Université de Montréal

Three Essays on Economic Behavior under Uncertainty: Theory and Empirical Evidences

Par

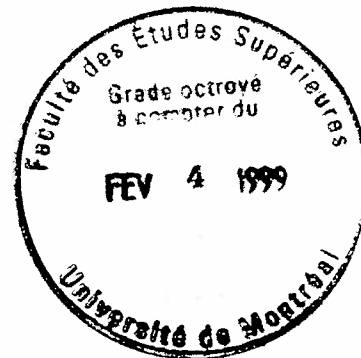## Kaïs Dachraoui

Département de sciences économiques
Faculté des études supérieures

Thèse présentée à la Faculté des études supérieures
en vue de l'obtention du grade de
Philosophæ Doctor
en sciences économiques

Septembre 1998

Université de Montréal
Faculté des études supérieures

Cette thèse intitulée:

Three Essays on Economic Behavior under Uncertainty: Theory and Empirical Evidences

Présentée par:

Kaïs Dachraoui

A été évaluée par un jury composée des personnes suivantes:

Président Rapporteur	GARCIA, RENE
Directeur de recherche	DIONNE, GEORGES
Codirecteur	LEMIEUX, THOMAS
Membre du jury	POITEVIN, MICHEL
Examinateur externe	FLUET, CLAUDE Université du Québec à Montréal
Représentant du doyen De la FES	RENAUD, STEPHANE École de relations industrielles

Thèse acceptée le Lundi, 14 Décembre 1988

Remerciements

Je tiens tout d'abord à remercier Georges Dionne, qui m'a pris sous sa direction et qui m'a suivi et aidé tout le long de la rédaction de cette thèse. Je le remercie pour sa générosité en son temps et son savoir.

Je tiens à exprimer toute ma reconnaissance à Thomas Lemieux pour m'avoir honoré en acceptant de codiriger cette thèse.

Je remercie les professeurs Yves Sprumont, Camille Bronsard et Bentley Macleod pour leurs enseignements et leur sincérité.

Mes remerciements vont aussi à Jean Farès, Mohammad Souheil Haddad et Paul Jhonson pour leur amitié et leur aide.

J'exprime toute ma reconnaissance à Sana Ben Aoun pour son amitié et son soutien inconditionnel tout le long de la rédaction de cette thèse.

Je remercie enfin les gens de CREST et spécialement Julien Bechtel et Francis Kramarz pour l'aide qu'ils m'ont fournie, sans eux l'accès à la base de données n'aurait pas été possible.

A mes Parents

Contents

Sommaire

Cette thèse présente deux volets. Dans un premier lieu on étudie des interactions entre la structure de capital d'une entreprise et les contrats de salaire qu'on observe dans ces mêmes entreprises. L'objectif est d'expliquer les différences de politiques de compensation salariales et de structure de capital par entreprise. Cette analyse micro-économique est aussi d'un intérêt macroéconomique puisque le nombre de faillites est un indicateur important de la performance d'une économie. Dans une deuxième partie on étudie les choix de portefeuille et l'effet d'une variation de paramètre de la distribution sur le choix de portefeuille optimal. Le but de cette étude est de généraliser certains résultats dans la littérature et d'étudier la robustesse de la statique comparative des portefeuilles optimaux.

Le premier chapitre présente un modèle théorique à deux périodes où un entrepreneur est appelé à engager des travailleurs et à trouver du financement pour un projet. Ce modèle est étudié sous deux angles. Dans un premier cas on considère le cas où l'entrepreneur et les travailleurs partagent les mêmes croyances sur les caractéristiques individuelles des travailleurs. Dans un deuxième cas on suppose que cette information est privée du coté des travailleurs. Dans chaque cas on résout le problème de décision de l'entrepreneur; on analyse la nature du contrat de travail optimal (long vs court terme), et on étudie l'effet de l'absence d'engagement sur la structure de capital optimale. On étudie aussi la variation de la structure de capital et du profil de salaire en fonction de la spécificité du capital physique de l'entreprise.

Dans le Chapitre 2, nous testons les prédictions de la théorie économique sur la détermination de structure de capital et les différentes prédictions contradictoires sur les liens entre structure de capital et politique de compensations au sein des entreprises. Un objectif du chapitre est d'identifier les coûts associés au choix de financement par dette et comment ces coûts varient avec les différents déterminants de choix de capital présentés dans la littérature. Ainsi, on estime une équation de ratio dette-équité sur différentes caractéristiques des entreprises et on inclut les valeurs prédites dans cette

première régression dans la régression des composantes des contrats de salaires.

Dans le troisième chapitre on généralise certains résultats dans la littérature sur les choix de portefeuille dans le cas d'un actif risqué et un actif sans risque au cas de deux actifs risqués et un actif sans risque. On étudie aussi comment l'aversion au risque affecte le choix optimal et on lie l'attitude vis-à-vis du risque à la corrélation des deux actifs risqués. Dans ce même chapitre on étudie la robustesse de la statique comparative des portefeuilles optimaux, et on applique ce résultat à la séparation à deux fonds mutuels.

La thèse se termine par une discussion générale des différents résultats trouvés et la contribution de cette thèse à la littérature économique.

Introduction Générale

Dans cette thèse nous traitons deux sujets qui concernent le comportement des agents économiques en présence d'incertitude. Dans la première partie nous nous intéressons aux liens entre la structure de financement d'une entreprise et les contrats de salaire qu'on observe dans cette même entreprise. Nous étudions dans cette partie le problème d'engagements contractuels et de l'asymétrie d'information dans le marché du travail.

Les liens entre structure de financement et contrats de travail n'ont pas souvent dépassé le stade théorique. Les travaux théoriques qui ont essayé d'établir le lien entre les deux marchés ont souvent abouti à des prédictions concernant l'emploi, ou la structure de capital. Dans ce cas les conclusions sont en faveur d'un sous-emploi en présence de risque de faillite. Farmer [1985] montre que le risque de faillite et la contrainte de liquidité, dans un monde avec asymétrie d'information, donnent naissance à une très grande volatilité de l'emploi ou à un sous-emploi comparativement à un monde avec pleine information. Kahn et Scheinkman [1985] montrent que le sous-emploi dans une récession vient aussi de l'augmentation du taux d'intérêt qui influence directement le financement des entreprises, un problème qui se répercute dans la demande d'emploi causant ainsi une baisse de la production en cas de récession. En ce qui concerne l'interaction entre la structure de financement et le profil de salaire Jaggia et Thakor [1994] montrent que dans le cas où les firmes prennent les décisions simultanément sur les choix de structures de capital et de contrats de travail, celles qui requièrent plus d'investissement spécifique auront tendance à: *i)* donner des profils de salaires moins aigus en fonction de l'ancienneté et *ii)* choisir des ratios de dette moins élevés, la cause étant la nature irréversible de l'investissement en capital humain dans le cas de perte d'emploi à cause de la faillite de l'entreprise. Un problème majeur avec le modèle de Jaggia et Thakor est l'hypothèse de plein engagement. L'hypothèse d'absence de plein engagement constitue la motivation d'un autre papier par Titman [1984] qui montre que si une entreprise offre un bien qui nécessite un service après vente (matériels informatiques, voiture,...), la structure de capital avec moins de dette peut servir comme un signal de la part de l'entreprise envers ses clients. En d'autres

5

termes une structure de capital adéquate permet d'endogénéiser les coûts associés à une faillite éventuelle, augmentant ainsi le bien être de l'entreprise. Une application du modèle de Titman est celui où une entreprise engage des travailleurs et que ces derniers sont appelés à investir en capital humain spécifique non transférable. Dans ce cas Titman arrive à la conclusion que ce genre d'entreprises a un ratio de dettes plus faibles pour assurer les travailleurs contre la perte d'emploi. Sarig [1988] montre que les entreprises les plus syndicalisées ou dont le capital humain est moins spécifique ont des ratios de dette plus élevés. Une telle structure de capital permet d'augmenter le pouvoir de négociation de l'entreprise en augmentant son point de menace. Titman et Wessels [1988] incluent le taux de séparation, les dépenses en recherches et développement et les coûts des ventes comme mesure de la spécificité de l'entreprise et trouvent une relation négative entre le ratio de dette et le degré de spécificité de l'entreprise. Ce résultat semble confirmer que les entreprises avec capital plus spécifique ont moins de dette comme signalé par Jaggia et Thakor [1994], un résultat obtenu dans un modèle sans asymétrie d'information et en présence de risque moral.

Dans l'essai 1 de ma thèse nous présentons un modèle théorique qui explique la détermination endogène du ratio dette-équité en fonction de la structure d'information dans le marché du travail en fonction de la spécificité du capital physique et en l'absence de plein engagement. J'abouti aussi dans le premier essai à expliquer la variation du profil des salaires et les taux de séparation par une différence de structure d'information et par l'absence de plein engagement. Je montre en particulier que dans un monde avec information incomplète mais symétrique, le contrat de travail optimal est de type *spot* où le salaire en chaque période est égal au salaire alternatif. Dans ce cas les décisions de choix de structure de capital et de choix de contrat de salaires sont indépendantes. L'intuition est que même si l'entreprise va en faillite pour ne pas pouvoir payer sa dette, les travailleurs n'assument aucune perte puisqu'ils sont payés au salaire alternatif. Un fait important à noter est que tous les types de travailleurs vont accepter le contrat offert par l'entreprise. Dans le cas où les travailleurs ont de l'information privée sur leurs types,

6

et à supposer que la qualité des travailleurs est un facteur important pour l'entreprise, on montre que la solution optimale donne lieu à un contrat de travail de long terme là où les travailleurs sont payés en bas de leur salaire alternatif sur le marché en première période et un salaire en deuxième période qui est égal au salaire alternatif plus un bonus qui dépend de l'habilité de chaque travailleur. Ce type de contrat est séparateur dans le sens que ce sont les travailleurs de haute habilité uniquement qui sont attitrés. On montre aussi dans cette situation que la dette crée une amélioration au sens de Pareto car elle permet de mettre en oeuvre le contrat de travail optimal. Sans dette le contrat de travail est non consistant à travers le temps et ne peut être mis en oeuvre.

Les évidences empiriques présentées au deuxième essai sur des données françaises montrent en effet que les entreprises avec plus de dette dans leurs structures de capital offrent des salaires plus faibles en début du contrat et un profile de salaire-ancienneté plus aigu. Dans ce même essai on teste aussi plusieurs théories économiques sur la détermination de la structure de capital. Les résultats montrent l'existence de coûts reliés à la dette. Ces coûts d'agence sont croissants avec le taux de croissance de l'entreprise et avec la volatilité de son revenu. Ces mêmes coûts décroissent avec le type d'assurance que peut offrir l'entreprise telle que la nature de son capital et les provisions pour les différents risques. On montre aussi un fait important, à savoir l'effet de la composition de la force de travail sur le niveau du ratio dette-équité. Dans ce chapitre on montre aussi que les entreprises les plus endettées offrent des salaires plus faibles en début du contrat et des rendements d'ancienneté plus élevés. Ceci suggère qu'une partie de l'hétérogénéité dans les politiques de compensations entre les entreprises peut être expliquée par des différences de choix de financement. Cette hétérogénéité dans les politiques de compensations a été montrée dans un travail empirique fait aussi sur des données françaises par Abowd, Kramarz et Margolis [1994].

Dans le Chapitre 3 nous étudions les choix de portefeuille optimaux dans une situation où un investisseur riscophobe fait face à deux actifs risqués et à un actif sans risque. On commence par analyser les propriétés du portefeuille optimal. Il est connu dans la

7

littérature sur le choix de portefeuille que, dans le cas où un investisseur fait face à un actif risqué et à un actif sans risque, l'agent investit un montant positif dans l'actif risqué si et seulement si l'espérance de rendement de l'actif risqué dépasse celle de l'actif sans risque. Dans ce chapitre on montre que ce résultat peut être étendu au cas de deux actifs risqués. On aboutit aussi à l'effet de l'attitude vis-à-vis du risque sur les choix optimaux et on montre que l'aversion au risque dicte un comportement plus prudent de la part de l'investisseur.

Dans ce chapitre on questionne aussi la robustesse de la statique comparée du portefeuille optimal. On montre qu'une variation d'un paramètre de la distribution d'un actif suivant une dominance stochastique de premier ordre fait que le poids relatif de cet actif dans le portefeuille optimal devient plus faible. On généralise ainsi le résultat de Milgrom [1981] avec un seul actif risqué. Une application de ce résultat concerne le théorème de séparation à deux fonds qui devient conséquemment non robuste à la statique comparée. Un problème de choix de portefeuille avec un nombre élevé d'actifs ne peut pas être ramené à un problème de choix entre deux actifs, ce qui rend le théorème de Meyer et Ormiston [1994] non valide pour plus de deux actifs.

Part I

Capital Structure and Labor Contracting

Chapter 1

Information Structure, Labor Contracts and the Strategic Use of Debt

Abstract

We introduce information structure as a variable to explain differences in salary profiles and rates of separation among firms. More specifically, we prove that in the case of symmetrical information in the worker-firm relation the salary contract is of the spot type. In the case where workers have private information on their type, the work contract is such that firms integrate a higher total wages bill into their future investment decisions. We also show that debt can improve welfare and permit the establishment of optimal work contracts. Moreover, in this case, debt is higher in the most specific firms. We also show how the quality of workers within a firm affects its financial structure, which identifies another determinant of debt-equity ratio. Two conclusions are drawn from this work: (i) the affirmations that more specific firms have lower debt ratios (Williamson, 1985) and offer flatter tenure-salary profiles are not always true; and (ii) the benefits of seniority in the firm are a measure of the degree of information symmetry in the labor market.

1.1 Introduction

In the economic theory literature the use of debt is explained at least by two factors. On the one hand, it serves to find funds to finance projects. On the other hand, it is a strategic matter; and it is this second point that we treat in this work. Brander and Lewis [1986] signal that, in an oligopolistic environment where decisions on production and financial structure are taken successively, debt is a strategic instrument allowing firms to take a more aggressive production stance against their competitors. This work treats the strategic issue of debt as it plays out in the job market. The paper was motivated by the following line of reflection: In the case where investors can dictate a firm's capital structure and where it is costly to monitor the productivity or output of workers, an appropriately selected financial structure may suffice to establish an optimal work contract. One example is that of the debt contract which can set the stage for contracts of the promote or fire type[1] (*up-or-out*). Similarly, a firm can choose a high level of debt to push its workers to work harder, so that the firm can pay its debts and keep its employees.

In theoretical studies, the relationship between financial structure and labor contracts has been dealt with from different aspects among which we can distinguish two categories:

1. If a firm operates on the basis of a long-term relationship with its workers and if these workers are expected to invest in specific human capital, the firm's capital structure will affect their future jobs. The choice to invest in specific, non-transferable human capital will, in this case, be affected by the capital structure and the optimal financial structure will then be determined endogenously so as to take this problem into account (Jaggia and Thakor, 1994). A direct implication is that the return on seniority must take into account the firm's financial situation. The most debt-laden firms are thus the most likely to make budget cuts. These cuts most often take the form of cuts in jobs or in the number of working hours.

---

[1]See Kahn and Huberman [1988] for labor contracts of this type.

This job insecurity, coupled with the fear of losing specific investment, leads workers to demand higher salaries at the start of the contract, thus generating a flatter salary-seniority curve. We will show that this conclusion does not necessarily hold under asymmetrical information.

2. In models of uncooperative interplay or those where negotiating powers are problematic, the most debt-laden firms prove to be the most aggressive in their strategies towards employees. In this sort of models, the foregone conclusion is that the union cannot extract more income than the firm's net profit (once all obligations to creditors have been honored). By issuing debt, the firm is obliged to pay its creditors as soon as it turns a profit. These payments thus limit the surplus on which the negotiation is based[2]. Dasgupta and Sengupta [1993], in particular, show that debt can improve total welfare. Their model is based on the idea that, in a context where surplus is shared according to each party's negotiating powers, financing by debt can alleviate the underinvestment problem. Another problem signaled by Perotti and Spier [1993] is the obligation to renegotiate labor contracts when the firm is unable to pay the salaries promised in the contract. In this case, exchanging equity by debt is advantageous because it reduces the surplus open to negotiation. In the case where share holders can alter the capital structure by exchanging equity for debt, Perotti and Spier show that this will result in a poor allocation of risk, leading risk averse workers to demand a higher equilibrium salary. Other papers have also dealt with the effect of debt on unions (Sarig, 1988, Bronars and Deere, 1991 as well as Wells, 1992).

The objective of this paper is to look at the role information structure plays in designing labor contracts and to analyze the effect a hypothetical absence of commitment on labor contracts would have on financial structure. These two points are viewed under different hypotheses about the relationship between information structure and the job

---

[2]Empirical studies indeed show the effect of unions' negotiating power on the assignment of salaries. See Abowd and Lemieux [1993].

market. This work is also concerned with how the specificity of fixed assets affects salary profiles and separation rates as well as the debt level. One conclusion of this paper challenges the prediction that more specific firms have lower debt (Williamson, 1985). This result contrasts with that of the Jaggia and Thakor model [1994] which shows that the most specific firms tend to choose lower debt ratios and to offer salary profiles that vary less with seniority. It also contrasts with that of Titman [1984] who shows that firms offering less easily replaceable goods or those requiring after-sales service have lower debt ratios. In their empirical studies, Titman and Wessels [1988] include dismissal rates[3], research and development spending, and sales costs as measures of the firm's specificity and find a negative relation between the debt ratio and the degree of the firm's specificity. However, it is not clear that the variables used for firm's specificity capture only this effect.

