RISK-BEARING, LABOR CONTRACTS, AND CAPITAL MARKETS

Patricia B. Reagan and René M. Stulz

I. INTRODUCTION

Many contractual arrangements have a dimension involving risk. Most prominent among them are labor contracts. One way to identify the different scenarios in which the contractual risk-bearing question can be addressed is by the extent to which different contracting parties have access to capital markets. By focusing our analysis in this way, we are able to demonstrate that even if agency problems are neglected, workers bear some risk in labor contracts.

Access to capital markets can be defined most usefully in terms of the costs to different contracting parties of trading financial assets. If one party can engage in capital market transactions at a lower cost than another party, then the second party may attempt to gain some of these benefits indirectly through contractual risk-bearing arrangements with the first party, be they implicit or explicit. This basic principle extends beyond labor contracts to many forms of contractual relationships involving the allocation of risk.

On the one hand, there is the scenario in which employers and employees have equal access to capital markets in the sense that they face the same investment opportunities. Under certain assumptions any risk-bearing through labor contracts can be undone by appropriate exchanges of assets.

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This case is discussed in Section II. We argue that this scenario does not correspond to observed contracting situations.

On the other hand, there is the scenario in which employers have a comparative advantage over employees in making transactions on capital markets. We analyze this case in Section III. The main point is that shareholders of a value-maximizing firm find it optimal to offer a labor contract that induces workers to bear some risk unless all risk is firm-specific and therefore diversifiable or unless the market price of aggregate risk is zero. If risk is not diversifiable, workers demand a compensating differential below the price shareholders require to bear risk for small increments in risk-bearing. This framework is particularly attractive, because the result of much recent literature—that firms bear all risk—appears to be an important special case of the more general model.

In Section IV we examine the implications for contractual risk-bearing arrangements of workers' holdings of other risky assets. Housing equity and human capital are two important examples of the kinds of risky assets that many workers hold. Holdings of these assets act as a hedge or reverse hedge against the risk of labor contracts and therefore impact on observed risk-bearing arrangements. This argument goes the other way as well: the risk in a particular labor contract affects the portfolio of risky assets held by workers. One implication of this argument is that managers, who are frequently compensated in part by shares of common stock of the company for which they work, attempt to diversify the risk of their contract by diversifying the company itself through acquisitions and mergers. Concluding comments are offered in Section V.

II. RISK-BEARING THROUGH LABOR CONTRACTS WHEN CAPITAL MARKETS ARE PERFECT AND COMPLETE

In this section we examine the conditions under which risk-averse workers and shareholders are indifferent to the way risk is allocated initially between the two contracting parties in the labor contract. A labor contract is defined in terms of the random variable $\tilde{w}$, which can be parametrized by a constant, c, and a scalar multiple, δ, of a random variable, $\tilde{Z}$.[1] The scalar δ may be thought of as a measure of the risk of the contract, holding constant the distribution of $\tilde{Z}$.

The wage is

$$\tilde{w} = c + \delta\tilde{Z}.$$

Workers and shareholders are said to be indifferent between two labor contracts if they are indifferent between the two combinations of δ, the distribution from which $\tilde{Z}$ is drawn, and c. The random variable $\tilde{Z}$ could

represent the value of an individual firm or of a portfolio of assets. Alternatively, it could represent the accounting profits of a division within a firm.

Sufficient conditions for workers and shareholders to be indifferent between labor contracts that imply different distributions of $\tilde{w}$ are that capital markets are perfect and complete with respect to the possible labor contracts.[2] Markets are defined to be perfect if they are competitive and there are no transactions costs, taxes, restrictions on borrowing or lending, or restrictions on short sales. Markets are defined to be complete with respect to the possible labor contracts if spanning conditions are satisfied. In other words, for any feasible distribution of $\tilde{Z}$, there exist securities, $i = 1, \ldots, n$, that can be formed into a portfolio such that

$$\sum_{i=1}^{n} \alpha_i \tilde{Z}_i = \tilde{Z},$$

where $\tilde{Z}_i$ is a random variable representing the payoff of security i at the end of the period and α_i is the number of units of asset i held. One of the securities, say $i = 1$, is a default-free discount bond that pays $1 at the end of the period. The price of this bond at the beginning of the period together with the future payoff, Z_1, defines the riskless discount factor, rendering it unnecessary to introduce explicitly a default-free discount rate.

