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Does Corporate Governance Matter in Deposit Insurance? DI and Moral Hazard in Joint Stock and Mutual Financial Intermediaries

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Résumé: Le but de cette recherche est d'analyser les effets de l'assurance dépôt sur le comportement face au risque d'une coopérative financière comparativement à une banque d'actionnariat publique. La méthodologie se base sur une définition d'une fonction d'utilité pour la coopérative financière fondée sur des critères spécifiques à ce type d'institutions. Nous comparons cette dernière à la fonction d'utilité, ou de maximalisation du profit, d'une banque d'actionnariat publique. Nous discernons une augmentation du niveau optimal de risque pour les deux institutions suite à l'introduction de l'assurance dépôt mais cette différence est plus faible pour la coopérative financière que pour la banque d'actionnariat publique. La gouvernance corporative de l'institution est ainsi un élément important à prendre en considération dans l'élaboration d'un régime d'assurance dépôt. Nous trouvons de plus que, de la même façon que les banques d'actionnariat publiques, ce risque moral peut être atténué à l'aide d'incitatifs tels que des primes ajustées au risque, un capital réglementaire ajusté au risque et possiblement des critères de réserve de liquidité.

Abstract : In this paper, we analyze the differences of effects of a deposit insurance schemes on financial cooperative and joint stock banks risk taking. We develop a methodology which includes the specifics of the utility function for the financial cooperative and we compare the results to a similar profit maximizing joint stock bank. We find that the introduction of deposit insurance does in fact increase optimal risk level for the financial cooperative but less so than the stock bank. Thus, corporate governance does matter in the level of risk exposure of a deposit insurance scheme. Further, like in joint stock banks, this moral hazard can be curbed through incentives such as risk adjusted premias, risk adjusted regulatory capital and possibly reserve requirements.

1 Introduction

The purpose of this paper[1] is twofold: i) to present a model that allows the evaluation of the effects in terms of *moral hazard* (MH) of introducing a *deposit insurance* (DI) scheme for a *financial cooperative* (FC)[2]; and ii) to reveal whether differences in corporate governance (mutal versus stock ownership) matters in the level of risk expousre of deposit insurance schemes. In the paper we also investigate some mechanisms that may be used by regulators to curb the incentives to moral hazard that appear with the introduction of such a scheme. The need for this research arises from the fact that FC are financial intermediaries with an objective function that differs notably from that of a *joint stock bank* (JSB). However, when considering DI for FC, as in other areas such as regulation and supervision, officials tend to apply mechanically principles developed for a JSB independent of the differences in coprorate governance.

Although some research has been done on DI and FC (notably Karels and McClatchey [14] and Kane and Hendershott, [13]) to our knowledge no theoretical model exists that articulates the set of incentives to which FC are subject when a DI scheme is introduced[3]. In a very cursory manner Lee and Kwok, [20], also make reference to DI for non-bank depository institutions including credit unions. While several effects are common to both FC and JSB, as we will report later on, some considerable diffrerences appear when considering DI for both types of insitutions. We will ignore in this paper the arguments about the pros and cons of DI and will assume that the regulator has sorted out these contradictions and has decided that a DI scheme for the FC is desirable.

The approach taken in this paper is a pragmatic one. We adopted a well known technique to model the objective function of a financial intermediary and introduced modifications -also well accepted in the literature- that adapt these functions to the situation of the typical FC. Then we introduced the DI using yet another accepted technique. We evaluate moral hazard by comparing the levels of the optimal probabilities of default for a financial institution with and without DI. The purpose of this approach is to make the modeling exercise as transparent as possible and focus on the effects that appear when introducing a DI scheme in a FC and how it differs from that of a JSB. To make the work even more transparent we model both the FC *and* the JSB and present results in parallel. Although in the second case we obtain results that are already well accepted in the financial literature they allow us to make the comparison of similarities and differences simpler.

The organization of the paper is as follows: starting in Section 2 we provide some factual and legal information related to FC; in Section 3 we focus on the formulation of the model that will be the basis of the analysis; in Section 4 we start exploiting this model to investigate the main questions of the paper: comparing the effect of the introduction of DI on both a FC and, as a benchmark, a JSB; in Section 5 we present results of a simulation designed to provide sharper insights about differences in behavior of both types of insitutions. In Section 6 we consider possible solutions to curb moral hazard in FC. Section 7 provides conclusions and policy recommendations.

2 Governance of financial institutions risk taking

A number of fundamental differences between JSB and CB suggest that there might be important ex-ante distinction to be made in terms of risk to which these two types of institutions might be exposed. These differences are related to governance and to the nature of the contract between the contracting parties in presence of asymmetric information. Perhaps the most important are:

- Agency conflicts between shareholders and debtholders (moral hazard).

[1] This research is the result of a concrete need that was identified at the Fondo de Garantías de Entidades Financieras (FOGAFIN), Colombia, when it was faced, toward the end of 1997, with the responsibility of developing proposals to include FC under a deposit insurance scheme. FOGAFIN faced two symmetric risks if it ignored the particularities of FC in structuring these proposals: i) based on the "social nature" of the FC it could make the DI scheme too lax encouraging moral hazard, or ii) by adopting standards applicable to a bank, it could make the DI scheme too severe. Both risks had to be avoided. The almost complete absence of research on this topic as well as the fact that no empirical data was available to study the actual behavior of FC in presence of a deposit insurance scheme–since there was none–forced us to take a theoretical approach to the problem.

[2] The expression "Credit Unions" (CU) to describe FC is a practice established predominantly in the United States. In this paper, we will use the more general expression FC.

[3] Kane and Hendershott, [13], analyze how differences in incentive structure constraint the attractiveness of interest rate speculation and other risk taking activities to managers and regulators of USA credit unions. The approach is mostly empirical and adapted to the particular characteristics and regulatory environment in which these credit unions operate. Although it provides some interesting insights, their applicability to the context of a FC in most developing countries is very limited.

- Agency conflicts between managers and shareholders (managerial conservatism and entrechment).
- The role of deposit insurance.

Our focus is on the third. It is widely known that the presence of deposit insurance encourages JSB shareholders to take even more risk (see Kopcke, [18]; Milhaupt, [22]; Brewer, [2]; Carr *et al.* [4]; Brewer and Mondschean, [3]; Dreyfus *et al.*[6]; Hassan *et al.,* [10]; Keeley, [15] to mention just a few), and this incentive increases as the financial situation of the bank deteriorates in what is known as "gambling for survival". Again, this gambling for survival is related to the "option-like" property of the deposit insurance and bank shares (Flood, [8]; Merton [21]). To our knowledge, no explicit model nor study exists that attempts to assess the effect of introducing a deposit insurance on FC incentives to expose the insurer to moral hazard. While JSB have often exercised the right to transfer liabilities of the institution to the deposit insurer (i.e. exercise the put option bought from the deposit insurer), FC belonging to major national network rarely exercise this option. Instead, in these networks, failing institutions are absorbed in the system through a process of mutualization of the failing CB liabilities, either through internal institution insurance schemes or through cession of assets and liabilities to the rest of the system.[4] Further, most (but not all) cooperative bank networks have built in their own "insurance funds." One notable exception are atomized United States styled CU movements where individual cooperatives do not belong to a tightly organized network of institutions. There, CU were rescued by a deposit insurance schemes specialy designed for the movement, which, after the latest reform, is owned collectively by affiliated CU. Even there, Kane and Hendershott [13] in a suggestively titled article, "The Federal Deposit Insurance Fund That Didn't Put a Bite on U.S. Taxpayers," explain the judicious use United States CU have made of their deposit insurance scheme, in stark contrast to the stock owned components of the financial system. Also focusing on the United States, Karels and McClatchey [14] examine the relationship between deposit insurance and risk-taking behavior within the credit union industry. Time series tests employing industry average financial ratios for federal and state credit unions did not support the increased risk-taking hypothesis. Although federal credit union capital declined immediately following the adoption of deposit insurance, the authors speculate that this was most likely the result of reduced capital requirements, not deposit insurance. Liquidity and loan delinquency ratios had a negative time trend coefficient, implying a decline in risk-taking behavior during the post-insurance period. Overall the authors found no evidence that the adoption of deposit insurance increased the risk-taking behavior of credit unions.