The rest of the paper is organized as follows: In Section 1.2 we present the general model. In Sections 1.3 and 1.4, we derive the financial and labor contracts, depending on the presence or absence of adverse selection. We discuss the implications of each model and the characteristics of the contracts. In Section 1.5 we compare the results obtained in each of the two models and analyze the implications, on both financial structure and on labor contracting. Different econometric issues are discussed in Section 1.6. The last section is devoted to concluding remarks. All the proofs, unless made in the text, are provided in Appendix 1.1.

1.2 The Model

We consider a firm which has its operations through two periods. At the start of the first period, the firm has access to a project which requires an initial investment of I_0 and the work of one employee. The return on this investment is noted as x and is random. The distribution density function is expressed as $f(x/z)$, where z represents the type of

---

[3]This is a prediction of the human-capital theory.

13

worker. In its second period, the firm has the option of investing another amount I_1 in the same project. Unlike Perotti and Spier [1993] the financial structure in the second period is not important since external investors do not participate in the second period investment. The return on this investment is noted as $y(z)$. The firm's economy also includes a bank which can serve as an external investor. We also suppose that if the firm does not invest in the second period, it can recuperate a fraction ($\delta < 1$) of its initial capital from the first period. Thus, the smaller the fraction of initial capital to be recuperated, the weaker the pressure to liquidate the project and redeploy the investment elsewhere. On the other hand, a high δ offers investors the opportunity of recuperating δI_0 to invest in other types of enterprises. In the framework of this model, δ is thus interpreted as a measure of the specificity of the investment in fixed assets and may be viewed as a measure of the capital's depreciation.[4]

1.2.1 Hypotheses and Information Structure

In this work, all economic agents are risk neutral. The production level x is observed by the firm without cost, but it is not observable by the worker. As in Gale and Hellwig [1985], we suppose that the bank can observe x, using a technology costing c. Information on types of individuals will be dealt with from two angles. We begin with the case where it is symmetrical, then take up the case where it is the worker's private knowledge, meaning that the firm and the bank have no certain knowledge about the type of worker. We suppose that there is an alternative, spot-type market where the salaries in each period are noted as u_1 and u_2. The hypothesis that the alternative salary is the same for everybody can be justified by the fact that work in this sector is the sort of manufacturing in which skill is not an important production factor.

In the first period, each worker decides to work for the firm or in the alternative sector. The firm makes two decisions in the second period: i) the decision whether or not

---

[4]In the case where δ is interpreted as a measure of depreciation, the value of I_1 can be supposed to be equal to $(1 - \delta)I_0$.

to invest and *ii*) if to invest. whether or not the same worker will be kept on or replaced by another.

In addition, it is supposed that $f(x/z)$ verifies the $MLRP$ condition[5]:

$$\frac{\partial}{\partial x}\left(\frac{f_z\left(x/z\right)}{f\left(x/z\right)}\right) \geq 0 \text{ for all } x \text{ and } z.$$

A priori beliefs about types of workers are expressed by the probability density function $p(z)$. Finally, it is supposed that $z \in [0, Z]$; $x \in [0, X]$ and $y(z)$ is an increasing function[6] in z which shows the importance of skill for the firm. We also suppose that the set defined by

$$\{z/y\left(z\right) - I_1 - \delta I_0 - u_1 - u_2 \geq 0\}$$

is not empty, so that it is possible for the firm to pay the whole second-period salary for certain types of workers.

1.2.2   Contracts Structure

At the start of the first period. the firm offers two types of contracts: one (w_1, w_2) is offered to the worker on a take-it-or-leave-it basis and another $(F, \min(x, D))$ is offered to the bank, where F is the amount that the bank pays out at the start of period and D is the reimbursement at the end of the period (debt face value)[7].

The fact that the salary of the second period is independent of production is justified by the hypothesis that workers do not observe the level of output[8].

---

[5]Monotone likelihood ratio property.

[6]We can write $y\left(z\right) = \int yg\left(y/z\right)dy$ where the distribution function $g(y/z)$ verifies the condition of first-order stochastic dominance.

[7]It is implicitly supposed that the bank does not participate in the second-period investment.

[8]In general, if it is supposed that w_2 is a function of first-period production then we know that the firm will announce x_1 so that the salary paid will be the lowest possible. This corresponds to adding to the maximization problem the constraint:

$$w_2 = \min_{x_1}\{w_2(x_1)\}$$

which translates into a fixed second-period salary.

1.3 Model with Information Symmetry on z

Let's suppose that all economic agents share the same opinions about types of workers. We distinguish two cases:

i) First case: $\int_{[0,Z]} y(z) p(z) dz - \delta I_0 - I_1 - u_2 < 0$

This inequality means that if the firm decides to hire a new worker in the second period, it will, on average, make a negative profit. This means that if the firm decided to fire the worker, then it would not invest in the second period.

Rules of decision at the second period : At the end of the first period, the firm observes x and updates its opinions on the type of worker; these new opinions are given by Bayes' rule, explicitly:

$$p(z/x) = \frac{f(x/z) p(z)}{\int_{[0,Z]} f(x/u) p(u) du} \text{ for } x \in [0, X]. \tag{1.1}$$

With its new beliefs, the firm evaluates the return on the second-period investment. For a performance x , the expected return is given by $E_x(y)$. After evaluating this expression, the firm decides whether or not to invest in the second period.

The following lemma will simplify the characteristics of optimal contracts:

Lemma 1   *(Milgrom, 1981) $E_x(y) = \int_{[0,Z]} y(z) p(z/x) dz$ is increasing in x,*
        where $p(z/x)$ is given by (1.1).

Lemma 1 stipulates that the higher the first-period production level, the greater the expected level of production in the second period. Given Lemma 1, we can put forward the following corollary.

Corollary 1 *Given the salary contract (w_1, w_2), the firm will keep the worker and invest in the second period if and only if first-period production exceeds $\overline{x}$, solution implicitly contained in the following equation*

$$E_x(y) - I_1 - \delta I_0 - w_2 = 0.$$

16

Given the firm's rule of decision, the utility for a worker with a contract (w_1, w_2) is given by the expression

$$w_1 + w_2 \int_{[0,Z]} \int_{[\overline{x}, X]} f(x/z) p(z) \, dx \, dz + u_2 \int_{[0,Z]} \int_{[0,\overline{x}]} f(x/z) p(z) \, dx \, dz.$$

We write this expression as $U(w_1, w_2, \overline{x})$.

With Corollary 1, the firm's decision problem in this case is written:

$$\max_{w_1, w_2, \overline{x}} \pi = \int_{[0,Z]} \int_{[0,X]} x f(x/z) p(z) \, dx \, dz - w_1$$
$$+ \int_{[0,Z]} \int_{[\overline{x}, X]} (E_x(y) - I_1 - \delta I_0 - w_2) f(x/z) p(z) \, dx \, dz + \delta I_0$$

subject to

$$U(w_1, w_2, \overline{x}) \geq u_1 + u_2 \tag{1.2}$$

$$w_2 \geq u_2 \tag{1.3}$$

Constraint (1.3) takes into account the fact that worker cannot make a commitment to stay in the firm if his second-period salary is lower than the alternative salary.

At the optimum, constraint (1.2) is binding. By substituting constraint (1.2) in the objective function and by differentiating with respect to w_2 and δ, we obtain

$$\frac{\partial}{\partial w_2} \pi = - \left[\int_{[0,Z]} f(\overline{x}/z) p(z) \, dz \right] (w_2 - u_2) \frac{\partial}{\partial w_2} \overline{x}(.) \tag{1.4}$$

and

$$\frac{\partial}{\partial \delta} \overline{x}(.) = \frac{I_0}{\frac{d}{dx} E_x(y)} \geq 0. \tag{1.5}$$

The expression in equation (1.4) is negative, which shows that at the optimum the second-period salary is chosen so that constraint (1.3) is binding. The result is summarized in the following proposition:

Proposition 1 *In a world where the worker has the same beliefs about its type than the firm, the solution to the firm's decision problem is as follows:*

The firm will invest in the second period and keep the same worker if and only if the output of the first period exceeds a certain level $\overline{x}$, solution implicitly contained in the equation

$$E_x(y) - I_1 - \delta I_0 - u_2 = 0. \tag{1.6}$$

In this case, salaries are expressed by

$\overline{w}_1 = u_1$

and

$\overline{w}_2 = u_2.$

The proof of Proposition 1 is built on the monotonicity of $E_x(y)$ given in Lemma 1 and on the absence of any commitment on the part of the firm.

The solution shows that if the firm can hope to extract no information from the worker, it will assume as much responsibility as possible in the decision to invest in the second period. This is observed in the fact that a low second-period salary does not cause any inefficiency in the decision to invest. The contract is also not open to renegotiation, since the worker and the firm cannot agree on a salary lower than u_2. The worker can not get any higher salary from any external labor market since the output of the first period is a private information to the firm. Moreover, the firm will always respect its commitment to invest and maintain the worker, since this is in its interest. The production threshold $\overline{x}$ acts as a restraint on the firm's debt-making capacity. From this stems a cost for debt if its level exceeds $\overline{x}$. In this case, it is clear that the firm's financial structure will affect the value of the project.

The sign in equation (1.5) shows that the probability that the firm will reinvest in the second period is higher when this capital is most specific. This is due to the fact that the firm has less incentive to transfer its capital to another type of investment, resulting in a lower risk of job loss in the second period.

ii) Second case: $\int_{[0,Z]} y(z)\, p(z)\, dz - \delta I_0 - I_1 - u_2 \geq 0$

This corresponds to the case where the firm can hire a new worker and pay him the u_2 salary, knowing that, on average, it will make a positive profit. The firm will thus still be disposed to invest in the second period even if the worker is dismissed.

Proposition 2 *In the case where the firm is still disposed to invest in the second period and in a world with information symmetry, the salary contract will be as follows:*

$\overline{w}_1 = u_1$

and

$\overline{w}_2 = u_2.$

In this case, the firm will keep the worker, if the first-period production level exceeds $\overline{x}$, solution implicitly contained in the equation

$$E_x(y) - \int_{[0,Z]} y(z)\, p(z)\, dz = 0. \qquad (1.7)$$

In the opposite case, the firm will hire a new worker.

In this model where information is symmetrical and incomplete, the solution is of the *up-or-out* type and salaries are assigned as on a *spot* market. The idea behind this last type of contract is that workers are not aware of their type and that the firm cannot use labor contracts to distinguish among them.

1.3.1 Financial Structure

The corollary following from Propositions 1 and 2 is that capital structure in no way affects the labor contract. Indeed, since the salary contract is of the *spot* type, the worker need not worry about the possibility of bankruptcy in the second period[9]. The

---

[9]This result contrasts with that of Jaggia and Thakor [1994] because of the absence of moral hazard in our framework.

reverse is, however, false. In fact, the labor-contract solution shows that if the first-period production exceeds a certain level, the firm should reinvest as it will have a good evidence of the worker's skill. This makes it possible to determine a cost for debt, if its level exceeds $\overline{x}$. Since all types of workers will accept the labor contact then the financial contract would be given by

$\overline{F} = I_0$ and $\overline{D}$ is solution to[10]:

$$
\begin{aligned}
I_0 &= \int_{[0,\overline{D}]} \int_{[0,Z]} (x + \delta I_0 - c) \, f\,(x/z)\, p\,(z)\, dx dz \\
&\quad + \overline{D} \int_{[\overline{D},X]} \int_{[0,Z]} f\,(x/z)\, p\,(z)\, dx dz.
\end{aligned}
\tag{1.8}
$$

We should now discuss the relation between $\overline{D}$ and $\overline{x}$. Two cases are possible:

a) $\overline{D} \leq \overline{x}$, in this case the firm investment decision at the second period is optimal. In fact, the firm debt is lower than the output level that gives a good signal about the worker's ability. In this situation we have a complete independence between labor and financial market.

b) $\overline{D} > \overline{x}$, in this situation and if shareholders are incapable of putting any equity in the project there will be a loss of efficiency in terms of investment. This loss of efficiency occurs when the output of the first period lies in $[\overline{x}, \overline{D}]$. However, the wage contract remains acceptable by workers.

1.4 Model with Asymmetric Information

1.4.1 A Contract with Commitment as Benchmark

In the model with symmetric information, the separation between firm and worker, if there is any, takes place at the end of the first period. In this model, however, and since

---

[10]Debt is priced by the market at the competitive rate (zero-interest).

workers know their types, the firm can use an appropriately selected labor contract to make the selection at the beginning of the first period. By offering a contract which satisfies the participation constraint, the firm can attract only good types of workers. In this section, we turn to the case where the firm will make, on average, a negative profit if it decides to hire a new worker in the second period[11], i.e.

$$\int_{[0,Z]} y(z) p(z) dz - I_1 - \delta I_0 - u_2 < 0.$$

One implication of this inequality is that the firm will have no interest in replacing a worker with another, which implies that investment and employment decisions are the same. We model the firm's decision to keep the worker by a variable $l(.)$, where $l(x)$ represents the probability that the firm will keep the worker, given that the first-period production level is x. This modelling allows us to deal with the general case where the firm plays with mixed strategies.

Given a labor contract $(w_1, w_2, l(.))$ the utility for a type-z worker is expressed as

$$w_1 + \int_{[0,X]} [l(x) w_2 + (1 - l(x)) u_2] f(x/z) dx.$$

Let's write this expression as $U_z(w_1, w_2, l(.))$.

Definition 1 *Let there be a labor contracts* $(w_1, w_2, l(.))$. *We say that* $(w_1, w_2, l(.))$ *is an* up-or-out *contact if there exists a parameter* a *such that*

$$l(x) = \begin{cases} 1 \ if \ x \geq a \\ 0 \ if \ x < a. \end{cases}$$

In the next proposition, we show that *up-or-out* contracts are always preferred by the firm, which facilites the resolution of the firm's decision problem.

---

[11]The other case will not be dealt with here. The reasoning is analogous to that of the model in the preceding section.

Proposition 3 *For any labor contract $(w_1, w_2, l(.))$, there always exists an up-or-out contract that is preferred by the firm.*

From this proposition, we can restrict the analysis to *up-or-out* contracts.

To simplify the firm decision problem, we start by analyzing the second period participation constraint of the worker:

$$w_2 \geq u_2.$$

Two cases are possible:

1. The participation constraint is binding:

$$w_2 = u_2.$$

We then have the following result:

Proposition 4 *When the second period participation constraint of the worker is binding, then:*

$$\overline{\overline{w}}_1 = u_1$$

and all workers' types accept the contract. The firm invests and keeps the worker in the second period if and only if the first period output is greater than $\overline{x}$ solution of equation (1.6).

The proof of Proposition 4 is obvious. In this case, the firm obtains the same profit level as in the case of symmetrical information. Let us write this profit as π^*. The labor contract from Proposition 4 is consistent over time: the firm shall not deviate from initial strategy at the beginning of period 2.

2. The participation is not binding:

$$w_2 > u_2.$$

22

In that case, we have the following proposition:

Proposition 5 *When the participation constraint of the worker in second period is not binding, then there exists $z^* \in [0, Z]$, such that the labor contract solves the following:*

$\overline{\overline{w}}_1 = 0$

$\overline{\overline{w}}_2 = y(z^*) - I_1 - \delta I_0.$

Moreover, the firm invests in second period if and only if the output in the first period is greater than $\overline{\overline{x}}$ solution of:

$$(y(z^*) - I_1 - \delta I_0 - u_2) \int_{\left[\overline{\overline{x}}, X\right]} f(u/z^*) \, du - u_1 = 0.$$

Finally, z^* is the solution of the following maximization problem $(P2)$:

$$\max_z \int_{[z,Z]} \int_{[0,X]} x f(x/t) \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt$$
$$+ \int_{[z,Z]} \int_{\left[\overline{\overline{x}}, X\right]} [y(t) - y(z)] f(x/t) \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt + \delta I_0$$

subject to:

$$[y(z) - I_1 - \delta I_0 - u_2] \int_{\left[\overline{\overline{x}}, X\right]} f(u/z) \, du - u_1 = 0. \qquad (1.9)$$

A solution to $(P2)$ exists since constraint (1.9) is compact.

We write the corresponding profit as π^{**}. Since the nature of the labor contract, it is easy to see that types $z > z^*$ will benefit from a salary greater than their opportunity ways.

We are now ready to derive the general solution to the firm decision under asymmetrical information.

