

Under universal banking, the situations are similar to the those under ring fencing at good and bad economy states. However, in systemic crisis, as the two subsidiary banks are committed to help each other whenever there is a shortfall (i.e. they are inseparable), the huge loss of casino bank will bring down utility bank, resulting in a failure of the banking group as a whole.

Using this proposed framework, our model suggests that total separation is always suboptimal both to the banking group and to the economy as a whole, due to the liqudation loss of casino bank at two economy states, of which one is avoidable. This results in a lower value in the banking structure of total separation.

The model also suggests that, there is no definite answer in choosing between ring fencing and universal banking, because the choice depends on the expected returns to utility bank and casino bank. The model shows that if the expected return to casino bank is relatively high compared with the expected return to utility bank, universal banking has a higher value than ring fencing, and vice versa.

The intuition behind this conclusion is explained as follows. First of all, it is obvious from Table 1 that there are fewer bank failures under ring fencing than under universal banking; therefore, ring fencing has a higher value if we only consider the number of bank failures at different economy states. Yet, our model shows that there exists an implicit mechanism which can offset (or even dominate) the value created from fewer bank failures.

This mechanism is originated from the required return demanded by the investors. For utility bank, its depositors are also risk-free due to the protection of deposit insurance, and therefore the required return is constant regardless of the banking structure. However, the situation is different in casino bank. As casino-bank depositors face different losses under different banking structures, they will demand different required returns accordingly. From Table 1, comparing the loss that casino-bank depositors have to bear under ring fencing and universal banking, it might at the first sight be persuaded that the losses are the same, because in both cases there is only one failure. However, this is not true.

The reason is because under ring fencing the loss in casino bank is solely borne by the casino-bank depositors, while under universal banking the loss in casino bank is jointly borne by utility bank. In the latter case, the actual loss to casino-bank depositors is less, and this reduces the required return demanded. A lower required return allows casino bank to keep less reserve to meet the withdrawal, and to invest more in the productive (but risky) asset to generate a higher expected return. This creates a positive value in the model which can offset the value created by fewer bank failures. If the expected return from the productive asset is sufficiently high, the value from a lower required return can dominate the value of fewer bank failures; this suggests that the banking structure of universal banking could have a higher value than ring fencing.

The insight from the model conclusion is that the choice of banking structure should not solely be determined by 'counting' the number of bank failures; we suggest that having a joint failure can be more beneficial to the economy *ex ante,* subject to certain conditions. Therefore, we suggest that careful evaluations have to be done to determine whether ring fencing is truly the best banking strcuture for the economy in the long run.

What is new in this study is the modelling of the trade-off under different banking structures. It investigates how the trade-off affects the risk and the return to (1) the subsidiary banks and to the banking group, (2) the required return demanded by the consumers, and (3) the cost of deposit insurance. This paper applies a similar framework as suggested in Diamond and Dybvig (1983) and Allen and Gale (1998) for the charaterisation of the subsidiary banks.

To the best of our knowledge, this is the first study to construct a theoretical model to compare the banking structures of total separation, ring fencing, and universal banking, and to evaluate the value of these banking structures.

The rest of this paper is organised as follows: the second section provides a brief literature review on ring-fencing and universal banking, the third section explains the model and its implications, and the final section concludes. In the appendix, the technical details are specified and derived.

LITERATURE REVIEW

Studies on Ring-Fencing

The studies on ring fencing in banking sector is still in its infancy. Exploring ring fencing in banking as a major objective is scarce in previous research; most of the previous papers discuss ring fencing only as a minor policy suggestion. Acharya (2011) comments that the introduction of ring fencing according to the ICB final report may fail because banks may be encouraged to take excessive risks within the ring-fenced subsidiary; also he argues that the major cause for the 2007-09 crisis was the risky mortgages and mortgage backed securities, which were held within the commercial banking exposures (within the fence); ring fencing, by itself, would not necessarily have controlled the risky exposures within the fence.

Chow and Surti (2011) discuss the motivation, content, operational challenges and potential costs of three major proposals for financial reform after the crisis; the three proposals include narrow utility banking (a reversion of deposit-funded banks into traditional payment function outfits without lending and investment banking activities), the Volcker Rule (forbidding deposit-funded banks to carry out certain types of investment banking activities), and ring fencing. The paper suggests that all proposals fail to consider the shadow banking sector, and since regulated banking institutions are likely to maintain links with the shadow banking sector, the systemic risk that is shifted to the unregulated shadow banking sector could still affect the regulated retail banks. They also suggests that ring fencing has a smaller loss of diversification benefits than the other two proposals. Yet, whether the loss of diversification benefits could be compensated by the gains of the proposals remains unclear.

Song (2004) briefly introduces and discusses ring fencing as a mean for supervision of foreign banks in emerging markets. The ring fencing discussed in Song's paper focuses on the insulation of domestic bank subsidiaries from foreign parent banks. Song comments that there may exist concerns for transparency because market participants do not understand the nature ring fencing, which could be very different during financial crises.

Empirical studies for ring fencing are hardly possible at the moment because of the lack of data. The

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existing empirical studies on ring fencing in banking industry are very different from the ring fencing suggested by ICB; they mainly focus on cross-border ring fencing (insulating domestic subsidiaries from foreign parent banks). Cerutti et al (2007) find evidence that subsidiary operations are preferred by foreign banks seeking to penetrate host markets by establishing large retail operations, while bank branches are more commonly found in countries that have higher taxes and lower regulatory restrictions. Cerutti et al (2010) focus on the costs of ring fencing (measured in terms of the amount of external capital that is required to cover capital shortfalls faced by the affiliates of these groups as a result of a credit shock) for cross-border banking groups under three different forms of ring fencing (partial, nearly complete, and full ring fencing); with the data from European bank groups and markets, they find evidence that under stricter forms of ring fencing, sample banking groups have substantially larger needs for capital buffers at the parent and subsidiary level than under less strict or in the absence of any ring fencing.