If markets are perfect and complete in the sense just defined, then neither workers nor shareholders care about the choice of $\tilde{Z}$, δ, and c, as long as the contracts have the same present value. Applying the logic of Modigliani–Miller (1958), they are indifferent to the way risk is initially allocated, because any allocation of risk can be exactly undone and, given their wealth constraint, the same preferred position achieved (Stiglitz, 1969).[3] For example, if $\tilde{Z}$ is the future market value of an all-equity firm and the workers prefer to bear no risk, then they can achieve this preferred position by appropriately shortselling shares of that firm.

There are good reasons to believe that contracts do not yield an indeterminate allocation of risk. It is therefore useful to examine the underlying reasons why the assumptions of complete and perfect capital markets are not empirically valid. These reasons include legislative restrictions that preclude certain types of transactions; differences in the information available to different traders, which lead to incentive and agency problems associated with certain types of transactions; and differences among traders in transactions costs, which result in differences in their investment opportunities. The implications of each are examined in turn.

The most important law that precludes certain types of trades is embodied in Section 16C of the Securities and Exchange Act of 1934. Restrictions on insider trading make it more difficult for employees of any firm to alter their holdings of that firm's shares if they are in a position to have special information. The law prevents, among other things, top management from shortselling shares in the firms for which they work. A large portion of management compensation often takes the form of firm shares. The reason for this, it is suggested, is to bring the objectives of management into closer conformity with the objectives of shareholders. Management, however, is generally unable to undo the risk associated with this type of contract.

The problem in trading assets when different traders have different information sets is basically the "lemons" problem. Traders who are less well-informed about a particular asset take sales (purchases) of that asset by better-informed traders as a signal that the future returns of that asset will be lower (higher) than those assessed by the market as a whole. Less well-informed traders will price-protect themselves, which reduces the benefits of these exchanges to better-informed traders. Employees are not necessarily trading on special information, but they will be perceived as so doing.[4] The prices at which they can trade will reflect this fact. In addition, if employees sell claims to assets whose future value they can affect, such as their own future wage payments or the accounting profits of a division within a firm, they have an incentive to behave opportunistically. Since the costs of monitoring intangibles like work effort are high, the agency costs of monitoring and enforcing such contracts are high.[5]

A final consideration in the relevance of the assumption of market completeness and perfection is that of transactions costs. It is widely believed that the costs of transacting on capital markets are a declining function of the quantity traded. If this is true, then large investors face different investment opportunities than do small traders. If workers are identified as small traders, and if shareholders, either individually or collectively through the firm, are identified as large traders, then the labor contract itself may act as a partial substitute for worker participation in capital markets. In the extreme, a labor contract could be written in terms of returns to a diversified portfolio of assets, but incentive and agency considerations suggest that this is not the form in which labor contracts substitute for worker participation in capital markets.

The preceding arguments suggest that capital markets are neither perfect nor complete. In particular, they suggest that workers do not transact on frictionless capital markets. We pursue the implications of these arguments for the allocation of risk through labor contracts in the following section.

III. RISK-BEARING, LABOR CONTRACTS, AND COSTLY CONTRACTING ON CAPITAL MARKETS

In this section we assume that shareholders have a comparative advantage in making capital market transactions. We adopt for simplicity the extreme assumption that employees hold no risky assets other than their labor contract. Shareholders, on the other hand, transact on capital markets that

are effectively perfect. This assumption is motivated by the fact that although workers are not precluded from trading on capital markets, they do not do so on a large scale. Holdings of firm shares tend to be concentrated in the hands of a relatively small number of investors (Baily, 1974; Blume, Crocket, and Friend, 1974). This observation is consistent with declining average transactions costs. In order to assess the importance of the restriction that the workers' only risky asset is their labor contract, the assumption that workers hold no risky assets is relaxed in Section IV.