Proposition 6 *When workers know their types, then the optimal labor contract between the firm and the worker is the following:*

i) When $\pi^{**} < \pi^*$, then the optimal contract solves:

$\overline{\overline{w}}_1 = u_1$

$$\overline{\overline{w}}_2 = u_2$$

in this case all types of workers accept the labor contract and the firm invests in the second period if and only if $x \geq \overline{x}$.

ii) When $\pi^{**} > \pi^*$, the optimal contract becomes:

$$\overline{\overline{w}}_1 = 0$$

$$\overline{\overline{w}}_2 = y(z^*) - I_1 - \delta I_0$$

where z^* is the solution of (P2). In this case, the firm keeps the worker and invest in the second period if and only if the first period output is greater than $\overline{\overline{x}}$ obtained as an implicit solution to:

$$(y(z^*) - I_1 - \delta I_0 - u_2) \int_{[\overline{\overline{x}}, X]} f(u/z^*) \, du - u_1 = 0. \tag{1.10}$$

We can rewrite (1.10) and obtain

$$\overline{\overline{w}}_2 = u_2 + \frac{u_1}{\int_{[\overline{\overline{x}}, X]} f(u/z^*) \, du}. \tag{1.11}$$

From expression (1.11) we see that the second-period salary is increased with a bonus tied to the worker's performance. Anticipation of this bonus means that all other types except $z < z^*$ will refuse to work for the firm. As to the first-period salary, it is set at its lowest level. The analogy can be made with models with deferred compensation, the initial low wage is what is called the period where workers 'posts a bond'. This bond depends on ability which induces a 'self-selection' from workers' side.

Unlike the model without asymmetric information, the firm integrates a higher total wages bill into its decision to invest in the second period, in order to attract good workers. This salary increase will create a higher probability that the project will not continue in the second period for bad type workers, thereby increasing the probability the worker will be out of a job. This way of discriminating between workers caused a loss of effectiveness, resulting in insufficient investment in the second period.

24

1.4.2   Labor Contract Time-Inconsistency and the Role of Debt

The problem with the labor contract described in Proposition 5 is that it is time inconsistent[12]. The firm cannot, in fact, ex-post, make the commitment to respect it, and will prefer to keep the worker even if the production level falls below $\bar{\bar{x}}$. The idea behind this is that the firm knows that the worker is type $z \geq z^*$. All workers will anticipate this *expost* behavior and will accept the initial contract. The firm will then be unable to make types-separation if appropriate instrument is not added. The firm must thus make a credible commitment to respect the contract offered and to stop the project if the first-period output is lower than $\bar{\bar{x}}$.

Up to now the financial composition of the firm's capital was irrelevant. We next show that capital structure will be a strategic tool in order to implement the optimal labor contact with type-separation. We suppose that the bank does not renegotiate the debt contract with the firm: if the firm is unable to payback its debt, the bank will stop the project and obtain δI_0, the liquidation value. A justification of this assumption is, for example, the lack of coordination or the existence of renegotiation costs (see the discussion below).

As a benchmark let's consider the case where the financial structure of the firm does not affect the labor contract offered by the firm. In this situation the financial contract, given believes about the worker's ability, solves:

$\bar{\bar{F}} = I_0$ and $\bar{\bar{D}}$ is solution to

$$
\begin{aligned}
I_0 &= \int_{\left[0,\overline{\overline{D}}\right]} \int_{[z^*,Z]} (x + \delta I_0 - c) f(x/z) \frac{p(z)}{\int_{[z^*,Z]} p(t)\,dt} dx\,dz \\
&+ \overline{\overline{D}} \int_{\left[\overline{\overline{D}},X\right]} \int_{[z^*,Z]} f(x/z) \frac{p(z)}{\int_{[z^*,Z]} p(t)\,dt} dx\,dz.
\end{aligned}
\tag{1.12}
$$

Before studying how strategic considerations would affect the financial structure of

---

[12]A strategy is said to be consistent over time if a future decision belonging to a strategy formulated at a specific time becomes non-optimal at some later date, even if no new information has appeared in the mean time.

the firm we compare $\overline{D}$ and $\overline{\overline{D}}$ respectively solutions of equations (1.8) and (1.12). We can prove the following proposition.

Proposition 7 *Suppose* $\delta = 0$, *then* $\overline{D} > \overline{\overline{D}}$

Proposition (7) shows how the quality of workers affects the debt face value and the corresponding probability of bankruptcy: if external investors know that the firm is hiring good type workers then the level of debt would be lower for the same amount borrowed for the investment. The reason is that better workers increase the probability of higher realizations and let the firm less vulnerable to bankruptcy. This proposition identifies another determinant of debt-equity ratio other than those mentioned in the literature[13].

We now study how the labor contract would affect the capital structure of the firm. We make the same analysis as in the previous section. We have two possible situations. We only discuss the case where $\overline{\overline{D}} < \overline{\overline{x}}$, the other case is similar to the analysis made in Section 1.3.1.

In this case the threat of liquidation is not credible and the firm can not implement the optimal labor contract since there is a time inconsistency in the optimal labor contract with type-separation. The firm can however rise the face value of debt up to $\overline{\overline{x}}$ to make separation in the second period credible. We have then the next result:

Proposition 8 *When* $\pi^{**} > \pi^*$, *then the firm will offer the same labor contract as in Proposition 5.*

Besides, the financial contract negotiated by the firm is the following:
$$\overline{\overline{D}} = \overline{\overline{x}}$$

and

$$\overline{\overline{F}} = \int_{[0,\overline{\overline{x}}]} \int_{[z^*,Z]} (x + \delta I_0 - c) f(x/z) \frac{p(z)}{\int_{[z^*,Z]} p(t)\,dt} dx dz$$
$$+ \overline{\overline{x}} \int_{[\overline{\overline{x}},X]} \int_{[z^*,Z]} f(x/z) \frac{p(z)}{\int_{[z^*,Z]} p(t)\,dt} dx dz$$

---

[13]See Harris and Raviv [1992] for a survey.

$$> I_0. \tag{1.13}$$

With Proposition (8) and equation (1.13) we find:

$$\frac{\partial}{\partial \delta} \overline{\overline{D}}(.) = -\frac{I_0 \int_{\left[\overline{\overline{D}}.X\right]} f\left(u/z^*\right) du}{\left[y\left(z^*\right) - I_1 - \delta I_0 - u_2\right] f\left(\overline{\overline{D}}/z^*\right)} \leq 0.$$

This shows that in a world with asymmetrical information the debt level is higher in firms whose assets are more specific (small δ). In the framework of this model, the fact that debt increases in relation to the degree of specificity stems from the low opportunity cost which makes the firm less likely to transfer funds to another type of investment. The firm can thus increase its debt and attract only the right type of workers without any large risk of liquidation. This result contrasts with that of Williamson [1985] who conjectured that higher asset specificity would reduce the ability of the firm to take on debt financing. Dasgupta and Sengupta [1993] offer a model where they show that Williamson conjecture holds over a range for the specificity measure δ. Hart and Moore [1994] discussed the relation between asset specificity and the maturity structure of debt.

In our model and contrarily to Perotti and Spier [1993], the financial structure of the firm in the second period is not important. However, after the signature of the financial contract and once the worker is hired, the firm would want to renegotiate with external investors before the realization of x. In fact once types are revealed, and since only high type worker is attracted, it would be beneficial to the firm to renegotiate the financial contact in order to avoid bankruptcy at the end of the first period and benefit from the positive net present value of the second period investment. If workers anticipate this renegotiation then type separation would not be feasible. In order to avoid this situation we suppose, in addition, that the firm is able to diversify its sources of financing leading to a harder coordination between external investors and preventing any kind of renegotiation. We then have that the implementation of optimal labor contract with separation over types dictates firm's behavior in two manners. First, the firm increases

27

its debt beyond its real need for the investment, and second, it disperses its sources of financing generating high renegotiation transactions costs.

1.5 Discussion

By comparing the salary contracts in the two models previously discussed, we see that information structure can play an important role in setting salaries. In the model with adverse selection, the second-period salary is raised to compensate for the low first-period salary, so that the bad types will not be attracted by the contract. With equations (1.6) we see that the separation rate depends solely on the second-period best alternative salary. The implication arising from the model with adverse selection is, however, different. In this model the separation rate is, in fact, a function of the alternative salaries of the two periods. These results are discussed in more detail in the two following sections.

In the firm's maximization problem, it is supposed that the worker is capable of seeing the level of production. On balance, what is important for the worker is to know if the production level in the first period exceeds or falls below $\bar{\bar{x}}$, since this is the only statistic that can define the labor contract. On balance, we know that the financial contract will yield a liquidation if and only if the first-period production level falls below $\bar{\bar{x}}$, which will then serve as a signal to the worker.

1.5.1 Salary Profile and Debt Ratio

It is reasonable to think that information structure will differ from one industry to the next. In certain types of occupations, workers as well as firms share the same beliefs about job performance. In other types of jobs, workers may be better informed than the firm about their productivity. Variations in salary profiles can thus be explained by differences in information structure. We conclude that the variation in salary profiles based on seniority can be used as a measure of the degree of information asymmetry in the job market. As stated in Proposition 5, in the model with adverse selection, the

second-period salary is a decreasing function of δ , which means that the salary-profile will be steeper in more specific firms. In the model without private information, the salary profile is independent of the specificity of fixed assets (δ).

We can in a similar manner explain the variation in debt ratio per firm.

1.5.2   Separation Rate

In the model with information symmetry, the separation rate is characterized by equation (1.6). In this equation we find

$$\frac{\partial}{\partial u_2}\overline{x}\left(.\right) = \frac{1}{\frac{d}{dx}E_x(y)} \geq 0. \tag{1.14}$$

This equation shows that the second-period separation rate is an increasing function of the second-period alternative salary. So, the higher the second-period salary, the greater the separation between firms and workers. Equation (1.6) also shows that the first-period alternative salary has no effect on the separation rate.

In the model with asymmetrical information, the separation rate is expressed by equation (1.10). This equation shows that, in contrast to the previous model, the separation rate depends on the alternative salaries of both periods. Differentiating (1.10), we obtain:

$$\frac{\partial}{\partial u_1}\overline{\overline{x}}\left(.\right) = -\frac{1}{\left[y\left(z^*\right) - I_1 - \delta I_0 - u_2\right] f\left(\overline{\overline{x}}/z^*\right)} \leq 0 \tag{1.15}$$

and

$$\frac{\partial}{\partial u_2}\overline{\overline{x}}\left(.\right) = -\frac{\int_{\left[\overline{\overline{x}},X\right]} f\left(u/z^*\right) du}{\left[y\left(z^*\right) - I_1 - \delta I_0 - u_2\right] f\left(\overline{\overline{x}}/z^*\right)} \leq 0. \tag{1.16}$$

Equation (1.15) shows that the first-period salary increases the separation rate in the second period. Contrary to the sign in equation (1.14), equation (1.16) shows that the second-period salary decreases with the second-period alternative salary.

29

1.6 Econometric Issues

The main conclusion from the previous analysis is that the level of debt is affected in two opposite ways by the work force. In fact, from one side and for strategic convenience firms may increase debt in order to attract only high skilled workers, and on the other side the high quality of workers makes this class of firms less riskier which under the assumption that debt is priced by the market competitive rate ensures a lower debt face value. The key implication from the previous analysis is that the quality of workers within a firm affects directly its capital structure. The analysis also explains variations in tenure-earnings profile across firms with different information structures besides the labor market and with different levels of capital specificity. This approach is confirmed empirically by Margolis [1996] and Abowd, Kramarz and Margolis [1994]. These two contributions use french data matching employer-employee information and show empirical evidences in favor of firm-specific seniority returns. In fact, from Propositions 1, 2 and 7 we can conclude that even if the same shock is allowed for all firms, we can explain variations in returns to seniority and intercepts across firms by allowing different firms to operate in different information environments.

One implication of this paper is that capital structure and contract wages are jointly determined. In Dachraoui and Dionne [1998] we account for this problem by using the next procedure.

Guided by the theory of financial capital structure, the determinants of firm's capital structure are first obtained by estimating the dynamic regression of debt-equity ratios over proxies for the different attributes that the theory suggests. In this regression we also include a measure for firms' needs in terms of ability. In a second step, the estimated debt-equity ratios are used to test the existence of a trade-off between wage contract components (starting wage and wage growth over the life contract). Abowd et al. [1994] found a negative correlation between these components. In Dachraoui and Dionne [1998] this analysis is extended by verifying how controlling for firm's capital structure affects this correlation.

1.7 Conclusion

In this work, we stressed the importance of information structure in analyzing interactions between financial decisions and job decisions. With the same model but different information structures, we reach dissimilar results. More specifically, the salary profile increases more with seniority when there is information asymmetry. This finding gives seniority another dimension aside from the conventional predictions of human-capital theory. This model thus answers the question as to whether seniority is profitable and gives an explanation for the variation in salary profiles from one industry to the next. In the same manner, we can explain the variation in the debt ratio by industry (Titman and Wessels, 1988). In this work, we also manage to determine the role of debt in establishing labor contracts. This finding which is proven in a framework with adverse selection can be generalized to cases where workers choose to perform and where this performance is not observable by the firm. The intuitive deduction is that a high debt level can be an incentive for workers to work harder. The incentive stems from the fear that the firm will go bankrupt and that workers will find themselves without a job. In this work we also show how debt can be affected by the quality of workers, as we reach the conclusion that firms with more able workers have less debt than do comparable firms with less skilled workers.

Bibliography

[1] Abowd, J. M., F. Kramarz and D. N. Margolis, "High Wage Workers and High Wage Firms," *NBER* Working Paper No. 4187, November 1994.

[2] Abowd, J. and T. Lemieux, "The Effect of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada," *Quarterly Journal of Economics*, November 1993, pp. 983-1014.

[3] Baldwin, C. Y., "Productivity and labor Unions: An Application of the Theory of Self-Enforcing Contracts," *Journal of Business*, April 1983, 56, pp. 473-94.

[4] Brander, J. A. and T. R. Lewis, "Oligopoly and Financial Structure: The Limited Liability Effect," *American Economic Review*, 1986, 76, pp. 956-70.

[5] Bronars, S. G. and D. R. Deere, "The Threat of Unionization, the Use of Debt and the Preservation of Shareholder Wealth," *Quarterly Journal of Economics*, February 1991, 16, pp. 231-54.

[6] Chang, C., "Dynamic Structure of Debt Contracts," *Journal of Economic Theory*, 1990, 52, pp. 68-86.

[7] Dachraoui, K. and G. Dionne, "Capital Structure, Cohort Effect and Returns to Seniority: Evidence From French Data," *mimeo*, Université de Montréal, 1998.

[8] Dasgupta, S. and K. Sengupta, "Sunk Investment, Bargaining and the Choice of Capital Structure," *International Economic Review*, February 1993, pp. 203-220.

[9] Gale, D. and M. Hellwig, "Incentive-Compatible Debt Contract: The One-period Problem," *Review of Economic Studies*, October 1985, 52(4), pp. 647-63.

[10] Harris, M. and A. Raviv, "Financial Contracting Theory," in Jean Jacques Laffont, ed., *Advances in Economic Theory*, Vol. 2. Cambridge: Cambridge University Press, 1992, pp. 64-150.

[11] Hart, O. and J. Moore, "A Theory of Debt Based on the Inalienability of Human Capital," *Quarterly Journal of Economics*, 1994, pp. 841-79

[12] Kahn, C. and G. Huberman, "Two-sided Uncertainly and Up or Out Contracts," *Journal of labour Economics*, 1988, pp. 423-44

[13] Margolis, D. N., "Cohort Effect and Returns to Seniority in France," *Annales d'Economie et de Statistiques*, 1996.

[14] Milgrom, P., "Good News and Bad News: Répresentation Theorems and Applications," *Bell Journal of Economics*, 1981, pp. 380-91.

[15] Perotti, E. C. and K. E. Spier, "Capital Structure as a Bargaining Tool: The Role of Leverage in Contract Renegotiation," *American Economic Review*, 1993, pp. 1131-41.

[16] Jaggia, B. P. and V. A. Thakor, "Firm Specific Human Capital and Optimal Capital Structure." *International Economic Review*, May 1994, pp. 283-308.

[17] Ravid, S., "On the Interaction of Production and Financial Decisions," Financial Management 1988, 87-99.

[18] Sarig, O. H., "The Effect of Leverage on Bargaining with a Corporation," *mimeo*, Tel Aviv University, 1990.

[19] Titman, S., "The Effect of Capital Structure on a Firm Liquidation Decision," *Journal of Financial Economics*, 1984 13, pp. 137-51.

[20] Townsend, R., "Optimal contracts and Competitive Markets with Costly State verification," *Journal of Economic Theory*, 1978, pp. 265-93.

[21] Wells, R., "Strategic Dynamic Debt," University of Southampton Working Paper No. 9221, April 1992.

[22] Williamson, O. E., "The Economic Institutions of Capitalism" 1985, New York: The Free Press.