FC are considered a part of the "solidarity economy" with rules of operation that are different from those of stock banks. As noted by Smith, Cargill and Meyer [28] among others, in a FC members are both owners of the intermediary and consumers (suppliers) of its output (input). They are considered non-profit organizations since their goal is to serve the member and not to accumulate monetary profits. It is particularly difficult to model FC with some exactitude. The nature of their objective function is complicated by the Cooperative Identity statement; the function of a cooperative (financial or otherwise) is guided by the seven principles of the International Cooperatives Association (ICA).[5] A profit maximizing objective function is hence generally considered inadequate to represent the behavior of FC. A FC, typically has a general non-profit objective, but this objective is attached to three other objectives that affect directly its management style: maximize services to its members at minimum cost; return the surplus of operations (profits) to its members, mostly in the form of services; or alternatively accumulate those surpluses in forms of capital reserves to strengthen the institution and facilitate its growth. Therefore, all FC do not share the same goals or objectives. However, we will assume a general objective function in Section 3 that follows the tradition of the theory of this type of institution.

Because the FC intermediates between its *member-net-savers* and its *members-net-borrowers* a conflict of interests arises. The importance of this conflict is that there is a considerable shift of interests away from savers to borrowers, something that doesn't happen in a JSB. The stockholders of these (or their agents) keep control of the decision process while borrowers are totally excluded. In FC with a strong borrower control, the likelihood of moral hazard arising is large, leading to severe problems of confidence in the system.

[4] One case where a cooperative movement took advantage of the state-sponsored deposit insurance scheme is the one that occurred in 1981 when in Quebec numerous cooperatives in one of the two then existing movements, the *Ligue des caisses d'économie*, failed. However, posterior liquidation of assets allowed the deposit insurance fund to recoup all advances made to depositors.

[5] http://www.coop.org/ica

2.1 Deposit Insurance for FC: issues

When faced with risk, there are three possible responses: transfer, retention and avoidance. We will analyze the case where risk is transferred to a third party such as a government agency, insurance company or a financial cooperatives movement. In this case, a premium is paid by the insured institution to cover against a potential loss. This premium can be fixed or a function of the size of the exposure and the degree of risk. With due cause, the members of the cooperative will feel safer knowing that their savings are protected should the FC be forced to liquidate.

DI for FC has lately become an important issue. By protecting the savings of depositors, DI stabilizes the financial intermediary which in turn limits the likelihood of bank runs. The mounting of safety nets for FC is gaining momentum, especially in countries for which this net already exists for the JSB and other depository institutions. In some countries, such as Canada, FC have put in place "stabilization funds" which have goals similar to DI. As these types of institutions have carved their positions in the financial markets around the world, regulators are taking a second look at them and starting to worry about their financial stability.[6] There are several reasons that justify this concern by regulators. Among these we mention:

- FC capture the savings of an increasingly large and mostly lower income population;
- They have become attractive intermediaries to provide access to financial services to MSE, rural financing and other less advantaged social sectors;
- The last 15 years have been a scenario of several burst-bust-burst experiences in the sector for several emerging markets (EM).[7]

DI is far from a perfect solution to all financial institution problems; flaws are present in its American form as discussed by Barth, Bradley and Feid [1]. Numerous studies were done on the pricing of DI, the best known derivation of the cost function was presented by Merton [21] which prices DI using derivatives theory. In this analysis, we will not attempt to define the exact pricing of the DI for a FC, we will simply assume that it is a positive function of risk and we will analyze the effects on moral hazard of this risk pricing.

The research gap in this area is considerable. There are a number of issues that need to be addressed regarding the setup of a DI for FC but that are impossible to cover in this paper. These include:

- Should the DI scheme cover depositors or institutions?[8];
- How should the *level* of premia compare in comparison with other depository institutions?[9];
- Should the premia be considered an expense or a rent-earning contribution to a capital fund?;
- Should the fund be administered by the cooperative system itself or by an independent (e.g. government) agency[10];
- Should deposits *and* shares (equity parts) to FC be covered or only the first?[11]

Some of these questions may seem strange when one is familiar with the DI debate in the context of JSB but start to make sense when studying some of the problems and practices of DI schemes for FC.

[6] In some countries, particularly in europe, mutual financial intermediaries organized in networks are the prime financial institution representing sometimes up four times the financial assets of the largest PMSB.

[7] This cycle of burst-bust-burst has put in evidence not only the (questionable) necesity of a DI scheme but also to understand much better the governance of FC and the role of external financing in the decision making of the cooperatives, to mention just two issues.

[8] Insurance for institutions would be an anathema in the context of JSB, however this is not so obvious in the case of FC. In Germany, as in other countries with similar FC organizations, the DI for the highly successful Raiffeisen Cooperative Banks system covers the institutions. For JSB, on the other hand, DI covers depositors but not institutions. There are indeed a number of arguments that support the idea that a DI for FC should cover the institution.

[9] Besides the fact that it is doubly difficult to assess value of FC assets, it is worth noting that a much *larger* proportion of the liabilities of a FC are covered by the DI. This is so because the great majority of liabilities are small and come under even the most stringent ceilings in DI converage.

[10] Here, as in other questions, the experiences are quite different. In some countries the DI scheme is managed by the system itself as part of a larger scheme of delegated monitoring (e.g. Germany). In other cases the fund is managed by a government agency (e.g. United States, see Walker, [32]). To see the complexity of the issue one only needs to refer to the recently booming debate about private (or joint private/government) insurance schemes in the United States (see for example Kane [12] and Lai and Wariwoda [19]).

[11] It should be remembered that in FC equity is not permanent, as a members can walk away from the institution when she wishes withdrawing her shares. Usually limitations may exist –specially for situations on financial stress– but this only implies a postponement of the withdrawal right.

3 The Model

In this section we introduce a neo-classical formal model of a financial intermediary adapted to the particular problem of the FC. We adopt here some elements of the objective function formulation by Smith, Cargill and Meyer (SCM) [28] embeded in a standard model of financial intermediation under information-assymetry .

3.1 Outline

Assume a FC with an objective function that depends on the value to members of their transactions with the FC. There are two types of members in a typical FC. Those whose principal relationship with the FC is that of a saver, and those that are principally borrowers[12]. As in extant modeling practices for FC, we represent the value to borrowers (and to savers) by the difference between the interest rate the FC charges (pays) to members and the best alternative reference rate available at the time with a JSB, net of costs and adjusted to the risk of loans. Assuming an overall environment of credit rationing, we assume that the availability of more credit to borrowers is valued higher than the availability of less credit. We also assume that FC are able to raise funds in the market (through deposits, CDT or bonds) from non-members[13] at market rates. We articulate the "conflict" of interests that the FC has to solve by maximizing a function that contains the weighted utilities for both types of members (borrowers and savers) net of costs.

To facilitate the understanding of how a FC operates and the implications this has for DI we will develop simultaneously two models: one for a FC along the lines described above, and one of a standard JSB, along the lines of Stiglitz and Weiss [29] and Tybout [30] among others, a case which is much better understood. Therefore although some of the results presented here for the stock bank may appear superfluous, they play the role of being the "base case" against which the case of the FC is contrasted. We take some elements of the work by Kambhu [11], in particular the way DI is introduced into the objective function for the JSB and the FC.

3.2 Assumptions

Assume a financial institution subject to a number of technical and regulatory constraints. We define the main balance sheet components of this financial institution as follows[14]:

Assets	**Liabilities**
Q_L	Q_S
Q_D	**Capital**
	K

where:

- Q_i, is the level of loans made to borrowers (or risky investments) ($i = L$); savings by depositors ($i = S$) and "short term funds" ($i = D$). L and S are non-negative, D can be either positive (money market investment) or negative (debt issue). We impose the following restriction:

$$0 < Q_S \approx Q_L < \infty$$

- K is the capital of the firm. For the FC, it is composed of member shares, reserves and retained earnings.

Our methodology also assumes that the financial intermediary is characterized by the following variables and assumptions:

[12] There is, of course, nothing special in this. This is indeed the same type of situation that exists in a standard JSB. The particularity of a FC resides in the fact that *both* types of members have the potential of influencing the decision process, something that is not possible in a JSB.

[13] Alternatively, members can invest in the FC either by buying shares or making standard deposits that are assumed to be compensated at standard market rates.