The problem can be posed in its most general form in the state-preference approach to contingent contracting popularized by Hirshleifer and Riley (1979). The labor contract of any one firm, firm i, divides the output of that firm in each state of the world between workers and shareholders. Assume, for simplicity, that firm i has one worker and one shareholder. If firm i faces only two states of the world and produces a single commodity, the solution to the labor-contracting problem can be graphed in an Edgeworth box, as in Figure 1. The dimensions of the Edgeworth box are given by the firm's output in state 1, O_1, and state 2, O_2.

The labor contract determines the worker's consumption and the shareholder's income from firm i in each state of the world. The shareholder's state-contingent income from a single firm does not correspond to his

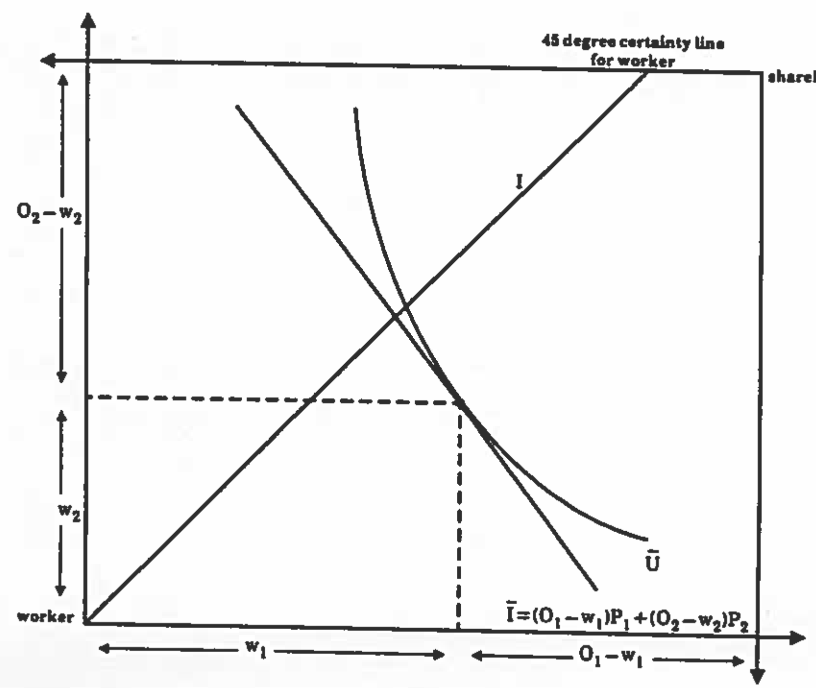

Figure 1.

consumption in each state of the world. Consumption for the shareholder depends on his holdings of other state-contingent claims as well as on his state-contingent income from the firm in question.

The shareholder, who has access to capital markets, can trade the state-contingent income from firm i, $(O_1 - w_1, O_2 - w_2)$, on competitive capital markets. If (P_1, P_2) is the price vector of contingent claims on units of output produced by firm i, the certainty equivalent of the shareholder's state-contingent income from firm i is

$$\bar{I} = (O_1 - w_1)P_1 + (O_2 - w_2)P_2$$

Therefore, all points along a line with slope $-P_1/P_2$ in the Edgeworth box have the same certainty equivalent income for shareholders. The shareholder chooses the labor contract that maximizes his certainty equivalent income, subject to the constraint that the worker receives a level of utility at least as great as she could obtain in her next best opportunity, $\bar{u}$.

By inspection, the worker bears no risk in a labor contract, i.e., $w_1 = w_2$, if, and only if, the worker's indifference curve, evaluated along the 45-degree certainty line, is tangent to the market price ratio of contingent claims on the output of firm i, $-P_1/P_2$. Hirshleifer and Riley (1979) show that the absolute value of the slope of the worker's indifference curve evaluated along the 45-degree certainty line is given by the ratio of the probabilities of occurrence of the two states. It follows that workers bear no risk if the price of state-contingent claims on capital markets are proportional to the probabilities of the two states occurring. This condition holds if shareholders are risk-neutral or if there is no aggregate risk, in the sense that all risk can be eliminated through diversification.