These empirical studies provide very limited insights for the type of ring fencing (of retail banking subsidiaries from other activities) suggested in the ICB final report. To the best of our knowledge, there has not been any theoretical modelling for ring fencing in banking industry in previous studies.

Studies on Universal Banking

Compared with those of ring fencing, the studies on universal banking are a lot more developed. Saunders (1999) comments on how different types of universal banking could have different impacts on bank competition. He points out that there are two ways to achieve the consolidation of financial services in the United States. One is by establishing *Section 20* under which banks are allowed to underwrite corporate securities; the other is by merger and acquisition of securities firms. Although the two ways of achieving universal banking can both achieve the goal of the consolidation of financial services, their impacts on bank competition are very different. The establishment of subsidiary banks has a pro-competitive effect on bank competition from the evidence that it lowers the yields for underwriting debts. On the contrary, merger and acquisition reduces the number of competitors in the market for investment banking services, and therefore has an anti-competitive effect. He reminds the regulators that monitoring the form of entry is necessary for a precise evaluation of the overall benefits in financial consolidation.

Wagner (2008) has a strong implication to this paper. In his paper, Wagner studies how more homogenised large banks affect financial stability. Wagner defines homogenised large banks as banks that extend beyond their traditional activities to combine investment banking and insurance activities in one organisation; this definition is very similar to the concept of universal banking. Wagner shows that the choice of investment made by individual banks are socially inefficient (too much investment is made in risky asset and not enough investment in liquidity), because individual banks do not internalise the impact of their investment choice on the aggregate liquidity level in the banking system. Moreover, homogenisation, which is defined as the possibility of banks to invest in an *aggregate asset* that has no idiosyncratic risk due to diversification, makes the problem worse; this is because homogenisation, through the reduction of inefficiencies, lowers a bank's cost of investing in the risky asset; this encourages a bank to invest more in risky asset and less in liquidity, and this in turn reduces financial stability. An important implication from Wagner's paper is that, although universal banking usually enjoys the benefits from risk diversification, it does not necessarily mean that it is a socially optimal banking structure because diversification of idiosyncratic risk does not affect the aggregate risk in banking system as a whole.

Although universal banking shares a few similarities as ring fencing, there are still major differences between the two banking structures. One difference is the limit on risk contagion: under ring fencing, the ring-fenced bank subsidiaries have a restricted limit on the transfer of funding to the non-ring-fenced subsidiaries. This is very different from the free transfer of liquid assets and other resources between the different branches within a universal bank; therefore, the efficiency of asset allocation in universal banking may be largely reduced under ring fencing. For this reason, the suggestions for potential benefits of universal banking, such as the diversification benefits suggested by Allen and Jagtiani (2000) and the de-specialisation efficiency suggested by Vennet (2002) and Overfelt et al (2009) and the strong evidence of being more cost- and profit-efficient in diversified institutions found in Chronopoulos et al (2011), may not be applicable under ring fencing.

The other major difference is the existence of moral hazard; under universal banking there exist incentives for excessive risk-taking due to the safety net (as suggested by Boyd (1999)) or other forms of moral hazards and conflicts of interest (as suggested by John et al (1994) and Boyd et al (1998)). These incentives may no longer exist under ring fencing because the non-ring-fenced subsidiaries are unlikely to be protected or subsidised by the authorities, and the risk-sensitivity from the investors is expected to increase and acts as a major source of control for the risk-taking behaviour in non-ring-fenced subsidiaries. Due to these major differences, it can be concluded that, although there exist similarities between universal banking and ring fencing, the results from the studies on universal banking should not be applied directly to the ring fencing.

For more general discussions and a wider scope of literature reviews on universal banking. Please refer to Calomiris (1995) for an excellent introduction for universal banking, and a comparison of the universal banking systems between the United States and Germany.

The proposed model in this study is related to a number of studies on bank liquidity models and bank failures, including Byrant (1980), Diamond and Dybvig (1983), Chari and Jagannathan (1988), Allen and Gale (1998, 2004, 2007), Zhu (2005), Samartin (2005), Diamond and Rajan (2005), Calomiris and Kahn (1991) and Marini (2008). However, since bank liquidity models are not the focus in this study, a thorough literature review on these models is not included here. For the readers who are interested in bank liquidity models applied in this paper, please refer to the mentioned papers for details.

MODEL AND IMPLICATIONS

The proposed model in this paper applies similar frameworks as in Diamond and Dybvig (1983) and Allen and Gale (1998) to capture the characteristics of utility bank and casino bank respectively. With these frameworks, the model studies how different banking structures affect the return to the subsidiary banks, which in turn affects the value of different banking structures. The model is summarised in Figure 1.

This section is subdivided into five parts, respectively explaining (1) the time horizon and the assets (production technologies) available in the economy; (2) the behaviour of consumers; (3) the banking group, utility bank and casino bank; (4) the three banking structures and their corresponding values; and (5) the implications of the model. All notations used in this model are listed in Table 2.

The Economy

This model has three dates (denoted by $0, 1, 2$). On date 0, all investments are made under uncertainty; on date 1, uncertainty is resolved and early liquidity demand is settled; on date 2, residual resources are distributed to the remaining claimants.

