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The Cost of Debt and the Risk-Adjusted Discount Rate for Owner Cash-Flows: Co-operatives vs. Investor-Owned Firms

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This paper values an input co-operative (co-op) that procures a single commodity from farmers and then processes and markets the output, and an otherwise identical firm structured as an Investor-Owned Firm (IOF) using the Capital Asset Pricing Model (CAPM) and the Black-Scholes option pricing model. The paper focuses on the right to residual claims aspect of ownership, ignoring the formal right to control, and uses a single-period model. Four conclusions emerge when co-op members are assumed not to make pre-emptive payoffs to themselves. First, the risk-adjusted discount rate (RADR) of equity of an unlevered IOF will always be higher than the RADR of the "owner" claims of an unlevered co-op. Second, for a given absolute level of debt the co-op will have lower effective financial leverage than an otherwise identical IOF. Third, for a given financial leverage the co-op owner claims will have a lower RADR than IOF equity. Finally and importantly, the cost of debt for an IOF will be higher than that of a co-op for the same leverage and/or absolute debt levels.

While an IOF can alter risk through both operating and financial leverage; a co-op has in addition a third dimension of risk–pre-emptive payoffs to members. Such pre-emptive payoffs increase risk to lenders.

Key words: co-operative, investor-oriented firm, lender risk

The Cost of Debt and the Risk-Adjusted Discount Rate for Owner Cash-Flows: Co-operatives vs. Investor-Owned Firms[1]

The cooperative (co-op) firm has been subjected to rigorous analysis in the economics paradigm. An indicative but certainly not an exhaustive list includes Bateman, Edwards and LeVay (1979), Dreze (1987), Hart and Moore (1998), and Hansmann (1996). However, there is much less analysis of the co-op in the mainstream finance paradigm as articulated, say, in Jensen and Smith (1984). I make this distinction between the economics and finance paradigms with some caution, given that the boundaries between these two are blurred. This article uses two valuation models that are "the major building blocks of the modern theory of financial economics finance" (Jensen and Smith 1984)–the Capital Asset Pricing Model (CAPM) and the Black-Scholes option pricing model– to provide insights into risk borne by lenders and owners of a co-op,

The important conclusion of this paper is that a co-op can be safer for lenders, implying a lower cost of debt, than an otherwise identical firm structured as an Investor-Owned Firm (IOF). A related conclusion is that risk adjusted discount rate (RADR) appropriate to the cash flows of the owners of a co-op is lower than that of the RADR appropriate to the cash flows of the owners of an IOF. Additionally, while the equity owners of an IOF can lever their returns using operating and financial leverage; co-op owners (co-op legislation and practice permitting) have an additional source of leverage–pre-emptive payoffs to owners. These conclusions have implications for valuation and financial analysis. I will show, for instance, that application of the IOF definition of financial leverage without modification, to the co-op context, is inappropriate. Srinivasan and Phansalkar (2003) provide an analysis of co-op risk in an accounting framework. This article formalizes this understanding in a valuation framework.

Given that co-ops and IOFs come in many different flavours, I focus on an agricultural marketing firm that procures a single commodity (such as wheat) from farmers and then processes and markets the output, as the core business that can be organized legally either as an IOF or as a co-op. Organized as an IOF the owners are the suppliers of equity. Organized as a co-op the owners are the member-farmers of the co-op who supply the single commodity. Hansmann (1996, pp. 11-23) defines ownership by two sets of rights: formal control rights and the right to residual earnings. In this article, the right to residual earnings (residual claim) is viewed as the central difference between an IOF and a co-op, with formal control rights ignored.

In general, the residual claim in an IOF is vested with capital suppliers; whereas the residual claim in a co-op can be vested with input suppliers (as in this article), with output purchasers (for example with farmers who buy fertilizer from a co-op), or with suppliers of labour in an employee-managed co-op. Usually co-op residual claimants, such as input suppliers, also bring in equity capital.