In an effort to make this result more specific we assume that both workers and shareholders are concerned only with the end-of-period mean and variance of asset returns and labor income.[6] Qualitatively, the conclusions about risk-bearing are the same as in the general state-preference approach to contingent contracting. In the mean-variance framework the capital asset pricing model holds, which implies that stockholders are rewarded for bearing only aggregate risk, i.e., nondiversifiable risk.[7] Workers' utility, on the other hand, is affected in the same way by the two kinds of risk, because they cannot diversify away firm-specific risk through security holdings.

We begin with the assumption that all workers are identical. In labor markets, workers are willing to accept a labor contract defined along a number of dimensions provided that they can achieve a level of expected utility at least as high as they could attain in their next best opportunity, denoted by $\bar{u}$. One dimension of that contract is risk-bearing. Workers are willing to bear risk if the firm offers them a risk premium in the form of higher expected income. Following Lintner (1969), expected utility is

$$E(\tilde{u}) = aE(\tilde{w}) - b\,\mathrm{var}(\tilde{w}), \qquad (1)$$

where $\tilde{w}$, a random variable, is wage income, E is the expectations operator, and $\mathrm{var}(\tilde{w})$ is the variance of wage income. Both a and b are positive constants.

The analysis of this section is simplified by the assumption that the level of effort is given. As long as the level of effort is given, the disutility of effort experienced by workers is fixed and can be ignored analytically. The implications of relaxing the assumption of fixed work effort is discussed at the end of this section. However, the focus of this paper is on the allocation of risk and not on workers' discretionary effort.

The shareholders' objective is to maximize their current wealth. In the present framework this implies that shareholders attempt to maximize the market value of their share of net revenue. Net revenue, denoted $\tilde{Y}$, is defined as the firm's revenue per worker gross of wage payments, but net of payment to all other factor inputs. $\tilde{Y}$ is a random variable with finite mean and finite variance.

The major question addressed in this section is: What is the sharing rule for $\tilde{Y}$ between workers and shareholders? From the perspective of the previous literature on this subject, the question can be rephrased as: What is the extent of risk that workers bear in a labor contract when all gains from trade are exhausted?[8]

If workers enter a labor contract, they require that the distribution of labor income be such that their expected utility is at least as high as what they could obtain from available alternatives, i.e., $\bar{u}$. The firm chooses the distribution of labor income subject to $E(\tilde{u}) = \bar{u}$. The contract is assumed to be enforced costlessly.

If labor contracts are restricted to a linear form, $\tilde{w} = c + \delta\tilde{Y}$, where c is a fixed payment and δ is a constant, labor income is riskless whenever δ is equal to zero. By restricting the analysis to linear sharing rules, it is possible to focus sharply on the question at hand and avoid tangential considerations.

With a linear sharing rule, the present value of the shareholders' stake in the firm, computed using the capital asset pricing model, is

$$V = \frac{(1-\delta)E(\tilde{Y}) - c - \lambda(1-\delta)\,\mathrm{cov}(\tilde{Y}, \tilde{R}_m)}{1+R} \qquad (2)$$

where

$E(\tilde{Y})$ = expected net revenue;
$\mathrm{cov}(\tilde{Y}, \tilde{R}_m)$ = covariance between net revenue and the return on the market portfolio,[9] $\tilde{R}_m$;
λ = price of risk, defined as $E(\tilde{R}_m - R)/\mathrm{var}(\tilde{R}_m)$;
R = riskless rate of interest.

All variables are denominated in real terms.

Shareholders maximize Eq. (2) subject to the labor market equilibrium condition $E(\tilde{u}) = \bar{u}$.