[14] We expand on the components of the balance sheet in Section 3.6.

- $R_{i,j}$,is the gross rate earned (charged) on these assets where i is the type of assets (L, S, D) and j is the type of institution (FC, JSB, M). It is assumed that the market (M) interest rate $(R_{D,M})$ charged on D is the same for an investment or a debt issue [15]. The rate charged to borrowers $(R_{L,j})$ and the rate offered to savers $(R_{S,j})$ are sensitive to the risk, ω, taken by the intermediary. In the presence of DI, $R_{S,j}$ is insensitive to risk (ω). The risk free (money market) investment Q_D is assumed to always exist and be available to the intermediary. This may simply represent the reserves kept with the central bank earning a rate of $R_{D,M} \geq 0$, or in a stabilization fund or liquidity fund as is often the case for FC. We impose the following restrictions:

$$0 < R_{S,JSB} \leq R_{S,FC} \leq R_{S,FC}(\omega) < 1 + 100\%,$$

$$0 < \frac{\partial}{\partial \omega} R_{i,j}(\omega) < 1$$

and

$$\frac{\partial^2}{\partial \omega^2} R_{i,j}(\omega) = 0^{16}.$$

As we will se later on, these restrictions will prove key to our formulation of the moral hazard (MH) problem following the introduction of DI.

- G represents the liquidation value of guarantees provided by the borrower.
- The intermediary is risk neutral.
- Each investment, generates a random end-of-period cash flow of X with density $f(X, \omega)$, where ω is an index of risk of the project and hence borrower[17]. X is a random variable representing the terminal cash flows of the borrower.
- This is a two-period model in which the intermediary (j) contracts the funds from depositors/bondholders/member at a rate $R_{S,j}$, then turns around and decides on the portfolio allocation. The positions are liquidated in the second period and we therefore have no asset liability management (ALM) complications.
- The expectation of the cash flows resulting from a loan is based on the following probability restriction[18]

  $$S\left(Q_L R_{L,FC}(\omega) - G\right) = 0$$

  given the fact that default occurs when $G + X \leq Q_L R_{L,FC}(\omega)$.
- The ownership of the FC is determined by the number of shares *only*. The level of funds (loans or savings) has no influence on the decision making .

3.3 Definition of Risk

With respect to the risk characteristics of the borrowers, we say that a borrower L, is a "better" risk class than a borrower H, if

$$\int_0^u f(X_L, \omega_L) dX \leq \int_0^u f(X_H, \omega_H) dX, \text{ for any } u, \ 0 \leq u \leq \infty. \tag{1}$$

For convenience we adopt the definition of "mean preserving risk" of Rothschild and Stiglitz [26] and will say that an increase in ω is a mean preserving risk increase if the two following conditions are met:

[15] We comment on this assumption in the conclusion.

[16] It would also be possible to assume that $\frac{\partial^2}{\partial \omega^2} R_{L,JSB}(\omega) \leq \frac{\partial^2}{\partial \omega^2} R_{L,FC}(\omega) = 0$, but for ease of interpretation we assume a linear relationship.

[17] The parameter ω can also be considered to be the index of pessimism of Tybout [30] and Virmani [31].

[18] $S(t) = \Pr(T > t) = 1 - F(t) = 1 - \Pr(T < t)$

$$\int_0^{\infty} [d\mathrm{F}(X,\omega)/d\omega]dX = 0 \tag{2}$$
$$\int_0^{y} [d\mathrm{F}(X,\omega)/d\omega]dX \geq 0 \text{ for } 0 \leq y \leq \infty$$

Given definition (2), a financial institution will be more "risk tolerant" the higher the ω it will be willing to accept, keeping other parameters of the model constant, or the less sensitive some lending parameters (such as lending rates and loan size) are to changes in ω.

It is difficult to ascertain the ability of a FC to screen loans and collect receivables. Frequently, the FC has the advantage of lending to a close knit community; the lender will know the personality/characteristics of the borrower and/or the borrower wants to maintain his[19] reputation in the community. The importance of reputation should not be underestimated since microfinance schemes often operate in small communities and the lending activity might be done in conjunction with a lending circle[20]. JSB usually do not have such close personal relationships to the borrowers. They do however usually operate with a more diverse pool of borrowers which reduces risks and with more advanced systems to screen and collect loans. FC also show a higher risk tolerance to potential borrowers (see Smith *et al.* [28]). For simplicity purposes, we will assume that the ability of a FC and a JSB to identify the risk (ω) is the same.

3.4 The Profit Function

The expected return to the intermediary from the lending operation will be represented as follows:

$$\mathrm{E}(\pi_{FC}(\omega)) = \int_0^{Q_L R_{L,FC}(\omega)-G} (X+G) f(X,\omega)dX - Q_S R_{S,FC}(w) + Q_D R_{D,M} \tag{3}$$

$\mathrm{E}(\pi_{FC}(\omega))$ represents the profit or operating excedents function for a FC. As we will see later on, contrary to the JSB, the profit function for the FC differs from its objective function.

Although it is often done, we do not include fixed transaction costs in this function. We do this mostly because, for being fixed, these disappear when we compute the *optimal risk taking probability of default* of the function and thus have no effect on the solution.

Given our initial assumptions, the first term of equation 3 represents the expectation of cash flows resulting from an *investment* in a loan. The second and third terms represent respectively the amounts "borrowed" from savers and the market investments (or borrowings from the market).

After some algebra [21], equation (3) can be rewritten as

$$\mathrm{E}(\pi_{FC}(\omega)) = Q_L R_{L,FC}(\omega) + Q_D R_{D,M} - Q_S R_{S,FC}(w) - \int_0^{Q_L R_{L,FC}(\omega)-G} \mathrm{F}(X,\omega)dX \tag{4}$$

where $F(X,\omega)$ represents the probability of borrower insolvency.

To note in this particular formulation is the parameter G that represents the guarantees, that the borrower is putting up to secure the loan. We assume that G is a known quantity. The reason for including guarantees (in contrast, for example to Stiglitz and Weiss [29] who use the equity investment of the firm, or Tybout [30], who uses none) is to make the model applicable to a wider range of situations. In most EM real guarantees they play a very special role in lending activities, in many ways quite different from the practices of most industrialized economies. By and large, project related guarantees are of little value in lending activities while the guarantees demanded by

[19] Although it is very appropriate in an analysis of FC to include females since they represent a large proportion of the clientele, we will use the masculine form in this essay for simplicity.

[20] A lending circle is a small group of people in which all member are borrowers. They have been introduced in Bangladesh by the Grameen Bank (http://www.grameen-info.org) to help the members with the borrowing process and also for "peer pressure" in the repayment of the loan.

[21] Detailed in Appendix A

lenders are mostly real estate or cash guarantees (see Fleisig [7]). This is particularly true for EM based MSE where a long standing tradition exists of collateralizing business loans with real estate. Although it is true that many MSE owners possess enough real estate to collateralize their business loans (in which case their access to the loan market will be much easier), many more are not in that position. In practice, a substantial portion of micro-enterprise loans in a typical EM bank, appear as personal-unsecured loans in their books. While in the case of a real estate secured loan default for whatever reason, genuine insolvency or moral hazard related, can easily be resolved by seizing the real estate collateral, this is not possible in the absence of such collateral. By defining G as the equity portion provided by the borrower we are back to the traditional formulation of the problem applicable to industrialized countries.

3.5 The Objective Function

For a JSB, the profit function is the same as the utility function:

$$\begin{aligned} \mathrm{U}_{JSB} &= Q_L R_{L,JSB}(\omega) + Q_D R_{D,M} - Q_S R_{S,JSB}(w) \\ &\quad - \int_0^{Q_L R_{L,JSB}(\omega)-G} \mathrm{F}(X,\omega)dX. \end{aligned} \tag{5}$$

Functions (4) and (5) represent the typical objective function [22] of the JSB firm and this is the function we will use here as the basis of our analysis to describe the behavior of the stock bank. On the other hand, the objective function for FC (see Smith *et al.* [28]), can be written as follows

$$\mathrm{U}_{FC} = \lambda\ NGL + \alpha\ NGS + \mathrm{E}\left(\pi_{FC}(\omega)\right)$$

The logic of this objective function is the following. λ and α represents the weight net-borrowers and net-savers respectively have on the decision making process of the FC, however this might present itself institutionally. As previously mentionned in the assumptions, they represent the level of shares held by net borrowers and net savers respectively; which is reflected by the influence each group has on the decision making process. We have assumed distinctive weights instead of setting $\alpha = 1 - \lambda$ since this enables us to better assess the impact net-borrowers and net-savers have on moral hazard and also to set $\lambda = \alpha = 0$ to study the behavior of a bank in a similar situation. We therefore have the restriction that either

$$\alpha + \lambda = 1$$

or

$$\alpha = \lambda = 0.$$

We assume that borrowers and savers are either net borrowers or net savers, and that positions that result from transactions are all net positions. The purpose of this distinction is to insure that the two types of participants act accordingly.