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The difference between the residual claims of the two forms of organization can be understood in terms of the end-of-period surplus distribution. Continuing with the marketing firm example, I assume that the commodity is procured at the start of the year and sold at the end of the year. In the case of an IOF, any end-of-year surplus is either distributed to equity holders as dividend or retained on their behalf with the firm. An IOF may also make during-the-year distributions to residual claimants in the form of "interim" dividends. Such interim dividends are tentative in that they can be recovered from equity holders if the end-of-year surplus is inadequate. In the case of a co-op interim payments can be made to input suppliers as a "tentative price" for supply. The year-end surplus can be distributed (either as a "price bonus" on supply or dividend on equity) or retained. In several countries the "tentative price" paid by a co-op is legally at par with "interim" dividends paid to equity holders by an IOF, and can be recovered, in part or in full, if the year-end surplus is inadequate. In other countries, the during-the-year payment is a pre-emptive payoff and treated at par with payments to outsiders (such as suppliers of consumables or lenders). The pre-emptive payoff is not recovered even if the year-end surplus is inadequate (see Srinivasan and Phansalkar 2003, p. 378).

In this article I will assume that the co-op members not only supply the entire input but also all the equity capital. Lenders to an IOF are protected by the fact that equity holders, as residual claimants, can only appropriate cash-flow remaining after the lenders' (and all other outside claimants') contractual obligations have been serviced by the firm. Lenders to a co-op are similarly protected except that payment to members for both input supply and equity can only be made after lenders' contractual obligations have been met. There is, therefore, a larger residual claim that is junior to the lenders' claims–this fact is the key to the difference between the costs of debt in the two forms of organization.

Other possible institutional features that distinguish co-ops and IOFs such as control rights will not be dealt with in this paper. Issues relating to the co-op form such as of open or closed membership are finessed, as are issues of retained patronage distribution or transferable delivery rights (Moore and Noel 1995). Property rights issues in multi-period co-ops, such as those analyzed in Jensen and Meckling (1979), will also be ignored (with a single period there are no free-rider or horizon problems.) The debate between traditional and new generation co-ops (Russo and Sabbatini 2005) is also immaterial here. This helps me focus on the core issue addressed here; that the nature of residual claim basis that distinguishes co-ops from IOFs alters both the cost of debt and the RADR of owner claims.

The rest of the article is organized as follows. The first section describes the valuation models that will be used, and their interrelationship. In the second section, the unlevered firm is valued in a CAPM framework, comparing an IOF with a co-op that procures only from members and whose members are residual claimants: supplying equity capital and commodity at start-of-period and receiving a stochastic cash flow at period-end (without pre-emptive payoffs). In the subsequent section the levered firm is valued in a Black-Scholes option pricing framework. A numerical illustration is then provided. Valuation is then done assuming that co-op members can make pre-emptive payoffs to themselves at the start. The final section presents the conclusions.

Valuation Models

The CAPM is an equilibrium asset pricing model that relates the expected return of security 'i' (r_i) to its systematic risk or beta (β_i), the expected returns on the market (r_m) and the risk-free rate (r).

$r_i = \beta_i*(r_m-r)$

The systematic risk of the security $\beta_i = \sigma_{im}/\sigma^2_m$ where σ_{im} is the covariance of the security with the market and σ^2_m is the variance of market returns.

The assumptions and proof of CAPM in a one-period model can be found in standard text books (see Copeland, Weston and Shastri 2005, pp. 147-152). The beta of levered equity of an IOF is driven by two risks: operational (business) risk arising from the use of fixed operating costs, and financial risk from the use of debt with consequent fixed interest payments (Mandlekar and Rhee 1984).

Black and Scholes (1973) derive the value 'c' of an European call option (with exercise price 'X' and exercisable on maturity at time 't') on an underlying stock (with market value E and standard deviation σ) that pays no dividends, and with a risk-free rate 'r'.

$c=E*N(d_1)-X*e^{rt}*N(d_2)$

In this equation $d_1=[\ln(Ee^{rt}/X)+0.5\ \sigma^2 t]/\sigma\sqrt{t}$ and $d_2= d_1- \sigma\ \sqrt{t}$, and N(.) is the cumulative distribution of a unit (with mean 0 and variance 1) normal variable. The option pricing model assumptions are elaborated in a subsequent section.

The Black-Scholes option pricing model for valuing financial options has been applied to the valuation of corporate liabilities (Smith 1979) such as debt and equity.