Appendix 1.1

Proof of Proposition 3. For a labor contract $(w_1, w_2, l(.))$ we define A and B as

$$A = \{z/U_z(w_1, w_2, l(.)) \geq u_1 + u_2\}$$

$$B = \left\{z/\int_A \int_{[0,X]} l(x) f(x/z) p(z/z \in A) \, dx \, dz - I_1 - \delta I_0 - w_2 \geq 0\right\}.$$

$A \cap B$ is the set of workers that would accept the labor contract offered by the firm. Let z^* be

$$z^* = \max_{A \cap B} \{z\}.$$

The total wage bill paid by the firm is given by

$$
\begin{aligned}
W &= \int_{A \cap B} \left[w_1 + w_2 \int_{[0,X]} l(x) f(x/z) \, dx\right] p(z/z \in A \cap B) \, dz \\
&\geq u_1 + u_2.
\end{aligned}
$$

Let z_1 be a solution to

$$y(z_1) - I_1 - \delta I_0 - u_1 - u_2 > 0.$$

z_1 exists by the assumption that the set

$$\{z/y(z) - I_1 - \delta I_0 - u_1 - u_2 \geq 0\}$$

is not empty. By the mean theorem we can prove that there exists a such that

$$\int_{[z^*, Z]} \int_{[0,X]} \left[w_2' l_a(x) + u_2(1 - l_a(x))\right] f(x/z) p(z/z \geq z^*) \, dx \, dz = u_1 + u_2 \qquad (1.17)$$

35

where $l_a\left(.\right)$ and w_2' are respectively given by

$$w_2' = y\left(z_1\right) - I_1 - \delta I_0$$

and

$$l_a\left(x\right) = \begin{cases} 1 \text{ if } x \geq a \\ 0 \text{ if } x < a. \end{cases}$$

Now we show that workers of type $z < z^*$ would not accept the contact $\left(0, w_2', l_a\left(.\right)\right)$. We start by showing that for all $a \leq b$ and for all x, we have that

$$K\left(x, z\right) = a \int_{[0,x]} f\left(u/z\right) du + b \int_{[x,X]} f\left(u/z\right) du$$

is increasing[14] in z.

In fact

$$\frac{\partial}{\partial z} K\left(x, z\right) = a \int_{[0,x]} f_z\left(u/z\right) du + b \int_{[x,X]} f_z\left(u/z\right) du$$

and since $f\left(x/z\right)$ verifies the $MLRP$ condition then

$$\int_{[0,x]} f_z\left(u/z\right) du \leq 0 \text{ for all } x.$$

In addition $a \leq b$, then

$$\frac{\partial}{\partial z} K\left(x, z\right) \geq b \int_{[0,x]} f_z\left(u/z\right) du + b \int_{[x,X]} f_z\left(u/z\right) du = 0.$$

By (1.17) and the previous result we have that

$$U_{z^*}\left(0, w_2', l_a\left(.\right)\right) \leq u_1 + u_2$$

---

[14]We can also show that $K\left(.\right)$ is decreasing in x which helps to get (1.17).

36

and

$$U_{z^*}\left(0, w_2', l_a\left(.\right)\right) < U_{z^*}\left(0, w_2', l_a\left(.\right)\right) \quad \text{for all } z < z^*$$

which shows that types $z < z^*$ do not accept the contract $\left(0, w_2', l_a\left(.\right)\right)$. The firm can then attract higher ability workers and pay the alternative wage, which means that $\left(0, w_2', l_a\left(.\right)\right)$ is preferred by the firm to $\left(w_1, w_2, l\left(.\right)\right)$. ∎

Proof of Proposition 5. For an *up-or-out* contact $\left(w_1, w_2, l_a\left(.\right)\right)$, let z_a be the unique explicit solution to

$$U_{z_a}\left(w_1, w_2, l_a\left(.\right)\right) = u_1 + u_2.$$

z_a exists since there will be at least one type of workers who is paid his alternative wage, otherwise the firm will reduce w_1 without affecting workers decision to accept the labor contract. As we did in the proof of Proposition 3, we can proof that the firm would prefer the contact $\left(0, w_2', l_{a'}\left(.\right)\right)$, where w_2' and a' are given respectively by

$$w_2' = y\left(z_a\right) - I_1 - \delta I_0$$

and

$$U_{z_a}\left(0, w_2', l_{a'}\left(.\right)\right) = u_1 + u_2.$$

The last expression can be rewritten as

$$\left[y\left(z_a\right) - I_1 - \delta I_0 - u_2\right] \int_{\left[a', X\right]} f\left(x/z\right) dx - u_1 = 0. \qquad (1.18)$$

Equation (1.18) is the participation constraint that we include in the maximization problem $\left(P2\right)$, where the objective function is obtained as follows:

$$\int_{\left[z, Z\right]} \int_{\left[0, X\right]} x f\left(x/t\right) \frac{p\left(t\right)}{\int_{\left[z, Z\right]} p\left(m\right) dm} dx dt$$

37

$$+ \int_{[z,Z]} \int_{[\overline{\overline{x}},X]} [y(t) - I_1 - w_2] \, f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt$$

$$+ \delta I_0 \int_{[z,Z]} \int_{[0,\overline{\overline{x}}]} f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt.$$

Rearranging terms and substituting $y(z_a) - I_1 - \delta I_0$ for w_2, the last expression can be written as:

$$\int_{[z,Z]} \int_{[0,X]} x f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt$$

$$+ \int_{[z,Z]} \int_{[\overline{\overline{x}},X]} [y(t) - y(z_a)] \, f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt + \delta I_0.$$

Which ends the proof of Proposition 5. ∎

Proof of Proposition 7. Let's define $V(D,z)$ as

$$V(D,z) \;=\; \int_{[0,D]} \int_{[z,Z]} (x-c) \, f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dx dt$$

$$+ D \int_{[D,X]} \int_{[z,Z]} f(x/t) \, \frac{p(t)}{\int_{[z^*,Z]} p(m) \, dm} dx dt.$$

We need to show that $V(D,z)$ is increasing in both D and z. If this is the case we will have

$V(\overline{D}, 0) = I_0 = V(\overline{\overline{D}}, z^*) > V(\overline{\overline{D}}, 0)$ which necessarily imply that $\overline{D} > \overline{\overline{D}}$.

Now we prove that $V(D,.)$ is increasing in z for all D.

After simplification and using the fact that

$$\int_{[0,X]} \int_{[z,Z]} f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dt dx = 1,$$

we can show that the derivative of $V(.)$ with respect to z has the same sign as

$$\int_{[0,D]} [D - x + c] \left[f(x/z) - \int_{[z,Z]} f(x/t) \, \frac{p(t)}{\int_{[z,Z]} p(m) \, dm} dt \right] dx.$$

38

By integration by part the last expression can be written as

$$c\left\{\int_{[0,D]}\left[f\left(u/z\right)-\int_{[z,Z]}f\left(u/t\right)\frac{p\left(t\right)}{\int_{[z,Z]}p\left(m\right)dm}dt\right]du\right\}$$
$$+\int_{[0,D]}\left[\int_{[0,x]}\left[f\left(u/z\right)-\int_{[z,Z]}f\left(u/t\right)\frac{p\left(t\right)}{\int_{[z,Z]}p\left(m\right)dm}dt\right]du\right]dx.$$

which is equivalent to

$$c\left\{\int_{[0,D]}f\left(u/z\right)du-\int_{[z,Z]}\left[\int_{[0,D]}f\left(u/t\right)du\right]\frac{p\left(t\right)}{\int_{[z,Z]}p\left(m\right)dm}dt\right\}$$
$$+\int_{[0,D]}\left[\int_{[0,x]}f\left(u/z\right)du-\int_{[z,Z]}\left[\int_{[0,x]}f\left(u/t\right)du\right]\frac{p\left(t\right)}{\int_{[z,Z]}p\left(m\right)dm}dt\right]dx.$$

Since the $MLPR$ condition implies $FOSD$, then we have

$$\int_{[0,x]}f\left(u/z\right)du\geq\int_{[0,x]}f\left(u/t\right)du \text{ for all } t\geq z \text{ and } x.$$

The last inequality implies

$$\int_{[0,x]}f\left(u/z\right)du\geq\int_{[z,Z]}\left[\int_{[0,x]}f\left(u/t\right)du\right]\frac{p\left(t\right)}{\int_{[z,Z]}p\left(m\right)dm}dt,$$

which ends the proof of Proposition 7.∎

Chapter 2

Capital Structure and Compensation Policy: Evidence from French Data

Abstract

In this chapter we study the interactions between capital structure, labor force participation and compensation policies within firms. Recent works have shown that there exists heterogeneity in compensation policies across firms (Abowd, Kramarz and Margolis, 1994). We introduce firms' capital structure in order to explain part of this heterogeneity. Estimation results show, in fact, that the composition of the labor force affects significantly firms' leverage which in turn affects the compensation policy of the firm. Empirical evidences also show that controlling for leverage explains a big part of the trade-off between starting compensation and returns to seniority confirming the theory of the leverage effect on wage contracting under adverse selection.

2.1 Introduction

Optimal capital structure, if there is any, should be explained by the trade-off between the costs and the benefits of debt financing versus equity in the firm's capital structure. In finance theory, variables like cash flow variability, bankruptcy costs and tax advantage have been stressed to explain variations in capital structure. Other works rely on agency costs and signaling theory to show how the relative bargaining power of owners vis-à-vis workers or how the specificity of human and physical capital could alter the composition of capital structure (Hart and Moore, 1994, Dasgupta and Sengupta, 1993 and Jaggia and Thakor, 1994). Empirical work in this area was most often compromised first, by error measures due to the difference between real value and book value and, second, by the existence of suitable proxies for the attributes that may affect capital structure. In fact, the rare empirical studies done in this direction (Bronars and Deere, 1991 and Titman and Wessels, 1988) used data that does not consider the labor force within firms. In the recent theoretical literature, it was shown, however, that this variable may affect considerably the composition of firm's capital structure. Moreover, it was also shown that firm's compensation policies and labor contracts in general are heavily related to firm's leverage (Farmer, 1985 and Khan and Scheinkman, 1985).

This study extends empirical work on capital structure theory in two ways. First, we are able to enhance the range of theoretical determinants of capital structure by introducing some recently developed theories that have not been yet analyzed empirically. This contribution is possible since our data contains new informations that were not available in previous studies. Second, we make a linkage between firms' financial structure and compensation policies within these firms. We do this by linking wage contracts component estimates over debt-equity ratios by firm which helps us to test the effect of firms leverage on wage contracts.

A further motivation for this empirical study is to explain a part of the heterogeneity that exists in returns to seniority among firms. In fact, as shown in Abowd, Kramarz and Margolis [1994] and Margolis [1996], imposing identical returns to seniority across

different firms (Topel, 1991) is a restrictive assumption that has to be reconsidered. When heterogeneity in returns to seniority across firms is considered, Abowd et al. [1994] found a standard error that is relatively large (0.044 relative to the mean across firms of 8.95E-4). As discussed in Margolis [1996], models with implicit contracts and costless mobility (Beaudry and DiNardo, 1991) can accommodate for this variance if we permit firm-specific shocks. In fact, as mentioned by Lamont [1994], debt overhang creates a minimal threshold value for investment returns. Below this threshold the firm cannot attract investors even if the net present value for the investment is positive. Expectations about the economy are then crucial in investment decisions, and more levered firms, in stagnant economies, are those who suffer the most, leading to a loss in investment efficiency.

In this paper we are more concerned with microeconomic effects. We will see how controlling for debt-equity ratio by firm affects the variance of returns to seniority across firms as well as the covariance between the firm fixed effect and the returns to seniority. Abowd et al. found a negative correlation (-0.63), which is in favor of a trade-off between starting salary and wage growth as predicted by human capital theory. This correlation should be lower once we control for firms leverage.

The main objective of this paper is to show how firms' capital structure explains heterogeneity in compensation policies across firms. We also study the interaction between firms capital structure and compensation policies in order to test for the presence of adverse selection in the labor market. In a first step we analyze how the composition of the labor force may influence capital structure. We then test how the estimated capital structure affects firms' compensation policies.

The rest of the paper is organized as follows. In Section 2.2 we present the theoretical background. In Section 2.3 we analyze the determinants of capital structure. Section 2.4 establishes the link between capital structure and compensation policies. The last section is devoted to conclusions.

2.2 Financial Structure and Compensation Policy: Theory

2.2.1 Motivation

Traditional econometric modelling of wage determination does not allow for heterogeneity in firm compensation policy neither for temporal variation[1]. A recent paper by Abowd, Kramarz and Margolis [1994] invalidates this approach by showing empirical evidences from French data in favor of firm-specific seniority returns. Using the same data, Margolis [1996] allows for still more heterogeneity in both compensation policy and seniority returns. His main finding is that a wage contract (ϕ, γ), where ϕ is the compensation at the beginning of the contract and γ is a measure of wage growth over the life contract[2], should be indexed by firm and by cohort: $(\phi_{j,T}, \gamma_{j,T})$, where j is a firm indicator and T denotes cohorts. He also found a much larger variance in $\widehat{\phi}_{j,T}$ within cohorts than within firms (16.90 versus 1.05), whereas cross-firms and cross-cohorts variations of $\widehat{\gamma}_{j,T}$ were not very different.

Until recently there was no theoretical support to such evidence[3]. Dachraoui and Dionne [1997], in an attempt to reconcile the literature with these recent empirical findings, extended on the traditional models by formally introducing the financial structure as a strategic firm's behavior towards the implementation of optimal labor contracts.

2.2.2 Theory

In the theory of human capital, firms and workers share the cost and the return of the investment. Suppose for example that the worker bears the total cost of the investment (lower starting salary) and then gets the total return in his investment. If the firm faces a probability of bankruptcy then the return on the investment in human capital becomes

---

[1]See Topel [1991], Murphy and Topel [1987].
[2]The notations are the same as in Abowd *et al.* [1994].
[3]See Margolis [1996] for a discussion.

risky and it becomes profitable for the worker and the firm to share this risk (implicit contract theory). This is the idea behind the work of Jaggia and Thakor [1994] who show that leverage weakens the force of long term contractual commitment by the firm and creates ex ante costs which are increasing with leverage. If the firm has to choose both capital structure and labor contracts, then we should observe firms with higher specificity having steeper tenure-earning profiles for their managers and lower debt-equity ratios. A similar idea to that of Jaggia and Thakor is that of Titman [1984]. The basic model is applied to the relationship between a firm and its customers. He shows that if the firm's product is durable and requires future services such as parts and repairs, the customer is paying not only for ownership of the product but also for an expected future stream of services. Consequently customers must assess the probability of the firm bankruptcy in both their decision to purchase the durable good as well as the price they are willing to pay. Note that this model can be applied to the firm-workers relationship. In fact, if a firm's labor force has acquired specific skills which cannot entirely be transferred to alternate employment, then workers bear costs if the firm goes bankrupt. Employees need to search for new jobs and learn new skills.

In Dachraoui and Dionne [1997], labor contract and capital structure are determined simultaneously. One finding is that the returns on seniority depends on information structure in the labor market. In fact they prove that when workers have private information about their ability, a long term contract with low wage at the beginning of the contract, associated with both a higher wage in the subsequent period and a risk of bankruptcy, is optimal since only high ability workers will accept such labor contract. The reason is that high ability workers are expected to produce more and hence the firm has less chance to be liquidated. This argument is true under the hypothesis that liquidation is associated with a job loss, which is a real cost since workers will have a lower alternative wage. The analogy can be made with models on deferred compensation (Becker and Stigler, 1974), where the initial low wage period is called the period where a worker 'posts a bond'. This bond depends on ability which induces a *self-selection*

from workers' side.

Dachraoui and Dionne [1997] have also shown that if firms and workers share the same information in the labor market, workers are offered higher wage at the beginning of the contact and the slope of wage over time is lower than under the asymmetrical information case. The intuition is that the firm cannot use wage contracts as a strategy to discriminate over workers and the risk of liquidation is compensated by a higher initial wage leading to a lower return on seniority. In this environment only *spot* contracts are observed. The optimal labor contract offered, as well as workers' decision to join the firm, are independent of the capital structure of the firm.

The next table summarizes the three different predictions discussed previously:

Table 1

Jaggia and Thakor, 1994	Dachraoui and Dionne, 1997	Dachraoui and Dionne, 1997
Model with moral hazard and endogenous types	Model with pure adverse selection	Model with symmetric information
Low leverage, steeper tenure earning profile and a negative correlation between leverage and wage growth.	High leverage, steeper tenure earning profile and a positive correlation between leverage and wage growth.	Flatter tenure earning profile and no correlation between leverage and wage growth.

2.2.3 Related Literature

A corollary from the previous analysis is that increasing the probability of bankruptcy via the capital structure can offer incentives either for workers to work harder (moral hazard models) or signal in order to influence the quality of the entry in the labor supply side (adverse selection models).

Suppose now that firm's and workers' payoffs are the outcome of bilateral bargaining[4], then the issuance of debt can be profitable to the firm since it reduces the divisible

---

[4]See Abowd and Lemieux [1993] for supporting empirical evidences.

surplus in the bargaining game by the amount of its face value, *ceteris paribus*. Rising debt is then Pareto improving in situations where investment is sunk since it lightens the underinvestment problem (see Dasgupta and Sengupta, 1993 and Bronars and Deere. 1991). In a model where the dynamic use of debt is allowed, Perotti and Spier [1993] show that altering the firm leverage is advantageous if the current earning cannot cover senior obligations. Hart and Moore [1994] study the link between the maturity of debt and the degree of assets intangibility (such as specific human capital). They show how an increase in the degree of intangibility makes the debt longer term.

From the empirical side, Titman and Wessels [1988] include the separation rate as a proxy for human capital specificity[5] and found that firms with low quit rates tend to have low debt ratios. Bronars and Deere [1991] present empirical evidences supporting the idea that industries with higher probability of union formation are more leveraged.

2.3 Determinants of Capital Structure

2.3.1 Theoretical Background

In this section we look for possible explanations for the existence of optimal capital structure. Our purpose is to identify explicative variables that we will use in the regression of debt-equity ratios.