The values of λ and α take is of crucial relevance. If $\lambda \approx 1.0$ we can say that the FC is "net-borrower dominated", while if $\alpha \approx 1.0$ we say that the FC is "net-saver dominated".

The Net Gain on Loans (NGL) is defined as $\left(R_{L,JSB}(\omega) - R_{L,FC}(\omega)\right) Q_L - G$. *Ceteris paribus*, a FC **net-borrower** will prefer a loan rate, $R_{L,FC}(\omega)$, inferior to the one obtained at the JSB, $R_{L,JSB}(\omega)$, (assuming that this member has access to credit elsewhere), a larger amount of credit, Q_L, (or a smaller cash interest payment given a loan size) and a smaller guarantee, G.

The Net Gain on Savings (NGS) is defined as $\left(R_{S,FC}(\omega) - R_{S,JSB}\right) Q_S$. A FC **net-creditor** will prefer a higher return on his savings over some comparable rate available in the market (provided that this saver has access to another financial institution that offers savings products) and a larger amount Q_S invested at this higher return[23]. When analyzing NGS we consider that the JSB has DI and therefore offers a risk free savings rate not function of ω.

[22] Objective function and utility function are used interchangeably.

[23] In the case of the net-saver member there is also value attached to the capitalization of the FC as an increase in retained earnings tends to increase the utility of the net-saver member. One could therefore justify the use of $\alpha\left[\left(R_{S,FC}(\omega) - R_{S,JSB}\right) Q_S + K\right]$ as the *NGS*.

Therefore, the utility funtion of the FC is

$$\begin{aligned} \mathrm{U}_{FC} &= \lambda \left(\left(R_{L,JSB}\left(\omega\right) - R_{L,FC}\left(\omega\right) \right) Q_L - G \right) \\ &+ \alpha \left(R_{S,FC}\left(\omega\right) - R_{S,JSB} \right) Q_S \\ &+ Q_L R_{L,FC}(\omega) + Q_D R_{D,M} - Q_S R_{S,FC}(\omega) \\ &- \int_0^{Q_L R_{L,FC}(\omega) - G} \mathrm{F}(X,\omega) dX. \end{aligned} \tag{6}$$

As previously mentioned, this function[24] compares the utility of being in an FC without DI to a JSB with DI.

A closer inspection of the objective function presented above reveals that we define as "benefit" arising from the intermediation process of the FC the reduction in cost for borrowers and increase in saving returns for savers over that of a JSB. Under "returns" to savers we include all other non-pecuniary benefits they may extract from being members of the FC. These non-pecuniary benefits, as we know, can be quite large. In EM, it can be the case that to offer services to the population regardless of class, sex or income is a benefit in itself. Technically, for a FC offering services where no other alternative is available, $R_{S,JSB}$ would be equal to zero (non-existent since no substitue exists) and $R_{L,JSB}(\omega)$ would be substantially high. Loans would originate, from moneylenders such as *paykars* in rural areas of Banglasdesh (see Yunus [33], p. 47-52) or from "pawn shops" in urban centres such as Chicago or Montreal. In this type of environment, the utility function of a FC would be quite high.

3.6 Inclusion of Deposit Insurance

The method to introduce deposit insurance premia follows the approach taken by Kambhu [11]. The DI is included through the balance sheet restriction

$$Q_L + Q_D + \rho Q_S = Q_S + (K - P(\omega)) \tag{7}$$

where ρ represents the reserve (or liquidity) requirements; $P(\omega)$ is the DI premia that can be either fixed or, as is the case here, made a function of the risk (ω); K is the capital that meets capital requirement standards. As mentioned in the assumptions (Section 3.2), Q_D can be either positive or negative; it represents the short liquidity needs of the FC, Q_L and Q_S are both strictly positive. One further restriction is that

$$0 < \frac{\partial}{\partial \omega} P(\omega) < 1$$

and

$$\frac{\partial^2}{\partial \omega^2} P(\omega) = 0^{25},$$

e.g. $P(\omega)$ is a positive linear function of risk.

Given equation (7) the balance sheet of our financial institution now has the following visual form:

Assets	**Liabilities**
Q_L	Q_S
Q_D	**Capital**
ρQ_S	$K - P(\omega)$.

By solving restriction (7) for Q_S we have:

[24] Objective functions similar to (6) of the weighted average of social welfare function are used not only to model FC behavior but have become canonical in modeling the financing and investment decisions of firms under conditions of asymmetric information, e.g. in dividend decisions (Miller and Rock, [23]), capital structure (Ross, [25]) among many others.

[25] We could also assume that $\frac{\partial^2}{\partial \omega^2} P(\omega) \geq 0$, i.e. a non-linear increasing function. Results remain essentially unchanged.

$$Q_S = \frac{Q_L + Q_D + P(\omega) - K}{1-\rho} \tag{8}$$

and introducing into equations (6) we obtain

$$\begin{aligned} \mathrm{U}_{FC,DI} = & \lambda \left[\left(R_{L,JSB}(\omega) - R_{L,FC}(\omega) \right) Q_L - G \right] \\ & - \frac{(Q_L + Q_D + P(\omega) - K)}{1-\rho} \left[R_{S,FC}(1-\alpha) + \alpha R_{S,JSB} \right] \\ & + Q_L R_{L,FC}(\omega) - \int_0^{Q_L R_{L,FC}(\omega) - G} \mathrm{F}(X,\omega) dX + Q_D R_{D,M}, \end{aligned} \tag{9}$$

this is the objective function for a FC with DI. Note that, due to the presence of DI the deposit rate $R_{S,FC}$ is riskless e.g. not adjusted to the risk ω assumed by the intermediary.

U_{FC,no_DI} and $\mathrm{U}_{FC,DI}$ are the functions to be maximized for the FC. Setting $\lambda = \alpha = 0$ in (9) gives the objective function to be maximized for the JSB with DI. We will concentrate our efforts on the difference of behavior between FC with and without DI. We will also consider the difference of behavior between JSB with and without DI, as well as the difference between JSB with DI and FC with DI.

3.7 Optimal Risk Level

Ideally a financial institution will increase its risk level until it maximizes its utility function. This level of risk can be found by setting the first derivative of (9) to zero.

To determine the optimal risk level, we calculate the first derivative of the utility function with respect to the risk index, ω

$$\begin{aligned} \frac{\partial \mathrm{U}_{FC,no\_DI}}{\partial \omega} = & \lambda Q_L \left[\left(\frac{\partial}{\partial \omega} R_{L,JSB}(\omega) \right) - \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \right] \\ & + (1-\alpha) \left(\frac{\partial}{\partial \omega} R_{S,FC}(\omega) \right) Q_S - \int_0^{Q_L R_{L,FC}(\omega) - G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX \\ & + Q_L \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \left(1 - \mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega) \right) = 0 \end{aligned} \tag{10}$$

and

$$\begin{aligned} \frac{\partial \mathrm{U}_{FC,DI}}{\partial \omega} = & \lambda Q_L \left[\left(\frac{\partial}{\partial \omega} R_{L,JSB}(\omega) \right) - \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \right] \\ & - \left(\frac{\partial}{\partial \omega} P(\omega) \right) \frac{\left[R_{S,FC}(1-\alpha) + \alpha R_{S,JSB} \right]}{1-\rho} - \int_0^{Q_L R_{L,FC}(\omega) - G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX \\ & + Q_L \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \left(1 - \mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega) \right) = 0 \end{aligned} \tag{11}$$

for the FC with and without DI respectively. The second derivatives of (10) and (11) are negative[26] and hence the utility functions are in fact maximized at these levels of risk. To measure the level of risk assumed by both types of intermediaries at the optimum, we solve both equation (10) and (11) for the probability of default $\mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega)$. To simplify the presentation, we set

$$Y \equiv Q_L R_{L,FC}(\omega) - G$$

and

$$\mathrm{F}_{x,\omega}(\omega) \equiv \int_0^{Q_L R_{L,FC}(\omega) - G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX$$