The economy has four types of agents: (1) consumers, (2) utility subsidiary bank, (3) casino subsidiary bank, and (4) the banking group. All agents are assumed to be risk-neutral; therefore, their utility function is linear and can be expressed simply by $U(x) = x$, where $x \geq 0$.

The initial endowment can be used for either consumption or production. The types of production technologies available in the economy are (1) storage technology, (2) safe asset, and (3) risky asset; their returns are summarised in Table 3.

The *storage technology* is a risk-free technology and preserves the endowment between any two adjacent dates without any loss of value; therefore, the gross rate of return from the storage technology is one, between any two adjacent dates.

The safe asset is a long-term and risk-free investment. It requires an input of endowment on date 0 and produces a constant gross rate of return $R > 1$ on date 2. If safe asset is liquidated on date 1; the gross rate of return from liquidation is assumed to be one.

The risky asset is also a long-term investment, which requires an input of endowment on date 0 and produces a return on date 2. However, the return to risky asset is random, and the randomness depends on three economy states ($S = H, M, L$), under which the risky asset generates gross rates of return of $R_H > 1$, $R_M = 1$, and $R_L < 1$ respectively; we further assume that the risky asset has a higher expected return than safe asset. The probability of having economy state S is denoted by p_s, which satisfies $p_H + p_M + p_L = 1$. If risky asset is liquidated on date 1, the gross rate of return from liquidation is assumed to be rR_S, where $r \in (0,1)$ is a discount rate and R_S is the realised gross rate of return for risky asset. Note that the information of R_S is resolved on date 1, all agents will be able to correctly predict the return to risky asset on date 2; i.e. rR_S is deterministic on date 1.

FIGURE 1: THE TIME LINE OF THE MODEL

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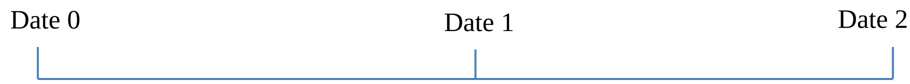

Date 0

Consumers receive an endowment of goods. They invest their endowment in one of the two subsidiary banks.

Subsidiary banks absorb the endowment from the consumers and invest in storage technology and different long-term assets.

The economy state is uncertain at this time.

Date 1

The economy state is known to all agents; the three different economy are denoted by $S = H, M, L$.

Early consumers withdraw their investment from their subsidiary banks.

If late consumers know that they will receive their promised return from their subsidiary banks on date 2, no bank run occurs; otherwise, bank run is triggered.

Different combinations of banking structure and economy states cause different bank-run scenarios.

Date 2

Depending on the banking structures and the capital shortfall, capital transfer may take place from one subsidiary bank to another.

The late consumers withdraw their investment from their subsidiary banks, if no bank run occurs on date 1.

After all consumers withdrawals are satisfied, the remaining profit is the net return to the subsidiary banks.

TABLE 2. NOTATIONS USED IN THIS PAPER

Notations	Definitions
λ	Probability of being an early consumers
$p_s \in \{p_H, p_M, p_L\}$	Probability of having economy state S
$R_S \in \{R_H, R_M, R_L\}$	Return to risk asset at economy state S
R	Return to safe asset
r	Discount rate for early liquidation of risky asset
$C_j \in \{C_t, C_r, C_u\}$	Required return for casino-bank depositors under banking structure j
$K_j^{ub} \in \{K_t^{ub}, K_r^{ub}, K_u^{ub}\}$	Expected net return to utility bank under banking structure j
$K_j^{cb} \in \{K_t^{cb}, K_r^{cb}, K_u^{cb}\}$	Expected net return to casino bank under banking structure j
$V_j \in \{V_t, V_r, V_u\}$	Value of banking structure j
D	Cost of deposit insurance

TABLE 3: RATE OF RETURN TO PRODUCTION TECHNOLOGIES

Date-2 Return (No Liquidation)

Economy State	Storage	Safe Asset	Risky Asset
$S = H$	1	R	$R_H > 1$
$S = M$	1	R	$R_M = 1$
$S = L$	1	R	$R_L < 1$

Date-1 Return (Liquidation)

Economy State	Storage	Safe Asset	Risky Asset
$S = H$	1	1	rR_H
$S = M$	1	1	rR_M
$S = L$	1	1	rR_L

Consumers

Consumers are assumed to be risk-neutral, perfectly-competitive and continuum, with a mass measure of initial endowment normalised to one. Each consumer has an identical but independent consumption pattern, which is uncertain on date 0. On date 1, the consumers realise their consumption pattern: those who choose to consume on date 1 are called *early consumers* and they only value consumption on date 1; the rest who choose to consume on date 2 are called *late consumers* and they only value consumption on date 2. The ex-ante utility function for a consumer can be given by

$$u(c_1, c_2) = \begin{cases} c_1, & \text{for an early consumer} \\ c_2, & \text{for a late consumer} \end{cases}$$

where c_1 and c_2 are the consumptions on date 1 and date 2 respectively.

The consumers do not know their consumption pattern on date 0; therefore, all consumers are date-0 identical. The consumption pattern of an consumer is a private information and therefore no agent (other than the consumer him/herself) can distinguish an early consumer from a late consumer at all times.

The probabilities of being an early consumer and a late consumer are given by the constant parameters λ and $1 - \lambda$ respectively. From the perspective of an economy as a whole, due to the continuum nature of consumers, the aggregate proportions of early and late consumers are constants, which are equivalent to the corresponding probabilities respectively.