A traditional view in constructing a theory of optimal capital structure is to make a trade-off between the gain from leverage because of the tax deductibility of interest expenses and bankruptcy costs[6]. Even if these factors seem to affect capital structure, the use of debt for other motivations than taxes remains a stylized fact. One explanation is the fact that operation within firms or between firms and markets (input or output

---

[5]In accordance to the theory of human capital (Becker, 1975), if workers invest in firm-specific on-the-job training, the firm and the workers should share the costs and the returns on the investment. The trade-off between a lower initial wage and a future compensation would then lead to a decreasing turnover.

[6]Bankruptcy costs include models with human specific capital (Jaggia and Thakor, 1994) and those with transaction costs (reorganization costs, legal fees,...).

markets) are not like what the existence of a representative agent or perfect market would predict which leads to models with agency costs or signaling hypothesis. For example, if financial markets are not perfect in the sense that market prices do not reflect all information, then it is possible that managers may use financial policy decisions to convey information to the market (Ross, 1977). Capital structure can also be a strategy for the firm when competing in the product and input markets (Titman, 1984, Brander and Lewis, 1986). In models with agency costs (Jensen and Meckling, 1976, Diamond, 1989, Harris and Raviv, 1992), it is argued that the ownership structure of the firm may affect the probability distribution of cash flows. These models give rational for bond covenants that make restrictions on dividend payments or subsequent financing such as restrictions on the issuance of new debt.

2.3.2 Empirical Model

The key implication of Dachraoui and Dionne [1997] model is that firms requiring workers with higher ability maintain higher debt equity ratios than do comparable firms where ability is less relevant[7]. One significant empirical prediction comes from the model. If workers have more information about their ability than the firm then the quit rates among workers assigned to tasks where the impact of ability is more important should be lower in high levered firms. At this stage we do not have information about quit rates to test directly this prediction. However, we can measure the firm's needs in terms of ability by using the percentage of engineers, technicians and managers in its work force. The reason is that those kinds of workers are usually assigned to tasks where the impact of ability is more important and the more this proportion is important the more $R\&D$ is important in the firm. We also control for the proportion of skilled blue color workers in the firm. Then, under adverse selection, these two variables should have positive coefficients in a regression on the determinants of debt-value ratios. However, these variables may also control for the specificity of the firm since it may be costly for the firm to replace these

---

[7]See Appendix 2.1.

47

inputs (Hart and Moore, 1994). In this later case a negative relationship is predicted, which is also consistent with the prediction of Jaggia and Thakor [1994].

We study the determinants of debt-value ratios by estimating the following regression[8]:

$$\frac{D_j}{V_j} = \gamma_0 + \gamma_1 EFFEC_j + \gamma_2 PING_j + \gamma_3 POQA_j$$
$$+ \gamma_4 GROWTH + + \gamma_5 VOLA + \gamma_6 ICA + \gamma_7 ICB$$
$$+ \gamma_8 PPCHA + \gamma_9 EBERC + \sum_j \alpha_j T_j + u_j, \qquad (2.1)$$

where D_j is for debt and V_j is the value of the firm which is given by the sum of long term debt and equity.

ICB represents total corporate immobilization. This variable is introduced to control for the firm's ability to secure debt with physical assets of known values which may help to avoid costs associated to the lack of information of bondholders and help firms to increase leverage. $PPCHA$ is a kind of protective covenant taken by bondholders. We expect that the more shareholders are able to offer such easy monitoring provisions, the less bondholders are reluctant to invest in the firm. Consequently bond covenants can reduce the agency costs of monitoring and a positive sign is predicted (Sy, 1997). We also introduce the amortization of corporate immobilization (ICA). *A negative sign for the coefficient is then predicted since this variable accounts* for non debt tax shields (DeAngelo and Masulis, 1980). $PING$ is the proportion of technicians and engineers in the labor force, whereas $POQA$ is that of skilled blue color workers.

Other variables are introduced as proxies for the different attributes that the theory of capital structure suggest they may affect the firm's debt equity ratio. These attributes[9]

---

[8] Abowd [1989] finds that an unexpected increase in union rents decreases equity by the same amount, Bronars and Deere [1991] make adjustment of the market value of equity and obtain similar results. Indeed the endogenous variable (observed debt/observed equity) is replaced by (observed debt/observed equity+estimated lost equity) and the correlation between debt and union threat remains positive significant.

[9] For a complete discussion see Titman and Wessels [1988] and Harris and Raviv [1992].

48

are growth (measured by *GROWTH*). In fact growth opportunities can be viewed as capital assets that can add value to the firm; this added value makes the agency cost in equity-controlled firms more important and then reduce leverage. Other indicators are, profitability (measured by *EBERC*) since it seems that firms prefer rising capital first from retained income (Myers, 1984) and, size and unionization potential measured by *EFFEC*. In equation (2.1) we also control for the volatility of the firm (*VOLA*). In fact, as argued in Bradley et al. [1984] the greater the variability of the earning, the greater the present value of costs of leverage and hence the lower the optimal level of debt.

Equation 2.1 also contains dummy variables for industry classification (T_j). In fact, Titman [1984] shows that industries where products are durable and require future services such that parts and repair have higher bankruptcy costs which reduce leverage. Bradley et al. [1984], also have shown that there is more variation in mean leverage debt-equity ratios across industries than within industries.

2.3.3 Data, Variables and Preliminary Results

The data set used in this empirical work is the same as in Abowd, Kramarz and Margolis [1994]. In this study we focus more on firms information. However, we introduce the estimates of wage contact components found by Abowd et al. [1994]. The sample of firms comes from the annual survey Bénéfices Industriels et Commerciaux (*BIC*), which collects a large amount of income statement, balance sheet, employment and flow of funds information in support of the French national accounts. The sample, constructed by INSEE, covers 10,824 firms followed from 1978 to 1992. Measures of firm performance include value added per employee, operating income as a proportion of total assets and sales per employee. Other variables are discussed below. As measures of factor inputs we calculated total real assets and total year-end employment. Detailed measures of the firm's employment structure (professional, skilled and unskilled) from the annual Enquête sur la Structure des Emplois (Survey of Employment Structure) are also added to the data.

In Table 2 we give definitions of variables and in Table 3 we report descriptive statistics of the data. *RATIO* is the ratio of the sum of the annual book value of debt by the sum of the annual book value of debt and the book value of equity over the period 1978-92.

The variable *ICB* represents total corporate immobilization. It includes all durable necessary inputs to keep the firm active. Examples of corporate immobilizations are: buildings, constructions and equipments. Note that immobilizations concern elements devoted to serve the firm in the long run. Inputs that are consumed during the current financial year are not included.

ICA measures the amortization of corporate immobilization. It includes provisions for depreciation to account for those immobilizations with depreciating values.

PPCHA represents provision for risks and charges; it includes provisions intended to cover risks and charges for realizations that are uncertain. The description of the nature of these risks are however precisely determined. Examples of these provisions are: provisions made to cover non insurable risks, provisions for losses in stock market, provisions for amends and penalties and provisions for high costly repairs that cannot be supported by the current financial budget.

The description of the other variables is straightforward.

As in Bradley et *al.* [1984] we first report regressions that relates the mean of long term debt to the mean of long term debt plus book value of equity for 31 industries. This first step is to see how the debt-value ratio is industry related in our data set. The results are presented in Table 4. We observe that the insurance industry (**T36**) has the lowest leverage (a mean of 0.186) while the financial industry (**T37**) is the higher levered (0.934). We also see that industry classification accounts only for 9,4% in the variation of leverage across firms while Bradley et *al.* [1984] obtained using American data that industry classification of non regulated firms explains 25% in the variation of leverage across firms.

50

Table 2

Variables Definition

RATIO	Firm debt to debt plus equity is calculated as the sum of annual book value of debt over 1978-92 divided by the sum of debt and equity over the same period.
EFFEC	Total full-time employment in thousands.
PING[a]	Proportion of engineers, technicians and managers in *EFFEC*.
POQA[b]	Proportion of high skilled workers in *EFFEC*.
GROWTH	The average of the first difference of the net operating income over the period 1978-92 devided by the average of total assets over the same period.
VOLA	Standard deviation of the first difference in net operating income over the period 1978-92 devided by the average value of total assets over the same period.
EBERC	Real operating income per unit of capital.
ICB	Total corporate immobilization over total assets.
ICA	Total amortizement of corporate immobilization over total assets.
PPCAH	Total provisions for risk and charges over total assets.

Notes *a* and *b*: *PING* corresponds to the categories 37 and 38, *POQA* corresponds to the categories 52-65 in the *PCS* (nomenclature des professions et catégories socioprofessionelles).

Table 3

Mean and Standard Deviation of Variables

Variable	Mean	Standard Deviation
$RATIO$	0.777	0.247
$EFFEC$	0.395	1.716
$PING$	0.248	0.187
$POQA$	0.466	0.240
$GROWTH$	$22.8E\text{-}5$	0.024
$EBERC$	482.142	8233.41
ICB	$41.4E\text{-}5$	0.004
ICA	$22.5E\text{-}5$	0.001
$VOLA$	$8.5E\text{-}4$	0.053
$PPCHA$	$1.6E\text{-}5$	0.00011
	$n = 10,824$	

Note: Means and Standard Deviations are based on the total sample of 10,824 firms over the period 1978 to 1992.

Table 4

Means of debt/debt+equity ratios and dummy variable coefficients

NAP 40	N. obs	Mean (Standard deviation)	Dummy variable coefficients (t-statistics)
T02	257	0.788 (0.189)	Omitted variable
T03	340	0.748 (0.206)	−0.030 (−1.590)
T06	34	0.519 (0.178)	−0.259 (−6.054)
T07	60	0.686 (0.157)	−0.091 (−2.737)
T08	43	0.639 (0.174)	−0.139 (−3.605)
T09	185	0.672 (0.185)	−0.106 (−4.763)
T10	51	0.646 (0.165)	−0.131 (−3.662)
T11	94	0.644 (0.174)	−0.133 (−4.753)
T12	231	0.690 (0.176)	−0.087 (−4.187)
T13	591	0.750 (0.153)	−0.028 (−1.656)
T14	581	0.748 (0.170)	−0.030 (−1.765)
T15	426	0.727 (0.154)	−0.050 (−2.811)
T16	181	0.727 (0.153)	−0.051 (−2.286)
T17	59	0.816 (0.297)	0.038 (1.148)
T18	575	0.733 (0.187)	−0.044 (−2.600)
T19	135	0.758 (0.551)	−0.019 (−0.788)
T20	374	0.740 (0.170)	−0.037 (−2.047)
T21	144	0.710 (0.145)	−0.067 (−2.793)
T22	288	0.757 (0.240)	−0.020 (−1.066)

NAP 40	Nobs	Mean (Standard deviation)	Dummy variable coefficients (t-statistics)
T23	224	0.735 (0.147)	−0.042 (−2.022)
T24	598	0.844 (0.136)	0.066 (3.917)
T25	2843	0.812 (0.183)	0.034 (2.369)
T29	259	0.840 (0.127)	0.061 (3.052)
T30	174	0.848 (0.761)	0.070 (3.110)
T31	483	0.802 (0.186)	0.024 (1.366)
T32	6	0.824 (0.114)	0.046 (0.479)
T33	727	0.803 (0.188)	0.025 (1.553)
T34	423	0.819 (0.590)	0.040 (2.254)
T35	21	0.736 (0.230)	−0.041 (−0.776)
T36	84	0.186 (0.156)	−0.591 (−20.213)
T37	304	0.934 (0.099)	0.156 (8.053)
Total	10,824	0.777 (0.247)	
R-square			0.094
F-statistics			37.271

Notes:

1-The first column identifies the industries, the second column gives the number of observations in each selected industry while column three presents the mean and standard deviations of the leverage ratio.

2-See Appendix 2.2 for industry classification in France.

3-Firm debt to debt plus equity is calculated as the sum of annual book value of debt over 1978-1992 divided by the sum of debt and equity over the same period.

2.3.4 Estimation Results on Capital Structure

Table 5 shows the estimates from equation (2.1). The first column reports the OLS estimation of equation (2.1). In the second column we add interaction terms between industry classification and $PING$, and between industry classification and $POQA$. We are then able to relax the assumption that labor force composition has the same effect on leverage across industries. Empirical evidences from the two regressions are in favor of theoretical predictions. In fact, we found that $GROWTH$ is negatively correlated with long term debt witch shows that agency costs are more important in presence of growth opportunities. We also found that volatility ($VOLA$) reduces leverage which is consistent with the theory of optimal capital structure (Bradley et al., 1984). The two regressions also show that the provisions for risk and charges ($PPCHA$) are positively correlated to leverage as predicted by the theory.

In the first regression we found that the composition of the work force has a direct impact on leverage. In fact, we found that the proportion of managers, engineers and technicians is negatively correlated to leverage while the proportion of skilled blue color workers is positively correlated to leverage, even when we control for industry classification. However, these coefficients are not specific to the industries and may even measure the inter-industry needs for technicians, engineers and skilled workers.

Once we add the interactions terms to the regression the coefficient of high skilled blue color workers ($POQA$) becomes not significant while that of the proportions of managers, technicians and engineers ($PING$) becomes more important (-0.361 compared to -0.062). The coefficients of the interactions between industry classification and $PING$ are all positive, except for three terms that are not significant. Those for $POQA$ are either positive or negative. The adverse selection explanation seems to be supported in many industries.

Table 5

Results of Debt to Value Ratios Estimates

Independent Variables	Coefficients (t-statistic)	Coefficients (t-statistic)
Intercept	0.834 (65.644)	0.863 (22.415)
GROWTH	−17.218 (−8.646)	−16.075 (−8.027)
VOLA	−35.152 (−7.742)	−33.631 (−7.421)
EBERC	$2.08E\text{-}7$ (−0.984)	$2.22E\text{-}7$ (−1.044)
PING	−0.062 (−5.061)	−0.361 (−4.244)
POQA	0.028 (2.690)	0.082 (1.226)
EFFEC	−0.000 (−0.862)	−0.008 (−0.859)
PPCHA	13.437 (20.516)	13.768 (20.913)
ICA	10.613 (5.708)	9.756 (5.190)
ICB	1.703 (1.354)	2.105 (1.650)
T08	−0.104 (−3.583)	−0.548 (−3.125)
T09	−0.068 (−4.025)	−0.183 (−2.759)
T10	−0.101 (−3.745)	−0.292 (−2.270)
T11	−0.076 (−3.550)	−0.282 (−2.306)
T12	−0.073 (−4.605)	−0.191 (−2.664)
T14	−0.027 (−2.079)	−0.151 (−2.918)
T16	−0.041 (−2.440)	−0.127 (−2.131)
T30	−0.002 (−0.114)	0.429 (2.798)

Independent Variables	Coefficients (*t*-statistic)	Coefficients (*t*-statistic)
PING*T09		0.477 (2.404)
PING*T11		0.457 (2.569)
PING*T12		0.447 (3.891)
PING*T13		0.321 (2.632)
PING*T14		0.464 (4.606)
PING*T15		0.345 (3.594)
PING*T17		0.712 (3.268)
PING*T19		−0.041 (−0.0223)
PING*T22		0.365 (3.528)
PING*T24		0.282 (2.552)
PING*T25		0.308 (3.486)
PING*T30		−0.386 (−1.864)
PING*T31		0.279 (2.482)
PING*T32		−0.281 (−0.333)
PING*T33		0.355 (3.841)
PING*T34		0.303 (3.073)
PING*T37		0.488 (3.835)
POQA*T08		0.674 (2.479)
POQA*T18		−0.206 (−2.454)
POQA*T22		−0.190 (−1.811)

Independent Variables	Coefficients (t-statistic)	Coefficients (t-statistic)
$POQA$*T23		-0.194 (-1.779)
$POQA$*T30		-0.488 (-2.819)
$POQA$*T33		-0.087 (-1.103)
$POQA$*T34		-0.173 (-2.296)
F-statistics	28.797	67.443
R-square	22.34	21.13
$n =$10,824		

Notes:

1-See Appendix 2.2 for industry classification in France.

2-Non reported coefficients are not significant.

3-T02 (agriculture industry) is the omitted industry.