[26] See Appendix A for proof that the second derivatives are in fact negative.

this derivative is positive by assumption (see equation 2). This yields, for the FC without DI

$$\begin{aligned}\mathrm{F}_{FC,no\_DI}(Y,\omega) &= \lambda\left(\frac{\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)}{\frac{\partial}{\partial\omega}R_{L,FC}(\omega)}-1\right)+\alpha\left(\frac{\frac{\partial}{\partial\omega}R_{S,FC}(\omega)}{\frac{\partial}{\partial\omega}R_{L,FC}(\omega)}\right)\left(\frac{Q_S}{Q_L}\right) \\ &+\frac{1}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}\left[1-\mathrm{F}_{x,\omega}(\omega)-Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)\right]\end{aligned} \tag{12}$$

and for the FC with DI:

$$\begin{aligned}\mathrm{F}_{FC,DI}(Y,\omega) &= \lambda\left(\frac{\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)}{\frac{\partial}{\partial\omega}R_{L,FC}(\omega)}-1\right)+\alpha\left(\frac{\partial}{\partial\omega}P(\omega)\right)\left[\frac{R_{L,FC}(\omega)-R_{L,JSB}(\omega)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}\right] \\ &+\left[1-\left(\frac{\mathrm{F}_{x,\omega}(\omega)(1-\rho)+\frac{\partial}{\partial\omega}P(\omega)R_{S,FC}(\omega)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}\right)\right]\end{aligned} \tag{13}$$

The borrower portion for equations (12) and (13) are identical . The introduction of DI changes the risk structure of the FC especially for member-savers since their deposit rates become risk free.

Using the same steps (or by simply replacing λ and α by zero) we determine the following "optimal risk taking probability of default" for the JSB

$$\mathrm{F}_{JSB,no\_DI}(Y,\omega)=\frac{1}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)}\left[1-\mathrm{F}_{x,\omega}(\omega)-Q_S\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)\right]$$

and

$$\mathrm{F}_{JSB,DI}(Y,\omega)=\left[1-\left(\frac{\mathrm{F}_{x,\omega}(\omega)(1-\rho)+R_{S,JSB}\frac{\partial}{\partial\omega}P(\omega)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)}\right)\right].$$

$\mathrm{F}_{j,\cdot}(Y,\omega)$ represents the probability of default of the optimal investment for the financial institution.

4 Deposit Insurance and Moral Hazard

4.1 Moral Hazard in Financial Cooperatives

We compare equations (12) and (13) to assess the MH risk caused by the introduction of DI. We find that the optimal risk taking probability of default is greater for the FC without DI by

$$MH_{FC}=(1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}-\frac{R_{S,FC}(\omega)\left(\frac{\partial}{\partial\omega}P(\omega)\right)(\alpha R_{S,JSB}+(1-\alpha)R_{S,FC})}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)} \tag{14}$$

In the previous equation MH_j corresponds to the arithmetic difference between $\mathrm{F}_{j,DI}(Y,\omega)$ and $\mathrm{F}_{j,no\_DI}(Y,\omega)$ and characterizes the moral hazard associated with DI for the financial intermediary j.

We expect the second term of equation (14) to be approximately equal to zero. The numerator is small, greater than -1 and smaller than 1. The denominator is considerably large due to the quantity of funds loaned, Q_L . The denominator is a positive function since $0<\rho<1$ and the sensibility of the lending rate to risk is a positive function. Due to the fairly large denominator, we can approximate the second to zero,

$$MH_{FC}\approx(1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}-0 \tag{15}$$

and since the fraction is approximately equal to one,

$$MH_{FC}\approx(1-\alpha)=\lambda$$

Evidently, equation (15) is a strictly positive function. The greater the weight of net member-borrowers, the greater the increase in the level of risk following the introduction of DI [27]. Therefore, a FC where borrower tend to dominate should operate at a higher risk level (ω) than one where savers tend to dominate.

Returning to equation (14) we can also state that MH will be high if:

- the level of funds invested in the FC by savers is small relatively to the loans made to borrowers, e.g. a small capital base

and

- the rate charged to borrowers is insensitive to variations in the risk level $\left(\frac{\partial}{\partial\omega} R_{L,FC}(\omega) = 0\right)$.

Equation (14) has a surprising characteristic: MH_{FC} is a positive function of the level of savings Q_S. However, we assume throughout this analysis that the influence on the decision making is determined solely by α and λ; we disregard their (more than likely) relationship to the level of funds Q_S and Q_L respectively.

4.1.1 Can MH_{FC} be negative?

To facilitate the interpretation of their intrinsic values, we choose to analyze the required values of $R_{S,FC}(\omega)$ and Q_S for MH_{FC} to be negative. We must have

$$R_{S,FC}(\omega) > \frac{Q_S(1-\alpha)(1-\rho)\left(\frac{\partial}{\partial\omega} R_{S,FC}(\omega)\right)}{\left(\frac{\partial}{\partial\omega} P(\omega)\right)(\alpha R_{S,JSB} + (1-\alpha) R_{S,FC})} \tag{16}$$

or

$$Q_S < \frac{R_{S,FC}(\omega)\left(\frac{\partial}{\partial\omega} P(\omega)\right)(\alpha R_{S,JSB} + (1-\alpha) R_{S,FC})}{(1-\alpha)(1-\rho)\left(\frac{\partial}{\partial\omega} R_{S,FC}(\omega)\right)} \tag{17}$$

to obtain an “inverse moral hazard” (the introduction of insurance would actually decrease the risk taking).

In (16), we have a large numerator due to Q_S and a small denominator (all elements are defined as smaller than one). Therefore this fraction should be greater than the possible values of $R_{S,FC}(\omega)$. A similar interpretation can be made to show that (17) should also not occur. Therefore the ”ìnverse moral hazard” effect is highly unlikely.

4.2 Moral Hazard and Profit Maximizing Stock Banks

For a JSB we find that

$$MH_{JSB} = \frac{Q_S\left(\frac{\partial}{\partial\omega} R_{S,JSB}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega} R_{L,JSB}(\omega)\right)} - \frac{R_{S,JSB}\left(\frac{\partial}{\partial\omega} P(\omega)\right)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega} R_{L,JSB}(\omega)\right)}. \tag{18}$$

This result can be found by setting $\alpha = 0$ in equation (14) and adjusting the appropriate rates from a FC rate to a JSB rate. Nonetheless, to check results, we derived equation (18) using the same methodology as for the FC.

[27] We can also express the relationship as

$$\begin{aligned} MH_{FC} &= \alpha\frac{\left[\left(R_{S,FC} - R_{S,JSB}\right)\left(\frac{\partial}{\partial\omega} P(\omega)\right) - Q_S(1-\rho)\left(\frac{\partial}{\partial\omega} R_{S,FC}(\omega)\right)\right]}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega} R_{L,FC}(\omega)\right)} \\ &+ \frac{Q_S\left(\frac{\partial}{\partial\omega} R_{S,FC}(\omega) - R_{S,FC}\frac{\partial}{\partial\omega} P(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega} R_{L,FC}(\omega)\right)} \end{aligned}$$

to better gauge the net saver-member influence.

4.2.1 Can MH_{JSB} be negative?

Using the same approach as for FC, we find that for the MH_{JSB} to be negative we would need either

$$Q_S < \frac{R_{S,JSB}\left(\frac{\partial}{\partial\omega}P(\omega)\right)}{(1-\rho)\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)} \tag{19}$$

or

$$R_{S,JSB} > \frac{Q_S(1-\rho)\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)}{\left(\frac{\partial}{\partial\omega}P(\omega)\right)}. \tag{20}$$

A quick analysis shows that (19) and (20) are unreasonable.