The consumers are assumed to have storage technology, but they cannot invest in the two assets directly. Therefore, the investment in assets have to be financially intermediated by a subsidiary bank. Due to the nature of risk neutrality, the subsidiary banks must provide the same expected rate of return to the consumers; as a result, the consumers are indifferent between the choice of subsidiary banks. Assuming that the consumers invest their endowment randomly in one of the subsidiary banks, each subsidiary bank will obtain an equal share (1/2 unit) of endowment on date 0.

Also, due to the perfect-competitive nature of the consumers, the consumers will be willing to invest in the subsidiary banks as long as the subsidiary banks provide the same expected returns as the storage technology. For simplicity, we assume that the consumers do not store their endowment on date 0, because the subsidiary banks provide an expected return which is equal to the storage technology.

Banking Group

The subsidiary banks—*utility bank* and *casino bank*—are under the same banking group. This banking group is assumed to have no endowment intially, but it has a financial-intermediation technology. This technology allows its subsidiary banks to collect endowment from consumers for the investment in long-term assets. The objective of the banking group is to maximise its expected net returns (the sum of the expected net returns from the subsidiary banks).

In this model, we assume that bank runs are triggered by consumers knowing that they will not get their promised returns in full subject to the sequential service constraint. As consumption pattern is indistinguishable, the late consumers (pretending to be early consumers) will withdraw on date 1 when they know that they will not get their promised return on date 2. Attempting to satisfy the withdrawals, the subsidiary banks will liquidate the long-term asset (sometimes, at a loss) on date 1. More detailed explanation of bank run is given in the following subsections.

Utility Bank

The key assumption for utility bank is that, the utility-bank depositors are assumed to be protected by deposit insurance, which guarantees their promised returns when utility bank defaults. This provides a risk-free nature to the consumers who invest their endowment in utility bank on date 0. However, to create the possiblity of a bank run in utility bank, we assume that consumers suffers a minor delay in consumption if they need to claim their promised return from deposit insurance; this reduces their utility by an infinitestimal amount. This assumption creates an incentive for utility-bank depositors to run utility bank (even though they can obtain their promised return from deposit insurance) when they know they will not be able to get their promised return from their subsidiary banks. The cost of deposit insurance is denoted by D, which is defined as the *ex-ante* expected insurance claim on date 0.

The model also assumes that, due to the protection of deposit insurance, the risk of utility bank is restricted by the bank regulation. This is represented by the forbidding of investment in risky asset. In other words, utility bank can invest only in storage technology and safe asset.

By definition, there is no uncertainty in utility bank per se: the proportions of early and late withdrawals and the asset returns are both known on date 0. This allows utility bank to promise a constant return to its depositors, and at the same time remains default-remote (except in the case of universal banking). Recall that as the consumers are perfectly competitive, utility bank only needs to offer the gross rate of return equivalent to the return from storage technology (which is one) to the its depositors, regardless of early or late withdrawals.

As utility bank can accurately predict the date-1 consumer withdrawal, which is equal to $\lambda/2$ unit of goods. Therefore, on date 0, utility bank invests $\lambda/2$ unit of endowment in storage technology (for the date-1 withdrawal of early consumers), and $(1-\lambda)/2$ unit of endowment in safe asset to generate a gross return of $R(1-\lambda)/2$ unit of goods on date 2.

Casino Bank

The key differences between utility bank and casino bank are that casino bank is not protected by the deposit insurance, and because of this casino bank is not restricted by bank regulation on its risk level; and therefore, casino bank can invest in all types of assets in the economy. However, due to the assumption that risky asset has a higher expected return than safe asset and casino bank is risk-neutral, casino bank will only invest in risky asset and storage technology.

As the return to risky asset depends on the economy state, casino bank is subject to potential loss which can trigger a bank run on date 1. And since the gross rate of return to the casino-bank depositors in a bank run is smaller than one, casino bank has to promise a higher gross rate of return (denoted as C) to its depositors (when the bank survives) such that the expected gross rate of return to casino-bank depositors is equivalent to the return from the storage technology; i.e. $C > 1$. Note that the promised return (C) must be the same for both date-1 and date-2 withdrawals; otherwise casino bank is not maximising its own return.

Recall that at economy states $S = M, L$, the returns to risky asset are $R_M = 1$ and $R_L < 1$ respectively, which are both below the promised return to the casino-bank depositors ($C > 1$). This implies that, without the help from utility bank, casino bank will fail to pay the promised returns to its depositors on date 2 (late consumers) at these states. This triggers a bank run in casino bank on date 1. Casino bank has to liquidate its risky asset at a discount rate to obtain a liquidated rate of return (rR_S) from risky asset.

Similar to the case of utility bank, casino bank invests a predictable amount of endowment in storage technology for date-1 withdrawal; the amount being invested is $\lambda C/2$ unit of endowment; this amount is expected amount of the date-1 withdrawal if no bank run occurs. The remaining $(1-\lambda C)/2$ unit of endowment is invested in risky asset, which generates a gross return of $R_S(1-\lambda C)/2$ units of goods on date 2.

Banking Structures

In this model, banking structures are defined based on the restriction of capital transfer between the two subsidiary banks. The definitions of the three types of banking structures are as follows.

- *Total separation* is defined as a banking structure under which the subsidiary banks are not allowed to transfer capital to each other, regardless of the economy states.
- *Ring fencing* is defined as a banking structure under which a subsidiary bank is allowed to transfer capital to the other bank, provided that the promised returns to its depositors have already been fulfilled.
- *Universal banking* is defined as a banking structure under which the subsidiary banks have joint asset and liability, and therefore they are committed to transfer capital to each other, whenever there is a shortfall in promised returns.

In this model, a capital transfer is defined as the transfer of net return from one subsidiary bank to the other *on date 2*, such that the subsidiary bank with a shortfall can fulfill its promised returns to all depositors to avoid a bank run being triggered.