Merton (1973) derives the CAPM in a continuous-time model, which is identical in structure to the one-period model. However, rates of return in the continuous-time model are instantaneous expected rates, and the beta is the instantaneous systematic risk. The CAPM and the option pricing model yield consistent valuations when applied to the context of corporate liabilities, the results are also consistent with MM (Modigliani-Miller 1958) propositions in a no-tax world (see Copeland, Weston and Shastri 2005, pp. 581-587).

Valuation of the Unlevered Firm

I make assumptions about the markets, the firm in general, and about the IOF and co-op in specific. These assumptions are intended to formalize the central difference between the IOF and co-op (the residual claim) in "low-fat" models amenable to analysis.

1. Markets are complete and the capital-asset pricing model (CAPM) holds. Specifically this implies that co-op members hold a diversified portfolio (including farm assets) satisfying CAPM assumptions.

2. The firm (whether IOF or co-op) operates with limited liability for a single period and then liquidates. At time t=0, an investment in fixed assets 'I' is made, financed entirely by equity. The initial investment 'I' will consist only of fixed assets. This is strictly speaking unnecessary but I am invoking this for expository clarity. The fixed assets have no salvage value at t=1, and the single period depreciation is 'I'.

   A specific quantity of a single commodity is procured at t=0. At t=1 the entire quantity procured is sold in all states of the world. The input commodity and the marketed output are each homogeneous, and exchanged in perfectly competitive markets. The unit-selling price is state-contingent and this is the driver of the systematic risk of revenues. Homogeneity ensures that I am effectively dealing with a single commodity (two grades of wheat, for instance would needlessly complicate analysis and not make a material change to my conclusions.)

   Also at t=1, the firm incurs a fixed operating cost 'fc'. This fixed operating cost is fully covered by available revenues in all states of the world and the firm will never default on these payments.

   There are no corporate or personal taxes. There no transaction costs, specifically agency costs are absent and the IOF and co-op have identical efficiencies.

3. The IOF procures the commodity at t=0 on credit from suppliers, processes and markets, and realizes state-contingent revenues at t=1. It pays the suppliers a fraction 'vc' of the state-contingent price realized, at t=1. Therefore, the systematic risk (beta) of the variable cost stream is equal to that of the revenue stream. Also, by this formulation variable cost will never be in default. This structure of fixed and variable cost is consistent with IOF analysis of the beta of equity (Mandleker and Rhee 1984). Equity holders receive a state-contingent end-of-period (t=1) distribution of the entire residual (after payment of variable cost and fixed operating cost) with a present value V (which is also the value of the unlevered IOF).

4. Co-op members join at time t=0, and provide any initial equity in proportion to their expected patronage (supply of the commodity). This ensures complete alignment of interest between members in their roles of suppliers of capital and suppliers of the commodity. For convenience I assume that any payments/surplus distribution to co-op members is made in proportion to the commodity supply (ignoring equity investments). Given the assumption of equity-commodity supply alignment there is no loss of generality on account of this assumption.

Co-op members supply the commodity at time t=0. They receive a state-contingent end-of-period (t=1) distribution of the entire residual (after payment of fixed operating cost) with a present value of V', referred to as owner claims (V' is also the value of the unlevered co-op). This again is a formalization of the co-op firm (Hansmann 1996).

Value and Cost of Owner Claims of the Unlevered Firm

The beta (systematic risk) of unlevered equity for an IOF can formulated in terms of the beta of the revenue stream. As stated earlier the single driver of firm operating risk is systematic risk of the revenue stream, β_{rev}. The variable cost stream has, by assumption 5 above, the same systematic risk as the revenue stream. The fixed cost stream has, by assumption 5 above, zero systematic risk. I define PV(rev) as the present value of the revenue stream discounted at an RADR appropriate to its systematic risk, and PV(fc) as the present value of the fixed cost stream discounted at the risk-free rate 'r'. The value of the IOF firm below is also the value of unlevered equity:

(1) $V = I = PV(rev)-vc*PV(rev)-PV(fc)$

The systematic risk of the unlevered IOF is a weighted-average of the systematic risks of the revenue, variable cost and fixed operating cost streams, and is given by:

$\beta_u = \beta_{rev}*PV(rev)/I - vc*\beta_{rev}*PV(rev)/I-0*PV(fc)/I$

(2) $\beta_u = \beta_{rev}/[1-1/(1-vc)*PV(fc)/PV(rev)]$

In the case of the co-op the value of the firm is the value of the revenue stream less the value of the fixed operating cost stream. The value of the co-op firm below is also the value of unlevered owner claims, and is given by:

(3) $V' = PV(rev) - PV(fc) = I + vc*PV(rev)$

The systematic risk of the unlevered co-op is given by:

$\beta'_u*PV(rev)-PV(fc)/I=\beta_{rev}*PV(rev)/I-0*PV(fc)/I$

(4) $\beta'_u = \beta_{rev}/[1-PV(fc)/PV(rev)]$

The RADR of unlevered owner claims can be obtained for each type of firm using the CAPM. Note that the RADD of unlevered owner claims of the co-op will always be lower than that if unlevered equity of an IOF, with positive variable or fixed costs.

Risky Debt in an Option-Pricing Framework

Financial Leverage and Value of the Levered Firm

The IOF may raise debt (market value D) at t=0 through zero-coupon bonds, with face (maturity) value F, due at t=1. Debt may be risky and will be priced accordingly. The fixed operating cost and variable cost are the senior claimants on revenues *vis-à-vis* debt at t=1. With debt claims junior to fixed operating cost and supplier payments there may be states of the world where default to lenders in part or full may occur. Because the firm operates in competitive markets the value of the firm (the market value of debt D and that of equity E) will be I. IOF leverage L is defined as D/V. Following from the MM Proposition-1 (Modigliani-Miller 1958) in a no-tax world, the value of the firm V=D+E will be invariant with leverage.

The co-op may raise debt (market value D') at t=0 through zero-coupon bonds. Debt claims at t=1 are junior to the fixed operating cost. As with the IOF, there may be states of the world in which debt is in default. The owner claims of co-op members' E' is equal to the value of the co-op firm V' less the value of debt D'. By analogy co-op leverage is given by:

(5) $L' = D'/V' = D'/[PV(rev)-PV(fc)]$

Comparing the two leverage relationships, with V' always greater than V, a co-op always has a lower leverage than an IOF with the same market value of debt. Again invoking MM Proposition-I the value of the co-op firm V'=D'+E' will be invariant with leverage.

Pricing Debt and Equity in an Option-Pricing Framework

By the assumptions in the previous section, the IOF has only two claims outstanding, zero-coupon debt with face value F maturing in one-period and equity. Also, there are no transaction costs, and the total value of the firm is unaffected by capital structure. Additionally, in order to apply the Black-Scholes option pricing model, the following are also assumed to be satisfied (see Smith 1979) in the context of a one-period framework: a known constant risk-free rate 'r', no dividend payments to equity is made till debt-holders are paid off at t=1 and the residual is then paid to equity holders, and that the underlying source of uncertainty is the firm's market value which is log-normally distributed with standard deviation σ.

In this paper, I justify the last assumption by specifying that the underlying source of uncertainty is the value of the revenue stream which is log-normally distributed with standard deviation σ_{rev}. Since the variable cost is perfectly correlated to the revenue stream and the fixed cost is constant, this will imply that IOF firm value is log-normally distributed. The valuation of debt in an IOF is a straight forward application of the Black-Scholes model (see Whaley 2006, pp. 419-424) and we have for a single period:

(6) $D=V*N(d_1)-F*e^r*N(d_2)$

With $d_1=[\ln(Ve^r/F)+0.5\ \sigma^2]/\sigma$ and $d_2= d_1- \sigma$

and the standard deviation of the firm $\sigma = \sigma_{rev}/[1-1/(1-vc)*PV(fc)/[PV(rev)]$

Now assume a co-op, otherwise identical to the IOF, except that co-op members as earlier provide equity and supply the commodity. If distribution of surplus to co-op owners is made at t=1, after the debt is repaid, the value of debt is now given by:

(7) $D'=V'*N(d'_1)-F*e^r*N(d'_2)$

Where V' is as defined earlier [PV(rev)-PV(fc)]

and $\sigma' = \sigma_{rev}*/[1-PV(fc)/PV(rev)]$

From the above, V' is greater than V and σ' is less than σ. Hence D'will be greater than D for a given face value of debt F. Co-op debt becomes more valuable than IOF debt of the same face value: as the standard deviation of the revenue stream increases, as the variable cost proportion (vc) increases, and as the fixed cost proportion [PV(fc)/PV(rev)] increases.