2.4 Capital Structure and Compensation Policy: Empirical Model and Estimation Results

The implication from the analysis in Section 2.2 is that compensation policies are strongly affected by leverage either because of the threat of bankruptcy or because debt can help firms to become credible. In this section we are looking to test the existence and the way wage contract are affected by leverage. We study the regression of labor contract components as a function of firm's capital structure. We will make the regression of starting compensation (ϕ_j) and the returns to seniority by firm[10] (γ_j) over debt-value ratio estimated in Section 2.3.4. The specifications to be estimated are the following:

$$
\begin{aligned}
\phi_j &= \alpha_0 + \alpha_1 \left(\frac{D_j}{V_j} \right) + \Gamma_1 Y_j + u_j \\
\gamma_j &= \beta_0 + \beta_1 \left(\frac{D_j}{V_j} \right) + \Gamma_2 Y_j + v_j,
\end{aligned}
$$

where Y_j is a vector of firms characteristics. These characteristics are the size of the firm, the labor force composition and the real value added inclusive of labor costs. In

---

[10] Abowd, Kramarz and Margolis [1994] use a sample of over one million French workers. The data includes individual's age, sex, location of job and occupation. Workers and employers were followed across years and each worker was assigned to the employer for which he has the largest number of paid days in a given year. The authors estimate the following specification:

$$
w_{i,t} = x_{it}\beta + \theta_i + \psi_{J(i,t)it} + \varepsilon_{it}
$$

where w_{it} is the compensation of individual i, for time t, x_{it} represent observed person-specific characteristics and θ_i is the time-invariant individual-effect.
The firm effect was decomposed as

$$
\psi_{J(i,t)it} = \phi_{J(i,t)} + \gamma_{1J(i,t)} S_{J(i,t)it} + \gamma_{2J(i,t)} T_1 \left(S_{J(i,t)it} - 10 \right),
$$

where ϕ_j and γ_j are parameters representing respectively the firm effect and the returns to seniority by firm to be estimated, $S_{J(i,t)it}$ is individual i's seniority at date t in firm $J(i,t)$ and $T_1(z)$ is the linear spline basis function. The projection method proposed by the authors allows them to account for individual and firm specific effects as well as for firm-specific returns to seniority. They start by projecting $\psi_{J(i,t)it}$ onto the firm and individual data (firm size and the person-average characteristics over time).

fact, in large firms a job entails team production or varied task so that an output index is difficult to implement. This difficulty creates incentives for life-cycle contracts that define payment scheme between workers and firms. At the same time in large firms, direct supervision is less effective than in small firms in which management is closer to the workforce. Consequently large firms are more likely to have piece rates. In small firms it is usually easier to monitor workers productivity and pay them according to their marginal product. The workforce composition has also an impact on the payment scheme since it is an indicator of the production procedure. The real value added inclusive of labor cost controls for the capital intensity. In fact, in a capital-intensive production workers have less control over the pace of production and a piece rates are likely to give the wrong incentives.

The direct estimation of the above two equations using ordinary least squares estimation would introduce an endogeneity bias since the financial structure of the firm and the labor contract can be chosen simultaneously. Under these circumstances, The ordinary regression produces inconsistent results. One way to avoid this problem is to use the Two-Stage Least Squares ($2SLS$) estimation method. The ratio of debt to firm value is replaced by the estimates obtained in the preliminary regression of equation (2.1), where the interaction terms were included. The new specification to be estimated is then,

$$\phi_j = \alpha_0 + \alpha_1 \widehat{\left(\frac{D_j}{V_j}\right)} + \Gamma_1 Y_j + u_j \qquad (2.2)$$

$$\gamma_j = \beta_0 + \beta_1 \widehat{\left(\frac{D_j}{V_j}\right)} + \Gamma_2 Y_j + v_j, \qquad (2.3)$$

Equations (2.2) and (2.3) can be tested separately to see how firms leverage can affect wage contract components. A more natural way of estimating these equations is to pool the whole information in the sample and test the above equations as a single linear

statistical model:

$$\begin{cases} \phi_j = \alpha_0 + \alpha_1 \widehat{\left(\frac{D_j}{V_j}\right)} + \Gamma_1 Y_j + u_j \\ \gamma_j = \beta_0 + \beta_1 \widehat{\left(\frac{D_j}{V_j}\right)} + \Gamma_2 Y_j + v_j. \end{cases} \quad (2.4)$$

We can write the system in (2.4), in terms of the jth observation, in matrix form as:

$$\begin{bmatrix} \phi_j \\ \gamma_j \end{bmatrix} = \begin{bmatrix} 1 & \widehat{\left(\frac{D_j}{V_j}\right)} & Y_j & 0 \\ 0 & 1 & \widehat{\left(\frac{D_j}{V_j}\right)} & Y_j \end{bmatrix} \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \Gamma_1 \\ \beta_0 \\ \beta_1 \\ \Gamma_2 \end{bmatrix} + \begin{bmatrix} u_j \\ v_j \end{bmatrix}, \quad (2.5)$$

or equivalently

$$y_j = X_j b + e_j,$$

with the notations:

$$y_j = \begin{bmatrix} \phi_j \\ \gamma_j \end{bmatrix}$$

$$X_j = \begin{bmatrix} 1 & \widehat{\left(\frac{D_j}{V_j}\right)} & Y_j & 0 \\ 0 & 1 & \widehat{\left(\frac{D_j}{V_j}\right)} & Y_j \end{bmatrix}$$

$$b = \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \Gamma_1 \\ \beta_0 \\ \beta_1 \\ \Gamma_2 \end{bmatrix}$$

$$e_j = \begin{bmatrix} u_j \\ v_j \end{bmatrix}.$$

The random error e_j has the characteristics

$$e_j \sim N\left(0, \Sigma\right)$$

where

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{bmatrix}$$

and

$$\sigma_{ij} = cov\left(u_i, v_j\right).$$

With the assumption of error normal distribution; we can write:

$$\begin{bmatrix} e_1 \\ e_2 \end{bmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{bmatrix} \sigma_{11}I_N & \sigma_{12}I_N \\ \sigma_{12}I_N & \sigma_{22}I_N \end{bmatrix} = W\right].$$

Given the matrix form that accommodates for the correlation that may exist between u and v, we need a statistical model that will use this additional information and increase the level of sampling precision. In order to take into account both dependent regressors and cross-equation correlation of the errors we use the Three-Stage Least Squares ($3SLS$) procedure.

Seemingly Unrelated Regressions (SUR) estimate parameters in equation (2.5). This method will make use of the eventual trade-off that might exist between the return to seniority and the starting wage.

The error covariance matrix is estimated as:

$$\widehat{\sigma}_{ij} = \frac{\left(y_i - X_ib_i\right)'\left(y_j - X_jb_j\right)}{N}. \tag{2.6}$$

The generalized least squares estimator is given by

$$\widehat{b} = \left(X'\widehat{W}^{-1}X\right)^{-1}X'\widehat{W}^{-1}y, \tag{2.7}$$

62

where $\widehat{W}$ is the estimated covariance matrix with elements given by (2.6).

Estimates of system (2.5) are given in Table 6. They show that firms leverage affects positively and significantly the returns to seniority within firms while the effect on the starting compensation is negative significant. These evidences indicate that more levered firms hiring workers pay a lower starting wage and a promise of higher growth in wage for the future. A theoretical model that accommodates for these findings is that of Dachraoui and Dionne [1997] who show that debt can be a strategy for the firm in order to create a self selection entry by workers (see table Table 1). This result contrasts with that of Jaggia and Thakor [1994]. As discussed in Section 2.2.2 a negative sign is predicted by their model for the relationship between firms leverage and returns to seniority.

In Table 7 we report the covariance matrix of the dependent variables (ϕ and γ) and the covariance matrix of errors. As we can see controlling for firms leverage reduces the covariance of starting salary and returns to seniority from -0.02 to -0.002 witch shows that debt is responsible in a big part for the trade-off between wage at the beginning of the contract and the future compensation, no matter the approach we take.

Table 6

Estimates

Parameter	Intercept	$RATIO$	$EFFEC$	$PING$	$POQA$
Estimates:ϕ-equation	0.003	−0.023	0.002	0.010	0.002
(t-statistics)	(0.70)	(−4.44)	(3.87)	(1.85)	(0.44)
Estimates:γ-equation	−0.006	0.005	−0.000	0.010	0.000
(t-statistics)	(−2.60)	(2.27)	(−1.74)	(3.79)	(0.11)

Table 7

Covariance Matrix

	Without controlling for leverage	Controlling for leverage
$\mathrm{Var}(\phi_j)$	$9.129E\text{-}3$	$9.388E\text{-}3$
$\mathrm{Var}(\gamma_j)$	$1.224E\text{-}3$	$2.03E\text{-}3$
$\mathrm{Cov}(\phi_j, \gamma_j)$	-0.0209	-0.002
	$n = 10,824$	

2.5 Conclusion

In this study we have put the emphasis on adverse selection in the labor market. We tested a linkage between labor and financial markets. This interaction was done in two ways. First, we have shown that the composition of the labor force within a firm affects its capital structure. In fact firms with more engineers and technicians use less debt in their capital structure than do other comparable firms. Second, we focused on the effect of firms leverage level on compensation policies, and found that more levered firms offer a lower starting wage and a higher returns to seniority. We also found that leverage accounts for a big part of the heterogeneity in compensation policies across firms. Specially, we showed that leverage is responsible for the trade-off between starting wage and wage growth.

The empirical evidences give also indication that firms leverage is positively correlated with corporate immobilization (ICB) which confirms that the type of assets owned by a firm affects its capital structure. We also stressed empirically the importance of bond covenants in the determination of observed capital structure as the coefficient of the provision for risk and charges ($PPCHA$) is positive significant. The variability of the earnings ($VOLA$) is shown to be inversely related to debt ratio confirming the existence of leverage-related costs.

The implication from our empirical evidences is a strong interaction between the financial market and the labor market. This result needs to be supported by strong imperfections in both markets (see also Ravid, 1988 and Dionne et *al.*, 1997 for similar conclusions).

Bibliography

[1] Abowd, J. M., "The effect of Wage Bargains on the Stock Market Value of the Firm," *American Economic Review,* 1989, pp. 774-800.

[2] Abowd, J. M., F. Kramarz and D. N. Margolis, "High Wage Workers and High Wage Firms," *NBER* Working Paper No. 4187, November 1994. Forthcoming *Econometrica.*

[3] Abowd, J. and T. Lemieux, "The Effect of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada," *Quarterly Journal of Economics,* November 1993, pp. 983-1014.

[4] Baldwin, C. Y., "Productivity and Labor Unions: An Application of the Theory of Self-Enforcing Contracts," *Journal of Business*, April 1983, 56, pp. 473-94.

[5] Becker, G., *Human Capital, A Theoretical and Empirical Analysis with Special Reference to Education,* 2nd edn, New York: National Bureau of Economic Research, Columbia University Press.

[6] Becker, G. and G. Stigler, "Law Enforcement, Malfeasance and the Compensation of Enforcers," *Journal of Legal Studies,* 1974, pp. 1-18.

[7] Beaudry, P. and J. DiNardo, "The Effect of Implicit Contracts on the Movement of Wages Over the Business Cycle: Evidence from Micro Data," *Journal of Political Economy,* 1991, pp. 665-88.

[8] Bradley, M., G. Jarrell and E. H. Kim, "On the Existence of an Optimal Capital Structure: Theory and Evidence," *Journal of Finance*. 1984, pp. 857-78.

[9] Brander, J. A. and T. R. Lewis, "Oligopoly and Financial Structure: The Limited Liability Effect," *American Economic Review*, 1986, 76, pp. 956-70.

[10] Bronars, S. G. and D. R. Deere, "The Threat of Unionization, the Use of Debt and the Preservation of Shareholder Wealth," *Quarterly Journal of Economics*, February 1991, 16, pp. 231-54.

[11] Dachraoui, K. and Dionne, G. [1997] " Information Structure, Labor Contracts and the Strategic Use of Debt," Working paper 98-03, Risk Management Chair, HEC-Montréal.

[12] Dasgupta, S. and K. Sengupta, "Sunk Investment, Bargaining and the Choice of Capital Structure," *International Economic Review*, February 1993, pp. 203-220.

[13] DeAngelo, H. and R. Masulis, "Optimal Capital Structure under Corporate and Personal Taxation," *Journal of Financial Economics*, March 1980, pp. 451-71.

[14] Diamond, D., "Reputation Acquisition in Debt Markets," *Journal of Political Economy,* 1989, pp. 828-62.

[15] Dionne, G., R. Gagné, F. Gagnon and C. Vanasse, "Debt, Moral Hazard and Airline Safety: An Empirical Evidence," *Journal of Econometrics*, 1997, pp. 379-402.

[16] Farmer, R., "Implicit Contracts with Asymmetric Information and Bankruptcy," *Review of Economics Studies,* 1985, pp. 1127-56.

[17] Hart, O. and J. Moore, "A Theory of Debt Based on the Inalienability of Human Capital," *Quarterly Journal of Economics*, 1994, pp. 841-79.

[18] Harris, M. and A. Raviv, "Financial Contracting Theory," in Jean Jacques Laffont, ed., *Advances in Economic Theory*, Vol. 2. Cambridge: Cambridge University Press, 1992, pp. 64-150.

[19] Jaggia, B. P. and V. A. Thakor, "Firm Specific Human Capital and Optimal Capital Structure," *International Economic Review*, May 1994, pp. 283-308.

[20] Jensen, M. C. and W. Meckling, "Theory of the firm: Managerial Behavior, Agency Costs, and Capital Structure," *Journal of Financial Economics*, 1976, pp. 305-60.

[21] Kahn, C. and J. Scheinkman, "Optimal Employment Contracts with Bankruptcy Constraints," *Journal of Economic Theory*, 1985, pp. 343-65.

[22] Lamont, O. A., "Corporate Finance and Macroeconomics," Ph.D. Dissertation, MIT University (May 1994).

[23] Margolis, D. N., "Cohort Effect and Returns to Seniority in France," *Annales d'Economie et de Statistiques*, 1996.

[24] Perotti, E. C. and K. E. Spier, "Capital Structure as a Bargaining Tool: The Role of Leverage in Contract Renegotiation," *American Economic Review*, 1993, pp. 1131-41.

[25] Petitjean, M., *Recueil Méthodique du Plan Comptable Revisé*, Economica, 1983.

[26] Ravid, S., "On the Interaction of Production and Financial Decisions," *Financial Management*, 1988, pp. 87-99.

[27] Ross, S. A, "The Determination of Financial Structure: The Incentive Signaling Approach," *Bell Journal of Economics*, 1977, pp. 23-40.

[28] Sarig, O. H., "The Effect of Leverage on Bargaining with a Corporation," *mimeo*, Tel Aviv University, 1990.

[29] Sy, A. N. R., "Debt Covenants, Maturity Structure and Agency Problems," Unpublished Ph. D. Dissertation, 1997, Faculty of Management, McGill University.

[30] Titman, S., "The Effect of Capital Structure on a Firm Liquidation Decision," *Journal of Financial Economics*, 1984, pp. 137-51.

[31] Titman. S and R. Wessels, "The Determinants of Capital Structure Choice," *Journal of Finance*, 1988, pp. 1-19.

[32] Topel, R., "Specific Capital, Mobility and Wages: Wages Rise with Seniority," *Journal of Political Economy*, 1991, pp. 145-76.

[33] Wells, R., "Strategic Dynamic Debt," University of Southampton Working Paper No. 9221, April 1992.

[34] Williamson, O. E., "The Economic Institutions of Capitalism" New York: The Free Press, 1985.

Appendix 2.1

As we know from Dachraoui and Dionne [1997], we may observe two types of labor contracts; a pooling one that we denote C_p and a separating one that we denote C_s. The expected payoff of C_p is

$$E\left(C_p\right) = u_1 + u_2,$$

where u_1 and u_2 are the alternative wages in period one and two respectively. Note that at the optimum this labor contract would be accepted by all kind of workers.

The separating labor contract offers a low payment in the first period and a higher wage in the second period. In expectation this contract offers

$$E_z\left(C_s\right) = u_2 + \int_{[D,X]} f\left(u/z\right) du \frac{u_1}{\int_{[D,X]} f\left(u/z^*\right) du},$$

where z is the type (ability) of the worker, D is the level of debt of the firm, and z^* is an endogenous variable of the firm's optimization problem[11]. As we can see from the previous equation[12]

$$\frac{dE_z\left(C_s\right)}{dD} \begin{cases} \geq 0 \text{ if } z \geq z^* \\ \leq 0 \text{ if } z \leq z^*. \end{cases}$$

The optimal solution is where the $z \geq z^*$ accept the offered labor contract, and then the expected payment is increasing in D.

Consequently we then have two possible situations. One in which the firm offers a pooling contract and where the parameters of the labor contracts are independent of the firm's leverage, or a separating contract to the more qualified workers such that the tenure earning profile is increasing in the leverage of the firm.

---

[11]z^* is defined by

$$E\left(C_p\right) = E_{z^*}\left(C_s\right).$$

[12]The proof is based on the $MLRP$.

Appendix 2.2

NAP 15	NAP 40
U01 Agriculture, sylviculture, pêche.	**T01** Agriculture, sylviculture, pêche.
U02 Industrie agricloles et alimentaires.	**T02** Industrie de la viande et du lait.
	T03 Autres industries agricoles et alimentaires.
U03 Production et distribution d'energie.	**T04** Poduction de combustibles mineraux solides et cokéfaction.
	T05 Production de pétrol et de gaz naturel.
	T06 Production et distribution d'électricité, distribution de gaz et d'eau.
U04 Industrie des biens intermédiaires.	**T07** Production de minerais et metaux ferreux. Première transformation de l'acier.
	T08 Production de minerais, métaux et demi-produits non ferreux.
	T09 Production de matériaux de construction et minéraux divers.
	T10 Industrie du verre.
	T11 Chimie de base production de fils et fibres artificiels et synthétiques.
	T13 Fonderies et travail des métaux.
	T21 Industrie du papier et du carton.
	T23 Industries du caoutchouc et de la tranformation des matières plastiques.
U05 A Industries de biens d'équipement professionnels.	**T14** Construction mécanique.
	T15 B Construction de matériels électriques et électroniques professionnels.
	T17 Construction navale et aéronautique.