The first-order conditions are

$$\frac{1}{a(1+R)} = \mu, \tag{3}$$

$$\frac{-E(\tilde{Y}) + \lambda \operatorname{cov}(\tilde{Y}, \tilde{R}_m)}{1+R} = \mu[-aE(\tilde{Y}) + 2b\delta \operatorname{var}(\tilde{Y})], \tag{4}$$

$$\bar{u} = a[c + \delta E(\tilde{Y})] - b\delta^2[\operatorname{var}(\tilde{Y})], \tag{5}$$

where μ is the Lagrangian multiplier. Equations (3) and (4) yield an explicit expression for δ:

$$\delta = \frac{\lambda a \operatorname{cov}(\tilde{Y}, \tilde{R}_m)}{2b \operatorname{var}(\tilde{Y})} \tag{6}$$

If the price of risk, λ, is equal to zero, the standard deviation of workers' revenue is always equal to zero. Therefore, if market prices of risky assets are set by risk-neutral traders, shareholders bear all the risk and workers bear none. Another case in which the standard deviation of labor income is zero occurs when the revenue of the firm gross of wage payments, i.e., $\tilde{Y}$, is uncorrelated with the return on the market portfolio. All the risk, in this case, is diversifiable, and shareholders act as if their coefficient of risk aversion is equal to zero.

It is widely recognized that the price of nondiversifiable risk is positive, which implies that the expected rate of return is not the same for all financial assets. The sharing rule derived in this paper suggests, therefore, that workers almost always bear some risk, since the covariance of the revenue of a firm with the return on the market portfolio is almost always nonzero. If this covariance is positive, δ is positive, and workers bear risk.

The model developed here is particularly useful because it puts in perspective the conventional wisdom that in the absence of agency problems, shareholders bear all of the risk in an optimal labor contract. This proposition has been advanced in a large number of models (for example, Bailey, 1974; Gordon, 1974; Stiglitz, 1974; Azariadis, 1975; Shavell, 1976; Grossman, 1978; Brown, 1980; and Green, 1981). The common element driving this result is the implicit assumption that either all risk is firm-specific and therefore diversifiable or that the market price of aggregate risk is zero. When either of these conditions is violated, optimality requires workers to bear some risk.

Shareholders are willing to sell claims to their uncertain stream of net revenue, provided that the price of these claims is at least as great as the market price, which represents the price that they themselves would have to pay. If the risk premium that workers demand to bear some risk is lower than the one required by shareholders, then a firm maximizes its market value by offering a labor contract that induces workers to bear some risk. This result is alluded to but not made specific in Grossman and Hart (1981) and Rosen (1982).

This result holds irrespective of the degree of risk tolerance of the shareholders of the firm. The risk premium that shareholders receive for bearing a given amount of risk depends on the market price of risk and does not depend on their degree of risk tolerance. For instance, it is possible for workers to bear no risk when the shareholders are more risk-averse than the firm's workers. As shareholders have access to capital markets, the risk they bear is a function of the portfolio they choose to hold.

In order to clarify the roles of aggregate and firm-specific risk in the distribution of claims to shares of the firm's net revenue between workers and shareholders, it is useful to consider the case in which the effects of aggregate and firm-specific risk on the revenue of the firm are separately observable. Let $\tilde{Y} = \tilde{A} + \tilde{S}$, so that $\operatorname{cov}(\tilde{S}, \tilde{R}_m) = 0$. $\tilde{S}$ is defined as firm-specific risk, and $\tilde{A}$ is defined as aggregate risk. The labor contract can now be written as $\tilde{w} = c + \delta_A\tilde{A} + \delta_S\tilde{S}$, because, ex post, the realization of $\tilde{S}$ is observable. It can be verified that

$$\delta_S = 0 \tag{7}$$

and

$$\delta_A = \frac{\lambda a \operatorname{cov}(\tilde{A}, \tilde{R}_m)}{2b \operatorname{var}(\tilde{A})}. \tag{8}$$

It immediately follows that the earlier literature is concerned only with firm-specific risk. If revenue gross of wage payments is not a function of aggregate risks, then $\tilde{Y}_A = 0$. In this case, workers bear no risks.