In order for the economy states to be meaningful, the three economy states are assumed to satisfy the following assumptions.

- When $S = H$, both subsidiary banks have positive net returns; i.e. no bank run occurs in any subsidary banks, and no capital transfer is needed.
- When $S = M$, there is a small capital shortfall in casino bank, which triggers a bank run; however, if capital transfer is allowed, utility bank can transfer enough capital (without affecting the promised returns to its depositors) to cover the shortfall in casino bank to avoid a bank run.
- When $S = L$, there is a large shortfall in casino bank, which triggers a bank run; due to the size of the shortfall, utility bank does not have enough capital to cover the shortfall in casino bank without affecting the promised returns to its depositors.

The above specifications can be expressed mathematically as

$$(1-\lambda)C - (1-\lambda C) < (R-1)(1-\lambda) < (1-\lambda)C - R_L(1-\lambda C) \quad (1)$$

The second term represents the net return to utility bank on date 2, which is bigger than the shortfall in casino bank at economy state $S = M$ (the first term), but smaller than the shortfall at economy state $S = L$ (the third term).

The value of each banking structure is defined as the net return to the banking group minus the cost to deposit insurance. Note that since there is no expected claim to deposit insurance under total separation and ring fencing (because utility bank remains default-remote regardless of the economy states), the expected claim to deposit insurance is zero. Therefore, the values of these two banking structures are simply the net expected returns to the banking group.

Also note that the expected return to the consumers does not affect the value of banking structure because the consumers' expected return is always the same (a gross rate of return of one) regardless of the banking structures. The detailed derivation for the value of each banking structures and other parameters are given in the technical appendix.

To avoid confusion in the following and in the technical appendix, some notations are subscripted with t, r, u, which stand for the banking structures of total separation, ring fencing, and universal banking respectively.

Model Implications

There are two important implications in the proposed model, which are explained in details in the following.

Required Returns to Consumers

One key feature of the proposed model is that it assumes that there is no information asymmetry in the economy, and therefore the consumers are fully aware of how different banking structures can affect the risk of their investment in the subsidiary banks; this in turn affects their required return for their investment from the subsidiary banks.

For the consumers who deposit in utility bank, they face a simple situation because there is no uncertainty in their return (due to the utility-bank investment in safe asset and the existence of deposit insurance); therefore the required returns from utility bank are the same (which is equivalent to the return of storage technology) regardless of the banking structure.

The situation is more complicated for the consumers who deposit in casino bank; they face different risk under different banking structures. Under total separation, casino bank fails to pay the promised returns at two economy states, which triggers bank run and asset liquidation (socially wasteful due to the discount factor r) at both states. This is a risk to the casino-bank depositors because they only receive their promised return at one economy state.

Under ring fencing and universal banking, the risk to casino-bank depositors is reduced because casino bank only fails to pay the promised returns at one economy state (due to the capital transfer from utility bank); therefore, the casino-bank depositors receive their promised return at two economy states. For this reason, it is obvious that the required return from casino bank is highest under total separation.

How about the required returns under ring fencing and universal banking? It is tempted to say that under both banking structures, casino-bank depositors face risk at one economy state and therefore the required returns should be the same; but this is wrong because of the assumption of inseparable asset and liability under universal banking.

Recall that under universal banking, when casino bank faces the worst economy state and suffers a bank run, all assets in the banking group are liquidated to attempt to satisfy the withdrawal; while under ring fencing, only assets in casino bank can be liquidated due to the capital transfer restriction. As a result, casino-bank depositors can retrieve more liquidated asset under universal banking than under ring fencing. Taking this into consideration, the required return from casino bank will be higher under ring fencing than under universal banking. The above discussion can be concluded in the Proposition 1; formal proof for this proposition is given in the appendix.

Proposition 1 *The required return from casino bank is highest under the banking structure of total separation and lowest under universal banking; i.e.* $C_u < C_r < C_t$.

Values of the Banking Structures

Proposition 1 is crucial to this paper as it shows not only the required returns under different banking structures, but also affects the investment portfolio of the casino bank.

Recall that casino bank invests $(1 - \lambda C)/2$ unit of endowment in risky asset, and this is function of the

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required return C. From Proposition 1, it can be concluded that investment in risky asset is the smallest under total separation and is the largest under universal banking. As risky asset has the highest expected return among all assets, a smaller investment means the expected return to casino bank (and also to banking group) is lower, and hence the value of the banking structure is lower.

Therefore, it is clear that total separation is always suboptimal to an economy, because ring fencing dominates total separation in both (i) a lower socially wasteful liquidation loss (from fewer bank runs) and (2) a higher expected return to casino bank (from the larger initial investment in risky asset). This result is concluded in Proposition 2, and the formal proof is provided in the appendix.

Proposition 2 *Both the social value and the expected return to the banking group is higher under the banking structure of ring fencing than under total separation.*

The comparison of the value between ring fencing and universal banking is more complicated: two opposite forces have to be considered. The positive force comes from a larger investment in risky asset under universal banking, which generates a higher expected return than under ring fencing; the negative force comes from the positive cost of deposit insurance under universal banking, which is by definition equal to zero under ring fencing.

To better explain these two opposite forces, consider the following example under universal banking. Assume that the return for risky asset at good state (R_H) is a variable, while the returns at other states (R_M and R_L) are constants; and further assume that the change of R_H does not violate the assumption that all casino-bank depositors get their promised at the good state ($S = H$), without any capital transfer from utility bank.