U05 B Équipements ménager, électronique grand public.	T15 B Équipements ménager, électronique grand public.
U05 C Construction de véhicules automobiles et d'autres matériels de transport terrestre.	T16 Construction de véhicules automobiles et d'autres matériels de transport terrestre.
U06 Industries des biens de consommations courants.	T12 Parachimie et industrie pharmaceutique.
	T18 Industries textiles et de l'habillement.
	T19 Industrie du cuir et de la chaussure.
	T20 Industries du bois et de l'ameublement; Industries diverses.
	T22 Imprimerie, presse, édition.
U07 Bâtiment génie civil et agricole.	T24 Industrie de mise en oeuvre du bâtiment et du génie civil et agricole.
U08 Commerce.	T25 Commerce de gros alimentaire.
	T26 Commerce de gros non alimentaire.
	T27 Commerce de détail alimentaire.
	T28 Commerce de détail non alimentaire.
U09 Transports et télécommunications.	T31 Transports.
	T32 Télécommunications et postes.
U10 Services Marchands	T29 Réparation et commerce de l'automobile.
	T30 Hôtels, cafés, restaurants.
	T33 Services marchands rendus principalement aux entreprises.
	T34 Services marchands rendus principalement aux menagers.
U11 Locations immobilières.	T35 Locations immobilières.

U12 Assurances.	**T36** Assurances.
U13 Organismes financiers.	**T37** Organismes financiers.
U14 Services non marchands.	**T38** Services non marchands.

Part II

Portfolio Choice

Chapter 3

Optimal Portfolio and Response to a Shift in a Return Distribution

Abstract

We study the properties of the optimal portfolio in a general situation with one risk free asset and two risky assets. We also show how a shift in a return distribution affects the composition of an optimal portfolio in the case of one riskless asset and two risky assets. We obtain that, in general, such a shift modifies the composition of the mutual fund. We also show that the separating conditions presented in the finance literature for the setting of the optimal portfolios, are not robust to the comparative statics following distributional shifts if we want to obtain intuitive results. This conclusion contrasts with that of Mitchell and Douglass [1997] who limited their analysis to portfolios with risky assets. Our discussion applies to a first order shift (FSD) but the same result can be obtained for increases in risk.

3.1 Introduction

In the literature, recent contributions on portfolio choice and its response to distribution shifts dealt with different situations: one riskless asset-one risky asset (Rothschild and Stiglitz, 1971, Dionne, et al., 1993), two risky assets (Hadar and Seo, 1990, Meyer and Ormiston, 1994, Dionne and Gollier, 1996), one riskless asset-two risky assets (Dionne et al., 1997) and, recently, an arbitrary number of assets (Mitchell and Douglass, 1997). This last contribution, however, relies on the stability of the mutual-fund separation. Here we show that such stability is not always possible and we propose a general result to mutual-fund variation following a first order stochastic dominance when the portfolio contains a safe asset. We also reach interesting results concerning the properties of the optimal portfolio and we generalize some known result in the case of one risky asset and one risk free asset. We consequently extend the result of Milgrom [1981] who proved, in a model with one risky asset, that a MLRP reduces the demand for the risky asset by all risky-averse investors.

In Mitchell and Douglass [1997], the problem is the following: an agent is allocating his initial wealth among n-risky assets: $\tilde{x}_i$, $i = 1, ..., n$. They show that there exists $\phi_1, ..., \phi_{n-1}$ and $\psi_2, ..., \psi_{n-1}$ and two funds $\widetilde{y}_1$ and $\widetilde{y}_2$ such that

$$\widetilde{y}_1 = \phi_1 \tilde{x}_1 + \phi_2 \tilde{x}_2 + ... + \phi_{n-1} \tilde{x}_{n-1} + \left(1 - \phi_1 - \phi_2 - ... - \phi_{n-1}\right) \tilde{x}_n,$$

$$\widetilde{y}_2 = \psi_2 \tilde{x}_2 + ... + \psi_{n-1} \tilde{x}_{n-1} + \left(1 - \psi_2 - ... - \psi_{n-1}\right) \tilde{x}_n,$$

where the n-assets problem can be reduced to a two-fund problem. Under their assumption of mutual fund stability (following a distributional shift), one can verify easily that the solution would yield the following identities:

$$\alpha_j\left(r\right) = \frac{\phi_j - \psi_j}{\phi_1} \alpha_1\left(r\right) + \psi_j \text{ for } j = 2, ..., n, \tag{3.1}$$

where α_j is the amount invested in asset $\tilde{x}_j$ and r is a shift parameter. Note that

parameters ϕ_j and ψ_j are independent of r. These necessary conditions are valid when the utility function is quadratic or when the returns are normally distributed and the utility function is exponential. (See Appendix 3.1 for these two examples.). However the above conditions are not necessarily verified for all utility functions that are in the class permitting two-fund separation (Cass and Stiglitz, 1970). In the next section we show that for $CRRA$, (3.1) does not hold when the portfolio contains a safe asset. Moreover the necessary conditions in (3.1), when they hold, are not sufficient to extend the theorem of Meyer and Ormiston [1994] when all ψ_j are not restricted to be positive. This is true since $\tilde{y}_2$ is restricted to be positive in Meyer and Ormiston article. Such considerations were not taken into account in Mitchell and Douglass [1997].

The rest of the paper is organized as follows, in Section 3.2.1 we study the properties of the optimal portfolio and we generalize some results of the portfolio with only one risky asset. In Section 3.2.2 we introduce a parameter that permits to study the reaction of the optimal portfolio according to a shift in the return distribution induced by a variation of the parameter. We then discuss the obtained result and its relation to mutual fund separation. The last section is devoted to conclusion.

3.2 General Results: the Case of One Risk Free Asset and Two Risky Assets

We consider a risk averse agent who allocates his wealth (normalized to one) between one risk free asset (with return x_0) and two risky assets with returns $\tilde{x}_i$ for $i = 1, 2$. We denote the cumulative distribution on asset $\tilde{x}_1$ conditional on x_2 as $F(x_1/x_2)$, and the cumulative distribution of the returns on asset $\tilde{x}_2$ as $G(x_2)$. For ease of presentation we suppose that $F(x_1/x_2)$ and $G(x_2)$ have density function given respectively by $f(x_1/x_2)$ and $g(x_2)$. The portfolio share of asset $\tilde{x}_i$ is α_i. We note α_i, $i = 1, 2$ as the investment

in asset $\tilde{x}_i$. The agent's end of period wealth W is then equal to

$$W = 1 + x_0 + \alpha_1 (x_1 - x_0) + \alpha_2 (x_2 - x_0),$$

by using the fact that $1 = \alpha_0 + \alpha_1 + \alpha_2$.

From now on we write W as $\alpha_1 (x_1 - x_0) + \alpha_2 (x_2 - x_0)$. This will not result on any loss of generality since $1 + x_0$ is constant. Optimal portfolio solves the following program (P):

$$\max_{\alpha_1, \alpha_2} \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} u \left(\alpha_1 (x_1 - x_0) + \alpha_2 (x_2 - x_0) \right) dF (x_1/x_2) dG (x_2)$$

where $[\underline{x}_1, \overline{x}_1]$ and $[\underline{x}_2, \overline{x}_2]$ are respectively the support of $\tilde{x}_1$ and $\tilde{x}_2$.

Assume we have interior solutions, the first order conditions associated to the above problem are:

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) u' \left(\alpha_1 (x_1 - x_0) + \alpha_2 (x_2 - x_0) \right) dF (x_1/x_2) dG (x_2) = 0, \qquad (3.2)$$

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_2 - x_0) u' \left(\alpha_1 (x_1 - x_0) + \alpha_2 (x_2 - x_0) \right) dF (x_1/x_2) dG (x_2) = 0. \qquad (3.3)$$

In particular, if the mutual-fund separation applies then the ratio $\frac{\alpha_2}{\alpha_1}$ is independent of the agent risk aversion and the mutual-fund has weights $\frac{\alpha_1}{\alpha_1 + \alpha_2}$ and $\frac{\alpha_2}{\alpha_1 + \alpha_2}$ on $\tilde{x}_1$ and $\tilde{x}_2$ respectively.

In the next section we characterize the optimal portfolio. In Section 3.2.2 we introduce a parameter to the density distribution and study how a shift in the parameter affects the optimal portfolio.

3.2.1   Characterization of the Optimal Portfolio

In this section we generalize some results know in the case an agent is allocating his wealth between two assets and show how risk aversion dictate the choice of the optimal portfolio. The next example will be useful for motivating Propositions 9 and 10.

Suppose u is a quadratic utility function, which means that $u''' \equiv 0$. The first order conditions (3.2) and (3.3) become

$$\alpha_1 \left(\sigma_{11} + m_1^2\right) + \alpha_2 \left(\sigma_{12} + m_1 m_2\right) = m_1$$

$$\alpha_2 \left(\sigma_{22} + m_2^2\right) + \alpha_1 \left(\sigma_{12} + m_1 m_2\right) = m_2$$

where σ_{ii} and σ_{ij} and are respectively for the variance of x_i and the covariance between x_i and x_j, and $m_i = E\left(\widetilde{x}_i - x_0\right)$. When $m_2 = 0$, the solution of the above system of two equations is:

$$\alpha_1^* = \frac{m_1 \sigma_{22}}{\sigma_{11}\sigma_{22} - \sigma_{12}^2 + m_1^2 \sigma_{22}}$$

$$\alpha_2^* = \frac{-m_1 \sigma_{12}}{\sigma_{11}\sigma_{22} - \sigma_{12}^2 + m_1^2 \sigma_{22}},$$

where the common denominator is strictly positive.

The first finding is that even when $m_2 = 0$, the asset proportion α_2 is not trivially equal to zero. Second, it is clear to verify that we have $Sign\left(\alpha_1^*\right) = Sign\left(m_1\right)$ and $Sign\left(\alpha_1^* \alpha_2^*\right) = -Sign\left(Cov\left(\widetilde{x}_1, \widetilde{x}_2\right)\right)$.

We keep the same notation for m_i and we denote $F\left(x_1/x_2\right)$ as the conditional distribution function of x_1 on x_2. We can prove the next result:

Proposition 9 *Suppose* $m_2 = 0$ *and* $F\left(x_1/x_2\right)$ *is monotone in* x_2 *for every* x_1, *then we have*

$$Sign\left(\alpha_1^* \alpha_2^*\right) = -Sign\left(cov\left(\widetilde{x}_1, \widetilde{x}_2\right)\right).$$

Proof

By the first order condition (3.3) we have

$$Eu_{\alpha_2} = \int_{\underline{x}_2}^{\overline{x}_2} \left(x_2 - x_0\right) I\left(x_2\right) g\left(x_2\right) dx_2 = 0$$

where

$$I\left(x_{2}\right) = \int_{\underline{x}_{1}}^{\overline{x}_{1}} u'\left(.\right) f\left(x_{1}/x_{2}\right) dx_{1}.$$

Taking the first derivative and by integration by part we get

$$I'\left(x_{2}\right) = \alpha_{2}^{*} \int_{\underline{x}_{1}}^{\overline{x}_{1}} u''\left(.\right) f\left(x_{1}/x_{2}\right) dx_{1} - \alpha_{1}^{*} \int_{\underline{x}_{1}}^{\overline{x}_{1}} u''\left(.\right) \left[\int_{\underline{x}_{1}}^{x_{1}} f_{x_{2}}\left(t/x_{2}\right) dt\right] dx_{1},$$

which can be rewritten as

$$I'\left(x_{2}\right) = \alpha_{2}^{*} \int_{\underline{x}_{1}}^{\overline{x}_{1}} u''\left(.\right) f\left(x_{1}/x_{2}\right) dx_{1} - \alpha_{1}^{*} \int_{\underline{x}_{1}}^{\overline{x}_{1}} u''\left(.\right) F_{x_{2}}'\left(x_{1}/x_{2}\right) dx_{1}.$$

Note that since $m_{2} = 0$, if $I\left(.\right)$ is monotonic then $Sign(Eu_{\alpha_{2}}) = Sign(I'\left(.\right))$. We argue that

$$Sign\left(\alpha_{1}^{*}\alpha_{2}^{*}\right) = Sign\left(F_{x_{2}}'\left(x_{1}/x_{2}\right)\right). \tag{3.4}$$

In fact suppose (3.4) is not true, then we would have $Sign\left(\alpha_{1}^{*}\alpha_{2}^{*}\right) = -Sign\left(F_{x_{2}}'\left(x_{1}/x_{2}\right)\right)$, and one can verify that $I\left(.\right)$ is monotonic which cannot be true if we impose an interior solution.

Moreover, by definition, when $m_{2} = 0$,

$$cov\left(\widetilde{x}_{1}, \widetilde{x}_{2}\right) = \int_{\underline{x}_{2}}^{\overline{x}_{2}} \left(x_{2} - x_{0}\right) \left[\int_{\underline{x}_{1}}^{\overline{x}_{1}} x_{1} f\left(x_{1}/x_{2}\right) dx_{1}\right] g\left(x_{2}\right) dx_{2}$$

and, by integration by part,

$$\int_{\underline{x}_{1}}^{\overline{x}_{1}} x_{1} f\left(x_{1}/x_{2}\right) dx_{1} = \overline{x}_{1} - \int_{\underline{x}_{1}}^{\overline{x}_{1}} \left[\int_{\underline{x}_{1}}^{x_{1}} f\left(t/x_{2}\right) dt\right] dx_{1}.$$

Using the last expression and, again, the fact that $m_{2} = 0$, we can write $cov\left(\widetilde{x}_{1}, \widetilde{x}_{2}\right)$ as

$$cov\left(\widetilde{x}_{1}, \widetilde{x}_{2}\right) = -\int_{\underline{x}_{2}}^{\overline{x}_{2}} \left(x_{2} - x_{0}\right) \left[\int_{\underline{x}_{1}}^{\overline{x}_{1}} F\left(x_{1}/x_{2}\right) dx_{1}\right] g\left(x_{2}\right) dx_{2}.$$

Under the assumption that $F(x_1/x_2)$ is monotone in x_2 for every x_1, we obtain

$$Sign\left(cov\left(\widetilde{x}_1, \widetilde{x}_2\right)\right) = -Sign\left(F'_{x_2}\left(x_1/x_2\right)\right). \qquad (3.5)$$

(3.4) and (3.5) end the proof of Proposition 9.

We can also show the next result.

Proposition 10 *Suppose $m_2 = 0$ and $\widetilde{x}_1$ and $\widetilde{x}_2$ are independent random variables, then $\alpha_2^* = 0$.*

Proof

If $\widetilde{x}_1$ and $\widetilde{x}_2$ are independent then $f(x_1/x_2) = f(x_1)$, we can then write the first order condition as:

$$
\begin{aligned}
Eu_{\alpha_2}(\alpha_1, 0) &= \int_{\underline{x}_2}^{\overline{x}_2} (x_2 - x_0) g(x_2)\, dx_2 \int_{\underline{x}_1}^{\overline{x}_1} u'(\alpha_1(x_1 - x_0)) f(x_1)\, dx_1 \\
&= m_2 \int_{\underline{x}_1}^{\overline{x}_1} u'(\alpha_1(x_1 - x_0)) f(x_1)\, dx_1 \\
&= 0.
\end{aligned}
$$

Note that if we keep the same assumption on the monotonicity of $F(x_1/x_2)$, then the independence assumption in Proposition 10 can be replaced by the assumption of a nil covariance[1].

Proposition 9 shows that even if the second asset is actuarially fair $(m_2 = 0)$ the asset proportion α_2^* at the optimum is not trivially equal to zero since it can be used for hedging purposes when $\widetilde{x}_2$ is correlated with $\widetilde{x}_1$. If the two assets are not correlated, then a risk averse investor[2] would not invest in the second asset which confirms the existence

---

[1] In fact, one can prove that if $m_2 = 0$ and $F(x_1/x_2)$ is monotone in x_2 for every x_1, then $cov(\widetilde{x}_1, \widetilde{x}_2) = 0$ implies that $\widetilde{x}_1$ and $\widetilde{x}_2$ are independent. We know that the reverse is always true.

[2] Even if risk aversion does not figure in the proof of Proposition 10, one should keep in mind that risk aversion makes the first order condition necessary and sufficient for a maximum. This is exactly what we use in the proof of Proposition 10.

of hedging in the optimal portfolio. This conclusion is confirmed by the relation through the covariance of the two random variables given in Propositions 9 and 10.

Now we turn to identify the different positions (long vs short) that the investor takes on the first risky asset depending on the expected return. We know that, in the situation where an agent is allocating his wealth between a risk-free asset and a risky asset, a necessary and a sufficient condition for an agent to invest a positive amount in the risky asset is that the expected return exceeds that of the riskless asset. In the next proposition we try to generalize this result to our model when we add another risky asset. In fact we can prove the next result:

Proposition 11 *Suppose $m_2 = 0$, then a necessary and a sufficient condition for the agent to invest a positive amount in the risky asset $\widetilde{x}_1$ is that the expected return on this asset exceeds that of the riskless asset (x_0).*

Proof

We need to prove that

$$Sign\left(\alpha_1^*\right) = Sign\left(m_1\right),$$

or equivalently that the first order condition (3.2) evaluated at $\alpha_1 = 0$, has the same sign as m_1. When $\alpha_1 = 0$, we verify that (3.2) is reduced to

$$Eu_{\alpha_2}\left(0, \alpha_2\right) = \int_{\underline{x}_2}^{\overline{x}_2} \left(x_2 - x_0\right) u'\left(\alpha_2\left(x_2 - x_0\right)\right) g\left(x_2\right) dx_2$$

which implies that

$$Sign\left(Eu_{\alpha_2}\left(0, \alpha_2\right)\right) = -Sign\left(\alpha_2\right).$$

By the above expression we see that if the individual invests 0 in the first asset then he would invest 0 in the second asset. It is then sufficient to prove that $Eu_{\alpha_1}\left(0, 0\right)$ has the same sign as m_1.