Returning to the case where only $\tilde{Y}$ is observable, this simple model of risk-bearing yields interesting implications for the cross-sectional and time series behavior of labor income. The total expected compensation that a worker receives is

$$E(\tilde{w}) = \frac{I}{a}\bar{u} + \frac{\lambda^2 a^2 \operatorname{cov}(\tilde{Y}, \tilde{R}_m)^2}{4b \operatorname{var}(\tilde{Y})}. \tag{9}$$

This suggests that whenever workers bear risk, i.e., $\operatorname{cov}(\tilde{Y}, \tilde{R}_m) = 0$ or $\lambda > 0$, they receive a risk premium in the form of higher expected income. Expected income is higher, ceteris paribus, the higher is the market price of aggregate risk, λ. Expected income is a convex function of the covariance of revenue gross of wage payments and the return on the market portfolio. It reaches a minimum when that covariance is zero. In this case, shareholders bear all the risk, because it is entirely diversifiable.

The variance of labor income, on the other hand, is a decreasing function of the variance of revenue gross of labor income and a convex function of

$\text{cov}(\tilde{Y}, \tilde{R}_m)$:

$$\text{var}(\tilde{w}) = \frac{\lambda^2 a^2 \text{cov}(\tilde{Y}, \tilde{R}_m)^2}{4b\,\text{var}(\tilde{Y})} \tag{10}$$

It reaches a minimum at $\text{cov}(\tilde{Y}, \tilde{R}_m) = 0$, when workers bear no risk. Although this result initially appears to be counterintuitive, it is consistent with the implications of the capital asset pricing model. Recall that an increase in the variance of net revenue, holding $\text{cov}(\tilde{Y}, \tilde{R}_m)$ constant, results in a larger fraction of total risk being unsystematic. Shareholders, who have a comparative advantage in bearing firm-specific risk, bear more risk, so that the variance of labor income declines. On the other hand, an increase in the absolute value of $\text{cov}(\tilde{Y}, \tilde{R}_m)$, holding $\text{var}(\tilde{Y})$ constant, results in a larger fraction of risk being aggregate or systematic. Workers bear more aggregate risk as the covariance of net returns to the firm and returns to the market increases in absolute value.

Finally, it is noted that the covariance of labor income with the retum on invested wealth is non-negative:

$$\text{cov}(\tilde{w}, \tilde{R}_m) = \frac{\lambda a\, \text{cov}(\tilde{Y}, \tilde{R}_m)^2}{2b\,\text{var}(\tilde{Y})}\,. \tag{11}$$

Equation (11) implies that risk-bearing considerations exert a procyclical force on the wage bill.[10]

The major point of this section is that workers bear risk whenever some risk of the firm is nondiversifiable. There are, however, many reasons besides those considered why workers bear risk. One reason mentioned in the literature on the principal-agent problem is that the objectives of workers and shareholders are not coincident when effort affects both workers' utility and the firm's market value and effort is not costlessly observable. Employees' reward function is selected so that they face incentives to choose actions more coincident with the objectives of shareholders. If workers' efforts could be monitored costlessly, then their reward would be based on a measure of effort. When the costs of monitoring are significant, the workers' compensation depends both upon a measure of the outcome of their activity and a measure of effort. In the extreme, when the costs of monitoring are sufficiently high, workers' compensation depends only on a measure of the outcome of their activity. If the effects of aggregate and firm-specific risk on the revenue of the firm are observable separately, these agency considerations result in labor contracts in which workers bear less aggregate risk and more firm specific risk.[11] Workers' efforts alter the distribution of firm-specific risk, whereas they have no impact upon the distribution of aggregate risk. As effort is not directly observable, it is optimal for the contract to reward workers in larger part on the basis of firm-specific risk to provide appropriate incentives.

IV. WORKERS' ASSETS AND LABOR CONTRACTS

In this section we explore the implications of relaxing the assumption that workers hold no risky assets. The resulting analysis suggests that risk-bearing arrangement might be a contributory factor in explaining certain seniority rules and the incompleteness of protection for workers against unanticipated changes in the price level as well as the incentives for top management to undertake mergers and acquisitions.

The end-of-period value of a worker's wealth, assumed for the moment to be comprised entirely of nontradeable assets, is a random variable, $\tilde{W}$. Assets are nontradeable in the sense that the worker cannot reallocate his wealth among different assets so as to affect its distribution. We will interpret $\tilde{W}$ later as the value of the worker's firm-specific human capital and the value of the worker's housing equity. The worker's expected end-of-period utility is assumed to be a function of the sum of end-of-period wealth, $\tilde{W}$, and labor income, $c + \delta\tilde{Y}$, where $\tilde{Y}$ is a measure of the employer's revenue gross of wage payments.