The expected rates of return of equity (r_E) and debt (r_D) of the IOF can be found as follows (see Whaley 2006, pp. 434-435):

$r_e = r+ (r_u -r)*\eta_e$

Where the elasticity of equity with respect to firm value is given by $\eta_e=\Delta_e*V/E$, with equity $\Delta_e=N(d_1)$.

$r_d = r+ (r_u -r)*\eta_d$

Where the elasticity of debt with respect to firm value is given by $\eta_d=\Delta_d*V/D$, with debt $\Delta_d=1-N(d_1)=N(-d_1)$.

Analogous equations can be written for the co-op, the underlying co-op firm value will also be log-normally distributed of the revenue is log-normally distributed.

Numerical Illustration

The above option-pricing formulations are illustrated with hypothetical numbers in table 1. The market-level assumptions are that the expected return on the market (r_m) is 12%, and the risk-free rate (r) is 5%.

Firm-level assumptions common to both IOF and co-op are: The initial investment in fixed assets (I) is 100. The revenue stream has an expected payoff at t=1 of 500, a beta (β_{rev}) of 0.8, and a standard deviation σ_{rev} of 40%. The variable cost to revenue ratio (vc) is 60% and the fixed cost incurred at t=1 is 84.87.

The expected return of the revenue stream [RADD=10.60%] can be calculated from β_{rev} using the CAPM. The present value of the revenue stream can be calculated [PV(rev)=452.08] by discounting the expected payoff using the RADD.

For the IOF, the value of the firm [V=100.00], the standard deviation of firm value [σ=56.98%], the unlevered firm beta [β_u=1.45] and RADD of the unlevered firm [r_u=15.13%] can be obtained.

Similarly for the co-op, the value of the firm [V'= 371.25], the standard deviation of firm value [σ'=48.71], the unlevered firm beta [β'_u= 0.97] and RADD of the unlevered firm [r'_u=11.82%] can be obtained.

Finally for a given face value of debt, debt and owner claim values and RADDs of debt and owner claims can be calculated. For instance if the face value of debt is 50, we obtain the market values and RADDs in table 1. With this value of maturing debt, IOF debt has a risk-premium while co-op debt is (at second decimal place) still risk-free. Co-op debt is worth 1.72 more than IOF debt and this is the value provided by co-op owners. Their claim is 1.72 less than the combined claims of IOF equity owners and input suppliers. Thus the wealth of co-op owners is 1.72 less than the combined wealth of equity holders and input suppliers of an otherwise identical IOF. This wealth shift to lenders in a co-op is the direct consequence of input suppliers in the co-op becoming junior claimants to lenders.

Table 2 shows debt and equity values and RADDs of debt and equity for IOF and co-op for various leverages. The unlevered cost of co-op owner claims is lower than that of unlevered IOF equity claims. The cost of debt in a co-op is lower than the cost of debt, with the same market value, in an IOF. Again the cost of debt in a co-op with a given leverage is lower than the cost of debt in an IOF with the same leverage.

Pre-emptive Payoff to Co-operative Members

I now modify assumption 5 in the first section.

> Co-op members are paid a price for the commodity supplied in two parts. The first is a pre-emptive payoff at time t=0. The second is a state-contingent end-of-period (t=1) distribution of all end-of-period surplus belonging to co-op members. This year-end distribution will be adjusted for the pre-emptive payoff if surplus exists, but if there is a year-end shortfall no part of the pre-emptive payoff will be recoverable from members [this is the situation that effectively prevails in India, see Srinivasan and Phansalkar (2003)].

The total initial investment, to be financed by debt and equity, is increased if pre-emptive payoffs are made, since these involve investment (over and above fixed assets) in a payment to suppliers-cum-owners at t=0. (This may be contrasted with the IOF in the previous section, where suppliers are paid at end-of-period). The making of pre-emptive payoffs not only involves an investment at t=0, but has the potential reduce the effective "equity" stake of members. The situation where such a preemptive payoff is financed by member equity is uninteresting (since such additional equity will merely offset the preemptive payoff). What is interesting is the situation in which such payoffs are financed with additional debt (over and above the debt used to finance fixed assets). Therefore, use of the pre-emptive payoff adds to the risk of a lender.