4.3 MH_{FC} relative to MH_{JSB}

Assuming the FC and JSB have similar levels of funds, reserve requirements, rate and premium sensibilities to risk; we can approximately state that

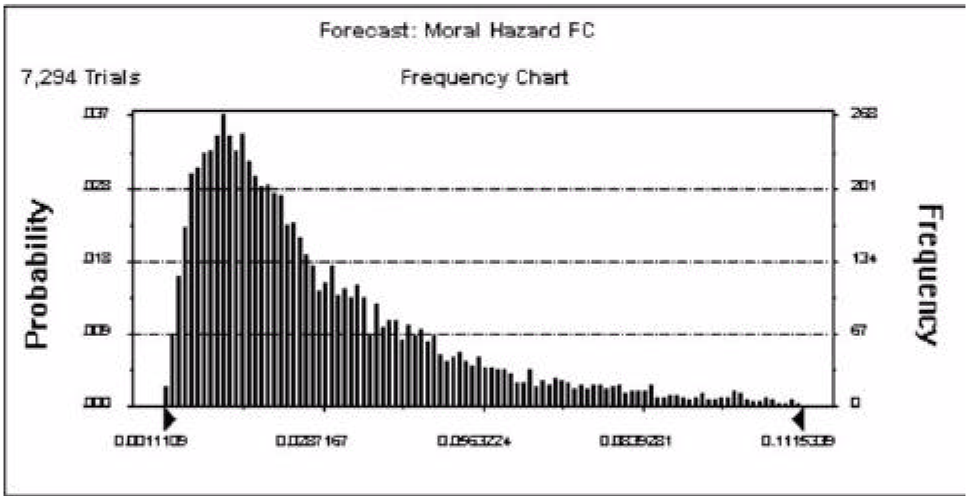
$$MH_{FC} \approx MH_{JSB} - \alpha\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}. \tag{21}$$

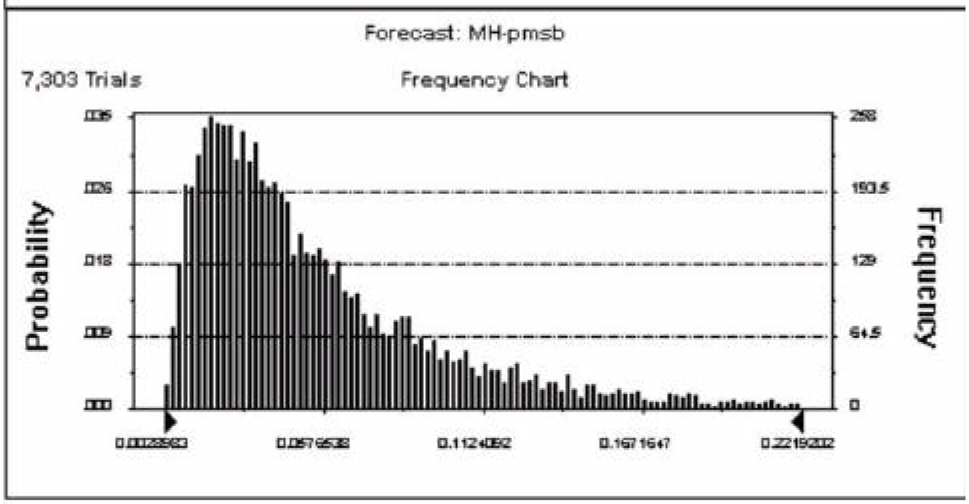
Therefore, **given similar characteristics, a FC should exhibit less moral hazard than a JSB following the introduction of a DI scheme**. Further, *cetris paribus*, the optimal level of risk taking by a JSB is equal to that of a FC where net borrowers totally dominate ($\lambda = 1.0$). As we will not4e in more detail later on, this is theoretically impossible and against empirical evidence.

Why would the moral hazard of a cooperative be less than that of a profit maximizing institution? As mentioned in the financial literature, the equity held by the investors in a stock bank is similar to a call option; the investors have a limited liability with unlimited upside potential and would therefore be willing to accept higher levels of risk. This difference in moral hazard levels is in direct relation to the weight of the net-saver member. In the case where the FC is "net borrower dominated" ($\alpha = 0$), the moral hazards of the two institutions are equal; the difference in MH levels is at its greatest where the FC is "net saver dominiated" ($\alpha = 1$). As previously mentioned, net-savers desire safety for their funds; volatility (riskiness) is not in their best interest. Also, a high level of net-savers is equivalent to a low level of net-borrowers, who are basically the "risky investments".

5 Simulations: The distributional properties of MH_i

To further our understanding of the possible range of MH values (positive or negative), simulations were performed using equation (14) and (18), by assuming distributions for each of the variables of the $MH_i, i = FC, JSB$. From these simulations, we obtain a distribution of MH_i skewed to the right and positive on all its domain which is in line with the analysis presented above.





Other statistics associated with the simulations are presented in the following table:

Statistics for Display Range	**Value FC**	**Value JSB**
Trials	7294	7303
Mean	0.0278842	0.0549036
Median	0.0214385	0.0425890
Standard Deviation	0.0212577	0.0414014
Variance	0.0004519	0.0017141
Skewness	1.39	1.41
Kurtosis	4.69	4.84
Coeff. of Variability	0.76	0.75
Range Minimum	0.0011109	0.0028983
Range Maximum	0.1115339	0.2219202
Range Width	0.1104229	0.2190219
Mean Std. Error	0.0002489	0.0004845

Of interest is that, for equal parameter inputs, while for JSB the range min and max are 0.0029 and 0.2190 with a median of 0.042, for FC the values go from 0.0011 to 0.1115 with a median of 0.021. That is, FC display much lower values of MH_i over the whole range with a median that is about half that of JSB. The mean for FC is also about half of that for JSB, although in both cases it is significantly different from zero.

Of interest is also the sensitivity of MH_i to the different input parameters. Measured by the rank correlation, the distribution of the sensitivity of the savings rate to risk is the critical assumption for both FC and JSB, with a rank correlation of close to 1.0 in both cases. For this, a lognormal distribution was chosen with a mean of 5.0% and a standard deviation of 5.0% to have a mode relatively close to zero. This is bad news since savings rates offered by FC are often very unsensitive to risk exposure of the institution because members lack access to other institutions. Next in order–but of opposite sign–is the sensitivity of the lending rate ($R_{S,i}(\omega)$) to risk with a rank correlation of about -0.15. Here again, as noted before (also by Smith *et al.* [28])) the almost universal practice is that FC tend not to adjust rates to project risk with the same rates being offered to all members. In the case of FC this is followed by α, the level of net-saver member control with a rank correlation of about -0.10. This analysis shows $\frac{\partial}{\partial\omega}R_{S,FC}(\omega)$, –i.e. the sensitivity of the savings rate to changes in the FC's asset risk in absence of a DI– as a decisive variable in the value of MH.

Perhaps a closing statement that can be made with respect to this simulation is that market parameters (savings and lending rates) are unlikely to present a great deterrent to risk taking in FC since they usually operate under less-competitive market conditions that JSB. This latter are likely to face much more competitive savings rates (specially in the interbank money market) that will be considerably more sensitive to asset portfolio risk exposure. This observation provides an excellent motivation to the analysis presented in the following section where we focus on regulatory mechanisms to curb FC risk taking.

6 Mechanisms to Curb Moral Hazard

We thus have a similar situation in JSB and FC. For both institutions, the introduction of DI increases the "optimal risk taking". These theoretical findings are no doubt interesting in themselves. However, FC regulators are concerned by more practical matters such as how they can curb or control MH. Given our previous relationships, we will investigate whether it is possible to curb MH using regulatory restrictions. This tactic has traditionally risen in the context of JSB for which regulatory capital is the most common approach.

We now tackle some key questions that appear with the introduction of an insurance scheme for FC:

- Does it matter whether the premia, P, is fixed or risk-adjusted? (section 5.1)
- Does it matter whether the regulatory capital, K, is fixed or risk-adjusted? (section 5.2)
- Does it matter whether the reserve requirements, ρ, are fixed or risk-adjusted? (section 5.3)

Of course, we know, from an extensive literature, the answer to the two first questions in the case of the JSB– reserve requirements is ususally not an considered in JSB as a mechanism to curb moral hazard, although it could. Thus following our approach, this is of concern to us only to the extent that it helps us to better understand the "toolbox" of FC or regulation agencies to deal with MH. For the case of the FC, we can add a further question of interest:

- Does it matter whether the FC is net-borrower dominated or net-saver dominated? (section 5.4)

We proceed to investigate each these questions.