If shareholders maximize the market value of the firm as in Section III by choice of c and δ subject to the constraint that $E(\tilde{u}) = \bar{u}$, then it follows that the optimal risk bearing coefficient is

$$\delta = \frac{\lambda a\, \text{cov}(\tilde{Y}, \tilde{R}_m)}{2b\,\text{var}(\tilde{Y})} - \frac{\text{cov}(\tilde{Y}, \tilde{W})}{\text{var}(\tilde{Y})}\,.$$

The first term is the same as the optimal risk-bearing coefficient calculated for the case in which workers hold no risky assets other than their labor contract. The second term is a hedging factor. If the value of the workers' capital asset, $\tilde{W}$, is negatively correlated with the value of the worker's wage, $c + \delta\tilde{Y}$, then the overall variance of the worker's total wealth, $\tilde{W} + c + \delta\tilde{Y}$, is lower. Therefore, the optimal risk-bearing coefficient is higher than would be the case if $\text{cov}(\tilde{Y}, \tilde{W}) \geq 0$. It is in this sense that workers' holdings of capital asset can act as a partial hedge against risk in the labor contract.

If nontradeable wealth is interpreted as firm-specific human capital, then the analysis of this section offers insights into certain seniority rules. Senior workers tend to hold more firm-specific human capital than do junior workers. Furthermore, the firm must offer workers with firm-specific human capital a higher expected lifetime utility, at any point in time, than they could attain elsewhere to induce these workers to remain with the firm. The value of firm-specific human capital is related positively to the market value of the firm, which in turn is positively related to contemporaneous cash flows gross of wage payments. Therefore, the covariance between labor income and firm-specific human capital, $\text{cov}(\tilde{W}, \tilde{Y})$, is higher for senior workers than for junior workers. Consequently, ceteris paribus, the risk premium required by senior workers to bear any given amount of risk exceeds that required by junior workers. It follows that efforts by management to maximize the firm's market value would result in contracts being written so that senior workers bear less risk than do junior workers.

This analysis also yields insights into why firms do not always offer workers complete protection against price-level uncertainty. The contract type that provides such protection, although it is generally incomplete, is the cost-of-living adjustment clause (COLA). In this instance, nontradeable wealth can be interpreted as the worker's equity in a house. If the real value of the house is uncorrelated with unanticipated changes in the price level, then the worker's total real wealth is positively correlated with changes in the price level, because a rise (fall) in the price level implies that the present value of fixed mortgage payments is lower (higher) in real terms. It follows that the more workers' wealth acts as a hedge against unanticipated inflation, the lower is the risk premium they require to bear aggregate price-level uncertainty, and the more risk they will bear in an optimal labor contract.

Just as we have argued that workers' portfolios of risky assets affect their willingness to bear risk through labor contracts, the labor contract itself affects workers' portfolio decisions. If we relax the assumption that workers do not engage in transactions on capital markets, while maintaining the idea that the average cost of transactions declines with volume, workers can affect the distribution of end-of-period wealth. However, the benefits from diversification are balanced at the margin against the transactions costs of diversification.

If there are no transactions costs, then workers hedge against the risk of their labor income and invest their wealth in a well-diversified portfolio. Both are made more difficult as transactions costs become larger and are characterized by more significant increasing returns to scale. The risk premium demanded by workers depends upon the covariance of labor income with the returns to wealth. The greater is the degree of diversification, the greater is the correlation of the returns to the employees' portfolio with the returns to the market portfolio. It follows that the more intensively workers transact on capital markets, the closer is their relevant measure of risk to that of shareholders and the smaller is the scope for mutually beneficial exchanges of risk through the labor contract.