As a change in R_H does not affect the risk level of casino-bank depositors, the required return of casino-bank depositors (C_u) remains unchanged; this further implies that the expected cost of deposit insurance also remains unchanged (In the appendix, we show that the cost of deposit insurance is not a function of R_H). As a result, it can be considered that the cost of deposit insurance is a constant force in the two opposite forces. On the other hand, a change in R_H does affect the expected return to risky asset; i.e. a higher R_H increases the expected return to the casino bank.

Therefore, there exists a threshold value of R_H under which the two opposite forces exactly offset each other. If R_H is above this threshold, universal banking has a higher value to the economy than ring fencing; otherwise, ring fencing has a higher value. This result is concluded in the following proposition (the formal proof of this proposition is in appendix):

Proposition 3 *The banking structure of ring fencing has a higher value than universal banking if* $g(R_H) < R$*, where*

$$g(R_H) = 1 + \frac{\frac{1}{2}\lambda(1-rR_L)(p_H+p_M)[p_H(R_H-1)-p_L(1-rR_L)]}{[p_H+p_M+\lambda p_L(1-rR_L)]\left[p_H+p_M+\frac{\lambda}{2}p_L(1-rR_L)\right]}$$

Proposition 3 tells us that whether ring fencing or universal banking provides a higher value to the economy depends on the value of R_H. If R_H is sufficiently large, the larger investment in risky asset under universal banking may generate enough value to cover the cost of deposit insurance, leading to the conclusion that universal banking is the best banking structure; if R_H is not large enough, then the cost of deposit insurance is higher and leads to the conclusion that ring fencing is the best banking structure.

To summarise, this model has two important predictions. First, the model suggests that total separation is not the best banking structures, because capital transfer is a valuable activity between subsidiary banks; the value of capital transfer comes from both the lower asset liquidation loss and the larger expected return from risky asset.

The second prediction is that there are two oppositing forces in the comparison between ring fencing and universal banking. These forces can dominate each other, resulting in a different choice for the best banking structure in an eocnomy.

Numerical Results

To provide a better understanding of the model, some numerical examples are generated in the following. Denote V_t, V_r, and V_u as the value of the banking structure of total separation, ring fencing and universal banking respectively.

<u>Numerical Example 1:</u> In the first numerical example, we apply the following model parameters.

$$p_H = 0.5,\ p_M = 0.3,\ p_L = 0.2,\ \lambda = 0.5,$$
$$R_H = 2.5,\ R_M = 1,\ R_L = 0,\ R = 1.8,\ r = 0.5$$

The following results are obtained.

$$V_t = 0.5481,\ V_r = 0.6444,\ V_u = 0.5788$$

This numerical example shows that if R_H is not large enough, then ring fencing is the optimal banking structure in the economy; universal banking is the second best; total separation is the worst.

Numerical Example 2: If $R_H = 10$ is applied, while the values of all other parameters remain unchanged. The following results are obtained.

$$V_t = 1.9370,\ V_r = 2.3111,\ V_u = 2.3435$$

With a sufficiently high value for R_H, universal banking becomes the optimal banking structure in the economy, while ring fencing is now the second best; total separation remains as the worst banking structure.

CONCLUSION

This paper introduces a framework that characterises the utility and casino banking activities in a banking group. Under this framework, this paper studies and compares the value of three banking structures: total separation, ring fencing and universal banking. The proposed model suggests that capital and liquidity transfer between subsidiary banks has a positive value. Forbidding this transfer (total separation) is socially suboptimal and is therefore not recommended. The comparison of value between ring fencing and universal banking is more complicated. The model suggests that this comparison depends on the returns to the bank subsidiaries. Specifically, the model shows that if the return to casino bank is relatively high compared with the return to utility bank, the higher return under universal banking could dominate the cost of deposit insurance. Therefore, to ensure that ring-fencing is the optimal banking structure, regulators should conduct careful assessment on the value of capital and liquidity transfer and the return to utility and casino banking sector.

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TECHNICAL APPENDIX

Derivations of Returns under Different Banking Structures

The first part of the appendix explains the technical derivation of the model, which includes the mathematical expressions for the values of different banking structures (V_j), the required return from the casino-bank depositors under each structure (C_j), the cost of deposit insurance (D), and also the net returns to utility bank and casino bank, respectively denoted as K_j^{ub} and K_j^{cb} where $j = t, r, u$.

Total Separation

Under total separation, transfer of capital between subsidiary banks is not allowed. As a result, utility bank always survives by definition and its expected net return is not affected by the economy states. Recall that utility bank invests $\lambda/2$ unit of endowment in storage technology (for the date-1 withdrawal of early consumers), and $(1-\lambda)/2$ unit of endowment in safe asset to generate a gross return of $R(1-\lambda)/2$ unit of good on date 2. The net return to utility bank is

$$K_t^{ub} = \frac{1}{2}(R-1)(1-\lambda)$$

which is the difference between the return from safe asset and the promised return to the utility-bank depositors withdrawing at date 2.

Casino bank survives only at the economy state $S = H$, and faces bank run at the states $S = M, L$. Let C_t be the promised rate of return under total separation when casino bank survives. The amount of endowment to be preserved in storage technology is given by $\frac{1}{2}\lambda C_t$ unit, and the amount of endowment invested in risky asset is $\frac{1}{2}(1-\lambda C_t)$ unit. The expected net return to casino bank is

$$K_t^{cb} = p_H \cdot \frac{1}{2}[R_H(1-\lambda C_t) - (1-\lambda)C_t]$$

which is the difference between the return from risky asset and the promised return to late consumers at the state $S = H$.