6.1 Does it Matter Whether the Premia is Fixed or Risk-Adjusted?

6.1.1 Financial Cooperatives

Updating equation (8) and equation (9) to include a fixed premia P instead of a risk adjusted premia $P(w)$ we obtain

$$Q_S = \frac{Q_L + Q_D + P - K}{1-\rho}$$

and the corresponding utility function

$$\begin{aligned} \mathrm{U}_{FC,DI} &= \lambda\ \left[\left(R_{L,JSB}(\omega) - R_{L,FC}(\omega)\right)Q_L - G\right] \\ &-\frac{(Q_L + Q_D + P(\omega) - K)}{1-\rho}\ \left[R_{S,FC}(1-\alpha) + \alpha R_{S,JSB}\right] \\ &+Q_L R_{L,FC}(\omega) - \int_0^{Q_L R_{L,FC}(\omega)-G} \mathrm{F}(X,\omega)dX + Q_D R_{D,M}. \end{aligned}$$

This yields the following MH relationship:

$$MH_{FC}^{A} = (1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}. \tag{22}$$

With regards to our initial assumptions (Section 2.1.1) equation (22) is positive on all its domain and is equal to the first term of equation (14). Given that the second term of that equation is negative, we conclude that a fixed premia increases moral hazard, e.g. **a risk-adjusted premia does in fact curb moral hazard in FC!.**

However, as seen in the development to equation (15), this second term is relatively small (≈ 0). In economic terms, this near insensitivity to risk adjusted premia we obtain for the FC can be explained as follows. First, let us tackle the issue of the effect of a risk-adjusted DI premia on risk taking. In FC, in absence of restrictions on capital accumulation (as is our case), members are indifferent to the results (called "operating surplus") and therefore to the effect of a risk-adjusted DI premia on these results. Net savers are interested mostly in the "spread" they receive on their savings and net borrowers in the risk tolerance the FC displays in its operations (a lower rate and higher amount of loans). This explains the negligible effect of an adjustment to the premia on the optimal risk taking. In fact, the simulation study (Appendix B) ranked the sensitivity of the premia to risk sixth out of ten on the sensitivity chart for the moral hazard of an FC. As long as the operating results are enough to maintain the spread, members will be indifferent to increases in premia.

The more detailed relationship (equation 14) of moral hazard to the sensitivity of the premia to risk, enables us to better analyze the characteristics of this relationship. The second term of equation (14) contains the sensitivity of the premia to risk. This term is negative and hence, the higher its value, the lower the value of the overall MH equation. Consequently, the higher the sensitivity of the premia to risk, the lower the moral hazard (which is what is hoped for). However, bringing the premia more sensitive to risk than need be ($\frac{\partial}{\partial\omega}P(\omega) > 1$) we will observe negative moral hazard e.g. the FC will in fact take on less risk following the introduction of DI due to the high costs (premia) of risk taking. The potential benefits of "one more unit of risk" would be outweighted by the greater cost of DI for this level of risk. This situation might be handy for situations where the insurer feels that the financial institution needs to lower its overall risk level, otherwise the insurer would need to terminate the coverage of the institution due to its excessive risk level.

6.1.2 Profit Maximizing Stock Banks

Following the same approach for the JSB as for the FC, we find

$$MH_{JSB}^{A} = \frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)}.$$

Comparing this result to equation (18), we see that as for the FC, a risk adjusted premia reduces moral hazard. In the same vein, this risk adjustment only slightly reduces MH. As MH_{JSB} compared to MH_{FC}, we notice that MH_{JSB}^{A} is higher than MH_{FC}^{A} by the weight of the net-savers; the higher the net-saver member level, the greater the difference.

6.2 Regulatory Capital (K)

6.2.1 Financial Cooperatives

Capital is the excess of assets over liabilities of a firm; it is the ownership and net worth in a business. In a FC, capital is composed of member shares, reserves and retained earnings. This is the financial base for a FC. There are several authors that emphasized the importance of regulatory capital restrictions to curb MH in banks (Kane and Hendershott, [13]) and some others have proposed schemes of DI premia based on inverse scales of premia and capitalization (see e.g. Chan, *et al.* [5] Kendall, [16], Kendall and Levonian, [17], among others).

How should capital be structured to minimize MH? Using the same approach as in section 5.1, we find the following function

$$
\begin{aligned}
MH_{FC}^{B} &= (1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)} \\
&\quad -\frac{R_{S,FC}(\omega)\left(\frac{\partial}{\partial\omega}\left[P(\omega)+K(\omega)\right]\right)\left(\alpha R_{S,JSB}+(1-\alpha)R_{S,FC}\right)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)},
\end{aligned}
$$

which we can compare to equation (14) to obtain

$$
MH_{FC}^{B}=MH_{FC}-\frac{\partial}{\partial\omega}K(\omega)\frac{R_{S,FC}(\omega)\left(\alpha R_{S,JSB}+(1-\alpha)R_{S,FC}\right)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}.
$$

Therefore, in a FC **the greater the sensibility of capital requirements to risk, the greater the reduction in moral hazard.** The contribution of a risk adjusted capital is however in the same scale as the contribution of the risk adjusted premia. One plausible solution to curb MH in FC would be to include both risk adjustments (premia and capital).

6.2.2 Profit Maximizing Stock Banks

For the JSB, we find that

$$
\begin{aligned}
MH_{JSB}^{B} &= \frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)} \\
&\quad -\frac{R_{S,JSB}(\omega)\left(\frac{\partial}{\partial\omega}\left[P(\omega)+K(\omega)\right]\right)}{Q_L(1-\rho)\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)}.
\end{aligned}
$$

This as the same implications as for the FC; greater sensitivity of capital to risk means lower moral hazard. We also notice that MH_{JSB}^{B} is greater then MH_{FC}^{B} and a functi8on of the level of net-savers control.

6.3 Reserve Requirements (ρ)

Reserves requirements is rarely considered as a mechanism to control moral hazard in JSB. Reserves management is considered fundamentally an instrument of monetary policy.[28] Prior to 1990, reserve requirements for most JSB in developed markets was between 3% to 5% of deposits. These regulations have however been phased out for multiple purposes such as increasing the control of monetary policy and offering a level playing field for all deposit taking financial institutions. In any case, this analysis assumes that reserve requirements would be tied to the risk level of the portfolio and not to the size of the deposits (a much simpler matter to implement). This assumption is evidently more difficult to justify than simple capital requirement. However, in FC, reserve requirements that can go as high as 10% of deposits (or assets!) are, in many counhtries, a common regulatory restriction that will insure liquidity of institutions that have limited or no access to the interbank market and to Central Bank facilities.

6.3.1 Financial Cooperatives

Using the same approach we find that a risk adjusted reserve requirement yields the following

$$
\begin{aligned}
MH_{FC}^{C} &= (1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)} \\
&\quad -\frac{\left(\alpha R_{S,JSB}+(1-\alpha)R_{S,FC}\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)(1-\rho(\omega))^2} \\
&\quad *\left[(1-\rho(\omega))\frac{\partial}{\partial\omega}P(\omega)+(Q_L+Q_D-K+P(\omega))\frac{\partial}{\partial\omega}\rho(\omega)\right]
\end{aligned}
$$

[28] Or, in developing countries operating under a financially repressed regime–a situation that is less and less frequent–, as a mechanism to finance fiscal deficit.

for the FC. Given our assumptions for the introduction of DI in section 3.6 this is equivalent to

$$
\begin{aligned}
MH_{FC}^{C} &= (1-\alpha)\frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,FC}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)} \\
&\quad -\frac{(\alpha R_{S,JSB}+(1-\alpha)R_{S,FC})*\left[(1-\rho(\omega))\frac{\partial}{\partial\omega}P(\omega)+Q_S\frac{\partial}{\partial\omega}\rho(\omega)\right]}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,FC}(\omega)\right)(1-\rho(\omega))^2}.
\end{aligned}
$$

MH_{FC}^{C} shows that a in a FC a **risk adjusted reserve requirements should lead to lower moral hazard**.[29]

6.4 Does it Matter Whether the Financial Cooperative is Net-Borrower Dominated or Net-Saver Dominated?

Simplifying equation 14 we had obtained

$$MH_{FC}^{'} = (1-\alpha)$$

and determined that moral hazard in a financial cooperative is a positive function of the level of net-borrowers. It is therefore desirable for a DI scheme that the FC be net-saver dominated. In fact, as some authors have shown, the risk taken by the net-borrower dominated FC in its lending portfolio can be quite substantial. However, as shown by Hart and Moore (H&M) [9], borrower domination has theoretical limits. H&M rely heavily on a version of the Median Voter Theorem by Roberts [24]. The Median Voter Theorem predicts that the outcome will be that which represents the median member and not that of either extreme. Moreover, if decisions are such that members in one or the other extreme of the preference scale desert, a shift in the median will occur with the old median members shifting in direction of the deserters and a new median appearing among members at the opposite side of the deserters giving more weight to their preferences in future decisions.On an empirical ground, Smith [27] investigated whether American *Credit Unions* (CU) tend to be dominated either by net-borrowers or by net-lenders. Smith found that *on average* CUs tend toward the middle ground.