Workers' attempts to diversify the risk of their labor contract need not be restricted to direct, personal investments in capital assets. For example, top executives are frequently compensated by shares of common stock in their corporation. It is consistent with the model presented here that executives attempt to diversify the risk associated with their contract by diversifying the firm itself. This diversification can be achieved by means of acquisitions of, and mergers with, other firms whose returns are imperfectly correlated with those of the original corporation.

V. CONCLUDING REMARKS

In this paper we examine the impact of capital markets on risk-bearing between workers and shareholders. In particular, we incorporate the distinction between aggregate and firm-specific risk into an analysis of risk-bearing in labor contracts. The main point of the paper is that when capital markets are accounted for explicitly, shareholders of a value-maximizing firm find it optimal to offer a labor contract that induces workers to bear some risk, unless all risk is firm-specific and therefore diversifiable. To the extent that other assets held by workers act as a hedge against riskiness in labor income, workers are willing to bear more labor income risk. On the other hand, if workers hold risky assets whose values are correlated with the firm's net cash flows, such as firm-specific human capital, workers are less willing to bear labor income risk.

This paper offers a useful way to integrate much of the earlier literature on labor contracts. If capital markets are introduced explicitly, the degree of risk tolerance of the stockholders of the firm becomes irrelevant. In particular, it is possible that stockholders bear all the risk in a labor contract even if they are more risk-averse than workers. The result of the earlier literature that workers bear no risk in optimal labor contracts obtains if the risk associated with the revenue of the firm gross of labor payments is diversifiable and if transactions costs on capital markets are such that stockholders have a comparative advantage in making transactions on these markets. If risk is not diversifiable, workers bear some risk through the labor contract.

The essence of our argument about contractual risk-bearing arrangements is general and extends beyond labor contracts. The same principles apply to "contracts" between consumers and public utilities, as enforced by regulatory agencies, about how risk is allocated between consumers and shareholders through service prices. It is also relevant for analyzing warranties offered by corporations on some types of consumer durables.

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NOTES

1. In order to derive explicit results we make a number of simplifying assumptions, the most significant of which is that contracts are enforced costlessly. This assumption allows us

to focus on the general problem of risk-bearing between workers and shareholders rather than explaining why specific contractual arrangements are observed.

Although this paper examines only one-period contracts, the model could be extended to a multiperiod setting. It would be difficult, however, to include in an analysis of optimal risk-bearing arrangements those features that are specific to multiperiod problems. In a multiperiod setting, workers are concerned about the returns to investments in human capital as well as the distribution of contemporaneous earnings. The issue is further complicated by distinctions between firm-specific human capital and other forms of human capital. An analysis of intertemporal labor contracting would address the issue of how a compensation package can be used to induce workers to invest optimally in human capital so as to maximize the market value of the firm.

2. A discussion of the alternative assumptions that yield results of this type is provided in DeAngelo (1981).

3. For a special case of this analysis, which introduces labor contracts, see Mayers (1974).

4. Scholes (1972) has documented this as an important empirical phenomenon for large secondary offerings.

5. Independent of the problem of effort, there is the problem of default. To the extent that bankruptcy laws imply that default involves real resource costs, they exacerbate the problem.

6. Clearly, in a multiperiod setting workers and shareholders would be willing to make trade-offs between the allocation of risk over time, the expected payments in each period, and the duration of the contract. These types of trade-offs are most obvious when workers, such as construction workers, appear to trade off high expected payments for contracts of short duration. Important as these intertemporal considerations are, we defer these issues to another paper in order to focus our analysis.

7. See Lintner (1965) and Sharpe (1964). For a review of the literature, see Jensen (1972). Also see Ross (1976). For a review of investment policy, see Baron (1979).

8. The question of what are the optimal forms of contractual provisions for risk-bearing, e.g., the choice of varying the number of hours worked versus varying the salary, is left for another paper.

9. It is assumed that all firms are small, so that the distribution of $\tilde{R}_m$ is independent of any one labor contract.

10. Because $\delta < 0$ if $\text{cov}(\tilde{Y}, \tilde{R}_m) < 0$, workers effectively shortsell securities which shareholders can sell on capital markets.

11. A formal proof of these results is available from the authors on request. Diamond and Verrecchia (1982) provide related results.

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