The rate of return to casino-bank depositors at the economy states $S = M$ and $S = L$ are $\frac{1}{2}[\lambda C_t + r(1-\lambda C_t)]$ and $\frac{1}{2}[\lambda C_t + rR_L(1-\lambda C_t)]$ respectively.

With these specifications, C_t can be determined by rearranging the following equation

$$p_H U(C_t) + p_M U\big(\lambda C_t + r(1-\lambda C_t)\big) + p_L U\big(\lambda C_t + rR_L(1-\lambda C_t)\big) = 1$$

$$C_t = \frac{p_H + p_M(1-r) + p_L(1-rR_L)}{p_H + \lambda[p_M(1-r) + p_L(1-rR_L)]} > 1$$

Substituting C_t into the K_t^{cb}

$$K_t^{cb} = p_H \cdot \frac{1-\lambda}{2}\left[\frac{p_H(R_H-1) - p_M(1-r) - p_L(1-rR_L)}{p_H + \lambda[p_M(1-r) + p_L(1-rR_L)]}\right]$$

Note that $K_t^{cb} > 0$ by definition and therefore the following expression must be true:

$$p_H(R_H-1) - p_M(1-r) - p_L(1-rR_L) > 0 \qquad (2)$$

The value of total separation V_t, is the sum of K_t^{ub} and K_t^{cb}

$$V_t = K_t^{ub} + K_t^{cb} = \frac{1-\lambda}{2}\left\{(R-1) + p_H\left[\frac{p_H(R_H-1) - p_M(1-r) - p_L(1-rR_L)}{p_H + \lambda[p_M(1-r) + p_L(1-rR_L)]}\right]\right\}$$

Ring Fencing

Ring fencing is defined as a banking structure under which utility bank is allowed to transfer capital to casino bank, provided that it has fulfilled the promised return to the utility-bank depositors. From equation (1), it is clear that under ring fencing, utility bank is only allowed to transfer capital to casino bank at the economy state $S = M$. The amount of capital transfer from utility bank to casino bank on date 2 is the gap between the promised return to the late-withdrawing casino-bank depositors and the return from the casino bank's risky asset at economy state $S = M$; this is given by

$$\frac{1}{2}[(1-\lambda)C_r - (1-\lambda C_r)] = \frac{1}{2}(C_r - 1) > 0$$

The capital transfer ensures that the late casino-bank depositors receive their promised return on date 2 to prevent the occurrence of a bank run on date 1 at the state $S = M$. However, as utility bank cannot transfer capital to casino bank at the state $S = L$, a bank run in casino bank is inevitable. Taking into consideration of the capital transfer, the expected net return to utility bank is given by

$$K_r^{ub} = \frac{1}{2}[(R-1)(1-\lambda) - p_M(C_r - 1)]$$

For casino bank, the expected net return under ring fencing is

$$K_r^{cb} = p_H \cdot \frac{1}{2}[R_H(1-\lambda C_r) - (1-\lambda)C_r]$$

where the required rate of return to the casino-bank depositors can be derived by rearranging the expected return to the depositors

$$p_H C_r + p_M C_r + p_L[\lambda C_r + rR_L(1-\lambda C_r)] = 1$$

$$C_r = \frac{p_H + p_M + p_L(1-rR_L)}{p_H + p_M + \lambda p_L(1-rR_L)} > 1$$

Substituting the expression of C_r into K_r^{ub} and K_r^{cb},

$$K_r^{ub} = \frac{1}{2}\left[(R-1)(1-\lambda) - p_M \cdot \frac{p_L(1-rR_L)(1-\lambda)}{p_H + p_M + \lambda p_L(1-rR_L)}\right]$$

$$K_r^{cb} = p_H \cdot \frac{1-\lambda}{2}\left[\frac{(p_H + p_M)(R_H - 1) - p_L(1-rR_L)}{p_H + p_M + \lambda p_L(1-rR_L)}\right]$$

Note that $K_r^{cb} > 0$ by definition and therefore the following expression must be true:

$$(p_H + p_M)(R_H - 1) - p_L(1-rR_L) > 0 \qquad (3)$$

The value of ring fencing V_r, is the sum of K_r^{ub} and K_r^{cb}

$$V_r = K_r^{ub} + K_r^{cb} = \frac{1-\lambda}{2}\left[(R-1) + \frac{p_H[(p_H + p_M)(R_H - 1) - p_L(1-rR_L)] - p_M[p_L(1-rR_L)]}{p_H + p_M + \lambda p_L(1-rR_L)}\right]$$

Universal Banking

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Universal banking is defined as a banking structure under which the subsidiary banks are committed to transfer capital to each other, whenever there is a shortfall. According to the model specifications, this means that utility bank needs to transfer capital on date 2 to casino bank at two economy states, $S = M, L$. At the economy state $S = M$, utility bank is able to transfer enough capital to prevent the occurrence of a bank run in casino bank on date 1. The amount of capital transfer on date 2 is

$$\frac{1}{2}[(1-\lambda)C_u - (1-\lambda C_u)] = \frac{1}{2}(C_u - 1) > 0$$

At the economy state $S = L$, utility bank does not have enough capital to transfer to casino bank to filfill the promised return to the casino-bank depositors (equation 1). Due to the joint-liability assumption, utility-bank depositors will run utility bank on date 1 knowing that the economy state is $S = L$. As a result, there will be a joint bank run under which all depositors (regardless of the subsidiary bank they deposited in) are assumed to equally share liquidation value of the banking group.