7 Conclusion

The purpose of this paper was to present a model that allows the evaluation of the effects in terms of moral hazard of introducing a deposit insurance scheme for financial cooperatives (FC) and how this compares with profit maximizing stock banks (JSB). We also investigated some regulatory mechanisms that may be used by regulators to curb the incentives to moral hazard that appear with the introduction of deposit insurance. Although we find that several of the effects that are known to exist when profit maximizing stock banks are covered by deposit insurance, there are a number of details that distinguish the financial cooperative and that are relevant in the implementation of a deposit insurance scheme for cooperatives. The main conclusions of the work are:

[29] For purpose of comparison we see that for JSB

$$
\begin{aligned}
MH_{JSB}^{C} &= \frac{Q_S\left(\frac{\partial}{\partial\omega}R_{S,JSB}(\omega)\right)}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)} \\
&\quad -\frac{R_{S,JSB}\left[(1-\rho(\omega))\frac{\partial}{\partial\omega}P(\omega)+Q_S\frac{\partial}{\partial\omega}\rho(\omega)\right]}{Q_L\left(\frac{\partial}{\partial\omega}R_{L,JSB}(\omega)\right)(1-\rho(\omega))^2}
\end{aligned}
$$

We notice that both of these moral hazard equations are smaller than their counterparts without reserve requirements adjusted to risk. Therefore, risk adjusted reserve requirements lowers the moral hazard of deposit insurance for the FC *and* for the JSB. Additionally, comparing MH_j^B to MH_j^C, we notice that its second term is more negative and hence risk adjusted capital would curb moral hazard better than risk adjusted reserve requirements. This justifies the preferential use in JSB of capital standards as a mechanism to curb moral hazard.

- Introduction of deposit insurance unambiguously leads to increases in optimal risk taking and thus moral hazard in FC. However this effect is lower for FC than for JSB. Simulations suggest that the effect is about half an intense in FC than in JSB. Generally, this is consistent with the empirical findings of Karels and McClatchey [14] and Kane and Hendershott, [13].
- The optimal risk taking in a financial cooperative is a positive function of the level of control by net-borrowers over net-savers. Measured by rank correlations, moral hazard exercicing behavior is most sensitive to the sen
- Moral hazard is greater for the profit maximizing bank than for the financial cooperative. This difference increases as the level of control by the member net-borrower increases. A financial cooperative net-borrower dominated will exhibit the same levels of moral hazard as a profit maximizing bank.

Among the regulatory measures that regulators and supervisors can introduce to curb moral hazard in financial cooperatives, we investigated and obtained the following:

- A premia adjusted to risk will curb moral hazard in the same fashion than risk adjusted capital requirements;
- Reserve requirements adjusted to risk will also contribute to curb moral hazard;
- A combination of the above risk adjustments will tend to curb better moral hazard than only one form of risk adjustment.

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Appendix A

A.1 Expectation of "Risky Investments"

The following describes the assumptions behind the expected cash flow from risky investment equation.

$$S(t) = \Pr(T > t) = 1 - F(t) = 1 - \Pr(T < t)$$

G : Collateral, Guarantee
$Q_{L,J}$: amount invested in risky assets, e.g. Loans made by insitution J
$R_{L,J}$: gross interest rate (1+r) charged on the loan by institution J
X : amount received from borrower
Default will occur if

$$G + X \leq Q_{L,J} R_{L,J}$$

and we also the constraint

$$0 \leq X,$$

hence

$$0 \leq X \leq Q_{L,J} R_{L,J} - G.$$

The model is based on the the following assumption that

$$S(Q_{L,J} R_{L,J} - G) = 0$$

From this assumptions we can now model the expectation of our risky investments

$$E\left(risky\_inv\right) = E\left(X + G\right)$$

$$\begin{aligned}
E\left(X + G\right) &= \int_0^{Q_{L,J}R_{L,J}-G} \left(G + x\right) f\left(x, w\right) dx \\
&= G \int_0^{Q_{L,J}R_{L,J}-G} f\left(x, w\right) dx + \int_0^{Q_{L,J}R_{L,J}-G} x f\left(x, w\right) dx \\
&= G + \int_0^{Q_{L,J}R_{L,J}-G} x f\left(x, w\right) dx \\
&= G + \int_0^{Q_{L,J}R_{L,J}-G} S\left(x, w\right) dx \\
&= G + \int_0^{Q_{L,J}R_{L,J}-G} \left(1 - F\left(x, w\right)\right) dx \\
&= G + \int_0^{Q_{L,J}R_{L,J}-G} dx - \int_0^{Q_{L,J}R_{L,J}-G} F\left(x, w\right) dx \\
&= G + Q_{L,J}R_{L,J} - G - \int_0^{Q_{L,J}R_{L,J}-G} F\left(x, w\right) dx \\
&= Q_{L,J}R_{L,J} - \int_0^{Q_{L,J}R_{L,J}-G} F\left(x, w\right) dx.
\end{aligned}$$

A.2 SOC of utility function

To proove that the utility function was in fact maximized we establish whether the second derivatives of (11) is negative.

$$
\begin{aligned}
\frac{\partial \mathrm{U}_{FC,DI}}{\partial \omega} &= \lambda Q_L \left[\left(\frac{\partial}{\partial \omega} R_{L,PMSB}(\omega) \right) - \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \right] \\
&\quad - \left(\frac{\partial}{\partial \omega} P(\omega) \right) \frac{[R_{S,FC}(1-\alpha) + \alpha R_{S,PMSB}]}{1-\rho} - \int_0^{Q_L R_{L,FC}(\omega)-G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX \\
&\quad + Q_L \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) (1 - \mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega)) = 0
\end{aligned}
$$

Given that $R_{L,j}$,$R_{S,j}$ and $P(\omega)$ are linear function;

$$
\begin{aligned}
\frac{\partial^2 \mathrm{U}_{FC,DI}}{\partial \omega^2} &= \lambda Q_L \; [(0) - (0)] \\
&\quad - (0) \frac{[R_{S,FC}(1-\alpha) + \alpha R_{S,PMSB}]}{1-\rho} - \frac{\partial}{\partial \omega} \left[\int_0^{Q_L R_{L,FC}(\omega)-G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX \right] \\
&\quad + Q_L \left[\begin{array}{c} (0)(1 - \mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega)) \\ + \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \frac{\partial}{\partial \omega} (1 - \mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega)) \end{array} \right]
\end{aligned}
$$

which yields

$$
\begin{aligned}
\frac{\partial^2 \mathrm{U}_{FC,DI}}{\partial \omega^2} &= -\frac{\partial}{\partial \omega} \left[\int_0^{Q_L R_{L,FC}(\omega)-G} \frac{\partial}{\partial \omega} \mathrm{F}(X,\omega) dX \right] \\
&\quad - Q_L \left(\frac{\partial}{\partial \omega} R_{L,FC}(\omega) \right) \frac{\partial}{\partial \omega} [\mathrm{F}(Q_L R_{L,FC}(\omega) - G, \omega)]
\end{aligned}
$$

and therefore

$$
\frac{\partial^2 \mathrm{U}_{FC,DI}}{\partial \omega^2} < 0.
$$

The same logic applies to equation (10).