Numerically this can be illustrated by modifying the illustration in table 1. Assume a pre-emptive payoff of 100 is made at t=0 to co-op owners. To finance this, the lenders are assumed to provide the same initial amount as in the illustration in table 1 plus an additional 100 at start. Using the Microsoft EXCEL goal-seek function, the debt face value increases from 50.00 to 154.61, the cost of debt from 5.00% to 5.28%; and the RADR of owner end-of-year claims from 12.82% to 16.05%. If the pre-emptive payoff is increased to 165.90, the debt face value increases further to 238.97 with a cost of debt of 6.24% (the same as that of the levered IOF in table 1); and the RADR of owner claims to 19.58%.

What the pre-emptive payoff does is to sandwich lender claims: such claims are junior to some co-op member claims (the pre-emptive payoff), and senior to the remaining member claims. While I have implemented the pre-emptive payoff effectively through financial leverage, it essentially represents a third dimension to risk. In addition to operating and traditional financial leverage available in IOFs, co-op members can use pre-emptive payoff to alter risk to owners and lenders.

Conclusion

This paper is a formalization of the central economic difference between a co-op (that does not permit a pre-emptive payoff) and an IOF and yields four related conclusions. All are rooted in the fact that the entire present value of payments to commodity suppliers made by the IOF, as well as invested equity, is available as owner value in the co-op. First, the RADR of equity of an unlevered IOF will always be higher than the RADR of the owner claims of an unlevered co-op. Second, for a given absolute level of debt the co-op will have lower effective leverage (as defined respectively for the two forms of organization being compared) than an otherwise identical IOF. Third, for a given leverage the co-op owner claims will have a lower RADR than IOF equity. Finally and importantly, the cost of debt for an IOF will be higher than that for a co-op for the same leverage and/or absolute debt levels. This occurs because there may be states of the world in which for a given debt maturity value, debt payments in an IOF may be in default, with debt payments in a co-op either being serviced fully or at lower levels of default.

A co-op that makes a pre-emptive payoff to members adds to risk: the cost of debt as well as the RADD of end-of-year owner claims increase.

The implication of this paper for practice and research is that standard tools of finance need adaptation before application in the co-op context. For instance Russo et al. (2001) address the issue of excessive leverage in agricultural co-ops, with leverage defined in the traditional IOF fashion (focusing on equity and not on the entire member residual claims). Co-op leverage in their paper would be lower if member residual claims on both inputs and equity capital were recognized (as in equation 5). Umarov (2002) while valuing co-op equity first converts the co-op into an equivalent IOF by assuming that the co-op pays a market price for inputs. His valuation discounts the free-cash flow (FCF—the cash flow to suppliers of debt and equity) at the weighted-average cost of capital. The protocols used in this paper would give co-op lenders a higher value than what Umarov obtains with correspondingly lower owner (combined input and equity) value. My position is that, in general, rather than convert a co-op into an equivalent IOF by treating purchases from co-op members as "payment to outsiders" and then valuing cash flows to equity; the entire cash flows to members should be valued at the owners' RADR.

References

Bateman, D.I., J.R. Edwards , and C. Levay. 1979, "Problems of Defining a Co-operative as an Economic Organization." *Oxford Agrarian Studies*. 8: 43-62.

Black, F., and M. Scholes. 1973. "The Pricing of Options and Corporate Liabilities." *Journal of Finance*. 31: 351-367.

Booth, L. D. 1982. "Correct Procedures for the Evaluation of Risky Cash Outflows." *Journal of Finance and Quantitative Analysis.* 17 (2): 287-300.

Copeland, T.E., J.F. Weston, and K. Shastri. (2005). *Financial Theory and Corporate Policy*. 4th ed. Boston: Pearson Addison-Wesley.

Dreze, J.1987. "Some Theory of Labour Management and Participation." in *Essays in Economic Decisions under Uncertainty.* Cambridge: Cambridge University Press.

Hart, O., and J. Moore. 1998. "Cooperatives versus Outside Ownership." National Bureau of Economic Research, Working Paper 6421.

Hansmann, H. 1996. *The Ownership of Enterprise*, Harvard University Press, Cambridge.

Jensen, M.C., and C. Smith. 1984. "The Theory of Corporate Finance: A Historical Overview." in *The Modern Theory of Corporate Finance*. Jensen M.C. and C.W. Smith (eds.). New York: McGraw-Hill.