Note that as the utility-bank depositors are protected by deposit insurance, their loss is compensated. As a result, their required return from utility bank remains the same as the other banking structures; i.e., a gross rate of one. The expected net return to utility bank is

$$K_u^{ub} = \frac{1}{2}[(p_H + p_M)(R-1)(1-\lambda) - p_M(C_u - 1)]$$

and the cost of deposit insurance D is

$$D = \frac{1}{2}\left[1 - \frac{1 + \lambda C_u + rR_L(1-\lambda C_u)}{2}\right]$$

which is the gap between the promised return to the utility-bank depositors and the (equal share of) liquidation value of the banking group.

For casino bank, the expected net return to casino bank is

$$K_u^{cb} = p_H \cdot \frac{1}{2}[R_H(1-\lambda C_u) - (1-\lambda)C_u]$$

where the required rate of return to the casino-bank depositors can be derived by rearranging the expected return to the depositors

$$p_H C_u + p_M C_u + p_L\left[\frac{\lambda C_u + rR_L(1-\lambda C_u) + 1}{2}\right] = 1$$

$$C_u = \frac{p_H + p_M + \frac{1}{2}p_L(1-rR_L)}{p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)} > 1$$

Substituting C_u into K_u^{ub}, K_u^{cb} and D

$$K_u^{ub} = \frac{1}{2}\left\{(p_H + p_M)(R-1)(1-\lambda) - p_M\left[\frac{\frac{1}{2}p_L(1-rR_L)(1-\lambda)}{p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)}\right]\right\}$$

$$K_u^{cb} = p_H \cdot \frac{1-\lambda}{2}\left[\frac{(p_H + p_M)(R_H - 1) - \frac{1}{2}p_L(1-rR_L)}{p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)}\right]$$

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$$D = \frac{1}{4}\left[\frac{(1-\lambda)(p_H + p_M)(1 - rR_L)}{p_H + p_M + \frac{\lambda}{2}p_L(1 - rR_L)}\right] > 0$$

Note that $K_u^{cb} > 0$ by definition and therefore the following expression must be true:

$$(p_H + p_M)(R_H - 1) - \frac{1}{2}p_L(1 - rR_L) > 0 \quad (4)$$

The value of universal banking V_u, is the sum of K_u^{ub} and K_u^{cb} minus D

$$V_u = K_u^{ub} + K_u^{cb} - D$$
$$= \frac{1-\lambda}{2}\left[(p_H + p_M)(R - 1) + \frac{p_H\left[(p_H + p_M)(R_H - 1) - \frac{p_L}{2}(1 - rR_L)\right] - p_M[\frac{p_L}{2}(1 - rR_L)]}{p_H + p_M + \frac{\lambda}{2}p_L(1 - rR_L)}\right]$$

Proof of Propositions

Proof of Proposition 1

Proposition 1 can be easily proved from the facts that

$$C_t - C_r = \frac{(1-\lambda)[p_H p_M(1 - r) + p_M^2(1 - r) + p_M p_L(1 - rR_L)]}{\left[p_H + \lambda\left(p_M(1 - r) + p_L(1 - rR_L)\right)\right][p_H + p_M + \lambda p_L(1 - rR_L)]} > 0$$

and

$$C_r - C_u = \frac{(1-\lambda)(p_H + p_M)\cdot\frac{1}{2}p_L(1 - rR_L)}{[p_H + p_M + \lambda p_L(1 - rR_L)]\left[p_H + p_M + \frac{\lambda}{2}p_L(1 - rR_L)\right]} > 0$$

□

Proof of Proposition 2

To show that ring fencing is better than total separation, we need to prove that $V_r - V_t > 0$. From the specifications of V_r and V_t,

$$V_r - V_t = \frac{1-\lambda}{2}\cdot A_0 \cdot (A_1 + A_2 + A_3)$$

where

$$A_0 = \left\{\left[p_H + \lambda\left(p_M(1 - r) + p_L(1 - rR_L)\right)\right][p_H + p_M + \lambda p_L(1 - rR_L)]\right\}^{-1}$$

$$A_1 = \lambda p_M p_L(1 - rR_L)[p_H(R_H - 1) - p_M(1 - r) - p_L(1 - rR_L)]$$

$$A_2 = \lambda p_H p_M(1 - r)[p_H(R_H - 1) + p_M(R_H - 1) - p_L(1 - rR_L)]$$

$$A_3 = p_H^2 p_M(1 - r) + p_H p_M^2(1 - r) + \lambda p_H p_M p_L(1 - r)(1 - rR_L)$$

Since A_0 and A_3 are positive by definition, and A_1 and A_2 are also positive (from equation (2) and (3)),

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therefore $V_r - V_t > 0$.

□

Proof of Proposition 3

The condition of ring fencing being a better banking structure than universal banking can be derived from the following expression

$$V_r - V_u = (1-\lambda)\cdot B_0 \cdot (B_1 - B_2) > 0$$

where

$$B_0 = \frac{p_L}{[p_H + p_M + \lambda p_L(1-rR_L)]\left[p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)\right]}$$

$$B_1 = (R-1)[p_H + p_M + \lambda p_L(1-rR_L)]\left[p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)\right]$$

$$B_2 = \frac{1}{2}\lambda(1-rR_L)(p_H + p_M)[p_H(R_H - 1) - p_L(1-rR_L)]$$

Since B_0 is positive by definition; $V_r - V_u > 0$ if and only if $B_1 > B_2$. Rearranging the expression, one can get

$$R > g(R_H) \equiv 1 + \frac{\frac{1}{2}\lambda(1-rR_L)(p_H + p_M)[p_H(R_H - 1) - p_L(1-rR_L)]}{[p_H + p_M + \lambda p_L(1-rR_L)]\left[p_H + p_M + \frac{\lambda}{2}p_L(1-rR_L)\right]}$$

□