Jensen, M.C., and W.H. Meckling. 1979. "Rights and Production Functions: An Application to Labor-Managed Firms and Co-determination." *Journal of Business*. 52: 469-506.

Mandleker, G.N., and S.G. Rhee. 1984. "The Impact of the Degrees of Operating and Financial Leverage on Systematic Risk of Common Stock". *Journal of Finance and Quantitative Analysis.* 19: 45-57.

Merton, R. C. 1973. "An Intertemporal Capital Asset Pricing Model." *Econometrica.* 41 (5): 867-887.

Modigliani, F., and M.H. Miller. 1958. "The Cost of Capital, Corporation Finance, and the Theory of Investment." *American Economic Review*. 48: 261-297.

Moore, C., and J. Noel. 1995. "Valuation of Transferable Deliverable Rights for Marketing Cooperatives." *Journal of Cooperatives*. 11: 39-50.

Russo, C., and M. Sabbatini. 2005."Incentives to Efficient Investment Decisions in Agricultural Cooperatives." *XI International Congress of the European Association of Agricultural Economists.*

Russo, C., D. Witherspoon, C. Peterson, and M. Sabbatini. 2001. "Effects of Managers' Power on Capital structure: A Study of Italian Agricultural cooperatives." *International Food and Agribusiness Management Review*. 3: 27-39.

Smith, C. 1979. "Applications of Option Pricing Analysis." *Handbook of Financial Economics*. J.L. Bicksler (ed.) Amsterdam: North Holland.

Srinivasan, R. and S.J. Phansalkar. 2003. "Residual Claims in Cooperatives: Design Issues." *The Annals of Public and Cooperative Economics*. 74, 3: 365-395.

Umarov, A.A. (2002). "Equity Valuation in New Generation Cooperatives." *Unpublished Master's Thesis*. North Dakota State University of Agriculture and Applied Sciences.

Whaley, R. 2006. *Derivatives: Markets, Valuation, and Risk Management.* New Jersey: John Wiley.

Table 1: Valuation of IOF and Cooperative with Debt Maturity Value of 50

	Value	Option Δ	Elasticity η	Volatility σ	RADR
IOF	**100.00**				15.13%
Equity	54.16	0.9440	174.29%	99.31%	22.65%
Debt	45.84	0.0560	12.22%	6.96%	6.24%
Co-op	**371.25**				11.82%
Owner Claims	323.69	1.0000	114.69%	55.87%	12.82%
Debt	47.56	0.0000	0.00%	0.00%	5.00%

RADR: Risk-adjusted Discount Rate

Table 2: Leverage and Valuation of IOF and Cooperative

IOF				Co-op			Co-op			
				Comparable Leverage			Comparable Debt Level			
L	D	r_d	r_e	D'	r'_D	r'_e	D'	L'	r'_d	r'_e
0.00	0.00	5.00%	15.13%	0.00	5.00%	11.82%	0.00	0.00	5.00%	11.82%
0.10	10.00	5.00%	16.25%	37.10	5.00%	12.58%	10.00	0.03	5.00%	12.01%
0.20	20.00	5.05%	17.64%	74.19	5.01%	13.52%	20.00	0.05	5.00%	12.21%
0.30	30.00	5.29%	19.34%	111.37	5.08%	14.71%	30.00	0.08	5.00%	12.42%
0.40	40.00	5.80%	21.33%	148.45	5.30%	16.16%	40.00	0.11	5.00%	12.64%
0.50	50.00	6.60%	23.65%	185.56	5.73%	17.91%	50.00	0.13	5.00%	12.88%
0.60	60.00	7.64%	26.35%	222.69	6.37%	19.99%	60.00	0.16	5.00%	13.13%
0.70	70.00	8.92%	29.59%	259.85	7.23%	22.53%	70.00	0.19	5.00%	13.40%
0.80	80.00	10.46%	33.76%	296.96	8.32%	25.83%	80.00	0.22	5.01%	13.69%

L and L' are leverage, D and D' value of debt, r_d and r'_d cost of debt, r_e and r'_e risk-adjusted discount rate of equity in Investor-owned Firm (IOF) and co-operative (co-op) respectively