82

From the first order condition (3.2),

$$Eu_{\alpha_1}(0,0) = u'(0) m_1.$$

Since $u'() \geq 0$ and by the concavity of u we have that $Sign(\alpha_1^*) = Sign(m_1)$.

Note that if $m_2 = 0$ then the optimal portfolio is completely characterized by Propositions 9 and 10 and 11.

3.2.2 Shift in the Return Distribution

In this section we show that the stability assumption is strong in the case of two risky assets-one risk free asset. In other words, the ratio of the two risky assets can be affected by a first order shift which means that the composition of the risky portfolio can be modified contrarily to the result in Mitchell and Douglass. We introduce a parameter in the distribution of x_1 and we denote the density function as $f(x_1/r)$. Here we suppose that $\widetilde{x}_1$ and $\widetilde{x}_2$ are independent random variables. In this section we deal only with the case where $\alpha_i \geq 0$, $i = 1, 2$.

We first introduce the next definition.

Definition 2 *Let I be an open set in $\Re$. We say that $\{f(./r)\}_{r \in I}$ verifies the monotone likelihood ratio property $(MLRP)$ if $\frac{f_r(x_1/r)}{f(x_1/r)}$ is decreasing in x_1 for all $r \in I$.*

The $MLRP$ is a special case of first order stochastic dominance (FSD). See Eeckhoudt and Gollier [1995] for details.

We have the next result.

Proposition 12 *Assume that (a) the utility function is $CRRA$; and (b) $\{f(./r)\}_{r \in I}$ verifies the $MLRP$ condition. Let $\alpha_1^*(r)$ and $\alpha_2^*(r)$ represent optimal investment decisions in the risky fund for a given level r. Then $\frac{\alpha_2^*}{\alpha_1^*}(r)$ is increasing in r.*

Proof

Differentiating the first order condition (3.2) with respect to r yields:

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0)^2 u''(.) f(x_1/r) g(x_2) dx_1 dx_2 \frac{d\alpha_1^*}{dr}$$
$$+ \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0)(x_2 - x_0) u''(.) f(x_1/r) g(x_2) dx_1 dx_2 \frac{d\alpha_2^*}{dr}$$
$$+ \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) u'(.) f_r(x_1/r) g(x_2) dx_1 dx_2$$
$$= 0. \tag{3.6}$$

The second term in the above equation can be rewritten as:

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0)(x_2 - x_0) \frac{u''(.)}{u'(.)} u'(.) f(x_1/r) g(x_2) dx_1 dx_2. \tag{3.7}$$

By the assumption of constant relative risk aversion ($CRRA$) we have:

$$(x_2 - x_0) \frac{u''(.)}{u'(.)} = \frac{c}{\alpha_2^*} - \frac{\alpha_1^*}{\alpha_2^*} (x_1 - x_0) \frac{u''(.)}{u'(.)}. \tag{3.8}$$

Substituting (3.8) in (3.7), we get, after some simplifications:

$$\frac{c}{\alpha_2^*} \int_{\underline{x}_2}^{\overline{x}_2} \int_{\underline{x}_1}^{\overline{x}_1} (x_1 - x_0) u'(.) f(x_1/r) g(x_2) dx_1 dx_2$$
$$- \frac{\alpha_1^*}{\alpha_2^*} \int_{\underline{x}_2}^{\overline{x}_2} \int_{\underline{x}_1}^{\overline{x}_1} (x_1 - x_0)^2 u''(.) f(x_1/r) g(x_2) dx_1 dx_2. \tag{3.9}$$

The first term in (3.9) is nil by the first order condition associated to the choice of α_1.

The expression in (3.6) can now be written as:

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0)^2 u''(.) f(x_1/r) g(x_2) dx_1 dx_2 \left[\frac{d\alpha_1^*}{dr} - \frac{\alpha_1^*}{\alpha_2^*} \frac{d\alpha_2^*}{dr} \right]$$

84

$$+ \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) \, u^{'}(.) \, f_r(x_1/r) \, g(x_2) \, dx_1 dx_2$$

$$= 0. \tag{3.10}$$

Since

$$\frac{d \left(\frac{\alpha_2^*}{\alpha_1^*} \right)}{dr} = \frac{\alpha_1^* \frac{d\alpha_2^*}{dr} - \alpha_2^* \frac{d\alpha_1^*}{dr}}{(\alpha_1^*)^2},$$

then, by (3.10)

$$Sign \left(\frac{d \left(\frac{\alpha_2^*}{\alpha_1^*} \right)}{dr} \right) = -Sign \left(\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) \, u^{'}(.) \, f_r(x_1/r) \, g(x_2) \, dx_1 dx_2 \right).$$

Now we prove that

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) \, u^{'}(.) \, f_r(x_1/r) \, g(x_2) \, dx_1 dx_2 \leq 0$$

under $MLRP$.

In fact,

$$\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} (x_1 - x_0) \, u^{'}(.) \, f_r(x_1/r) \, g(x_2) \, dx_1 dx_2$$

$$= \int_{\underline{x}_1}^{\overline{x}_1} \left[(x_1 - x_0) \int_{\underline{x}_2}^{\overline{x}_2} u^{'}(.) \, g(x_2) \, dx_2 \right] f_r(x_1/r) \, dx_1$$

$$= \int_{\underline{x}_1}^{\overline{x}_1} K(x_1) \, f_r(x_1/r) \, dx_1, \tag{3.11}$$

where

$$K(x_1) = (x_1 - x_0) \int_{\underline{x}_2}^{\overline{x}_2} u^{'}(.) \, g(x_2) \, dx_2.$$

Note that $K(x_1) \begin{cases} \leq 0 & \forall x_1 \leq x_0 \\ \geq 0 & \forall x_1 \geq x_0. \end{cases}$

Let's define

$$k(u) = \frac{K(u) f(u/r)}{-\int_{x_0}^{\overline{x}_1} K(v) f(v/r) \, dv} \quad \text{for } u \in [\underline{x}_1, x_0].$$

By the first order condition (3.2) we have:

$$\int_{x_0}^{\overline{x}_1} K(x_1) f_r(x_1/r) \, dx_1 = -\int_{\underline{x}_1}^{x_0} K(x_1) f_r(x_1/r) \, dx_1 \geq 0,$$

which implies that

$$\int_{\underline{x}_1}^{x_0} k(u) \, du = 1 \text{ and } k(u) \geq 0 \text{ for } u \in [\underline{x}_1, x_0]. \tag{3.12}$$

Now using (3.12) we can write the last term in (3.10) as:

$$\int_{\underline{x}_1}^{x_0} k(u) \frac{f_r(u/r)}{f(u/r)} \left\{ -\int_{x_0}^{\overline{x}_1} K(v) f(v/r) \, dv \right\} du$$

$$+ \int_{x_0}^{\overline{x}_1} K(v) f(v/r) \frac{f_r(v/r)}{f(v/r)} \left\{ \int_{\underline{x}_1}^{x_0} k(u) \, du \right\} dv$$

$$= -\int_{\underline{x}_1}^{x_0} \int_{x_0}^{\overline{x}_1} k(u) K(v) f(v/r) \frac{f_r(u/r)}{f(u/r)} du dv$$

$$+ \int_{\underline{x}_1}^{x_0} \int_{x_0}^{\overline{x}_1} k(u) K(v) f(v/r) \frac{f_r(v/r)}{f(v/r)} du dv$$

$$= \int_{\underline{x}_1}^{x_0} \int_{x_0}^{\overline{x}_1} k(u) K(v) f(v/r) \left(\frac{f_r(v/r)}{f(v/r)} - \frac{f_r(u/r)}{f(u/r)} \right) du dv. \tag{3.13}$$

Since $k(u) \geq 0$, $K(v) \geq 0$ for $u \in [\underline{x}_1, x_0]$, $v \in [x_0, \overline{x}_1]$ and by $MLRP$ we also have

$$\frac{f_r(v/r)}{f(v/r)} \leq \frac{f_r(u/r)}{f(u/r)} \text{ for } (u, v) \in [\underline{x}_1, x_0] \times [x_0, \overline{x}_1].$$

The term in (3.13) is negative. Consequently, we have:

$$\frac{d\left(\frac{\alpha_2^*}{\alpha_1^*} \right)}{dr} \geq 0.$$

86

Proposition 12 shows that a FSD contraction that affects one asset will reduce the weight of this asset in the optimal fund. This FSD may reduce both α_1^* and α_2^* but the relative effect on α_1^* is more important. It should be notified that $\frac{\alpha_2^*}{\alpha_1^*}$ is increasing in r for all $u(\cdot)$ that are $CRRA$ and whatever the level of risk aversion. This means that the two-fund separation theorem holds for all r since $CRRA$ functions are in the class of utility functions that permit mutual-fund separation. The additional restriction on $MLRP$ is to yield a particular direction on the variation of the ratio $\frac{\alpha_2^*}{\alpha_1^*}$. Consequently, when the two-fund conditions hold, following a FSD shift, the investor must first evaluate the variations in the proportions of the risky asset and then decide how to divide his total wealth between risky and safe assets.

3.3 Conclusion

In this paper, we have shown that it is not appropriate to limit the adjustment of total wealth between the risky portfolio and the safe asset following a FSD shift in a return distribution, even when the two-fund separation theorem holds. The investor must first evaluate the effect of the shift on the relative proportions of the risky assets in the risky portfolio and then decide how to adjust his total investment between the safe asset and the adjusted risky portfolio. The same conclusions holds for mean preserving spreads (Dionne, Gagnon and Dachraoui, 1997). Another conclusion is that the separation of conditions on both utility functions and distribution functions does not hold to obtain intuitive variations in risky assets following a distribution shift. In other words, it is not possible to limit conditions either on $u(\cdot)$ or on $F(x/r)$ to obtain the desired results. This means that the separating conditions presented in the finance literature hold for the setting of the optimal portfolios but are not robust to the comparative statics following distributional shifts if we want to obtain intuitive results. We also reach interesting conclusions concerning the optimal portfolio, namely if one of the risky assets is actuarially fair then the necessary and sufficient condition for the agent to invest a positive amount

in the other risky asset is the same as the case of one risky asset-one riskless asset. The optimal portfolio also shows that a risk averse agent makes hedging when the two random returns are correlated.

Bibliography

[1] Cass, D. and J. Stiglitz, "The Structure of Investor Preferences and Asset Returns, and Separability in Portfolio Allocation: A Contribution to the Pure Theory of Mutual Funds," *Journal of Economic Theory* 2, 1970, pp. 122-60.

[2] Dionne, G., L. Eeckhoudt and C. Gollier, "Increases in Risk and Linear Payoffs," *International Economic Review* 34, 1993, pp. 309-19.

[3] Dionne, G., F. Gagnon and K. Dachraoui, "Increases in Risk and Optimal Portfolio," Working Paper, Risk Management Chair, HEC Montréal, 1997.

[4] Dionne, G. and C. Gollier, "A Model of Comparative Statics for Changes in Stochastic Returns with Dependent Risky Assets," *Journal of Risk and Uncertainty* 13, 1996, pp. 147-62.

[5] Eeckhoudt, L. and C. Gollier, "Demand for Risky Assets and the Monotone Probability Ratio Order," *Journal of Risk and Uncertainty* 11, 1995, pp. 113-22.

[6] Hadar, J. and T. K. Seo, "The Effects of Shifts in a Return Distribution on Optimal Portfolios," *International Economic Review* 31, 1990, pp. 721-36.

[7] Huang, C. and R. H. Litzenberger, *"Foundations of Financial Economics,"* North-Holland, N. Y. (New-York), 1988.

89

[8] Meyer, J. and M. B. Ormiston, "The Effect on Optimal Portfolios of Changing the Returns to a Risky Asset: The Case of Dependent Risky Returns," *International Economic Review* 35, 1994, pp. 603-12.

[9] Milgrom, P., "Good News and Bad News: Representation Theorems and Applications," *Bell Journal of Economics,* 1981, pp. 380-91.

[10] Mitchell, D. W. and S. M. Douglas, "Portfolio Response to a Shift in a Return Distribution: The Case of n-Dependent Assets," *International Economic Review* 38, 1997, pp. 945-50.

[11] Rothschild, M. and J. Stiglitz, "Increasing Risk: II. Its Economic Consequences," *Journal of Economic Theory* 3, 1971, pp. 66-84.

Appendix 3.1

Example 1 *Suppose that the utility function is quadratic or that the returns distribution is normal and the utility function is exponential. Define $\{F(x_1/x_2, ..., x_n, r)\}_r$ as a mean preserving spread, then conditions in (1) are verified and the composition of the two funds remains stable following a mean preserving spread.*

Let us start with the quadratic utility function.

We consider the last $n - 2$ first order conditions:

$$
\begin{cases}
\displaystyle\sum_{1}^{n-1} \alpha_j^*(.) \int \cdots \int (x_2 - x_n)(x_j - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n) \\
\qquad + \int \cdots \int x_n (x_2 - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n) = 0 \\
\\
\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\
\\
\displaystyle\sum_{1}^{n-1} \alpha_j^*(.) \int \cdots \int (x_{n-1} - x_n)(x_j - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n) \\
\qquad + \int \cdots \int x_n (x_{n-1} - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n) = 0.
\end{cases}
\tag{3.14}
$$

Since the increase in risk is a mean preserving spread then one can verify, under the *ceteris paribus* assumption[3], that

$$
\int \cdots \int (x_l - x_n)(x_1 - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n)
$$

is independent of r for all $l = 2, ..., n - 1$.

The same result applies for the terms

$$
\int \cdots \int x_n (x_j - x_n)\, dF(x_1/x_2, ..., x_n, r)\, dG(x_2, ..., x_n) \text{ for } j = 2, ..., n - 1
$$

---

[3]On the *ceteris paribus* assumption see Meyer and Ormiston [1994] and Dionne and Gollier [1996].

and

$$\int \cdots \int (x_l - x_n)(x_j - x_n)\, dF(x_1/x_2, \ldots, x_n, r)\, dG(x_2, \ldots, x_n) \text{ for } l, j = 2, \ldots, n-1.$$

We can write the system in (3.14) as:

$$\begin{cases} \sum_1^{n-1} a_j^2 \alpha_j^*(.) + a_n^2 = 0 \\[2em] \cdot \\ \cdot \\ \cdot \\[1em] \sum_1^{n-1} a_j^{n-1} \alpha_j^*(.) + a_n^{n-1} = 0. \end{cases}$$

The last system has $n-1$ parameters and $n-2$ equations that yield one degree of freedom. The solution of the above system can be written as:

$$\begin{cases} \alpha_2^*(.) = a_2 \alpha_1^*(.) + b_2 \\[2em] \cdot \\ \cdot \\ \cdot \\[1em] \alpha_{n-1}^*(.) = a_{n-1} \alpha_1^*(.) + b_{n-1}. \end{cases}$$

The most important fact here is that $a_2, \ldots, a_n, b_2, \ldots, b_n$ are independent of r.

Notice that if $b_j \geqslant 0$, for $j = 2, \ldots, n-1$, then we can extend the result of Meyer and Ormiston [1994] to the case of n-assets.

As an example we consider the case where $n = 3$. We find that:

$$\alpha_2^* = -\frac{\sigma_{33}^2 + (e_1 - e_3)(e_2 - e_3)}{(e_2 - e_3)^2 + \sigma_{22}^2 + \sigma_{33}^3}\alpha_1^* + \frac{\sigma_{33}^2 - e_3(e_2 - e_3)}{(e_2 - e_3)^2 + \sigma_{22}^2 + \sigma_{33}^3}, \tag{3.15}$$

92

where

$$e_i = E\left(\tilde{x}_i\right).$$
$$\sigma_{ii}^2 = var\left(\tilde{x}_i\right).$$

As we can see from (3.15), the second term on the right hand side is negative for a range of the parameters e_2, e_3 and σ_{33}^2. As a result, even if the problem with three assets can be reduced to a problem with only two assets, we need to restrict the support of the two assets to be always positive if one wants to extend directly the result of Meyer and Ormiston [1994].

When the utility function is exponential and the returns distribution is normal, we use the Stein's lemma to write the last $n-2$ first order conditions as:

$$cov\left(\alpha_1^*\left(\tilde{x}_1 - \tilde{x}_n\right) + ... + \alpha_{n-1}^*\left(\tilde{x}_{n-1} - \tilde{x}_n\right) + \tilde{x}_n, \tilde{x}_j - \tilde{x}_n\right)$$
$$= -\frac{E\left(u'\right)}{E\left(u''\right)} E\left(\tilde{x}_j - \tilde{x}_n\right), \text{ for } j = 2, ..., n-1. \tag{3.16}$$

Since u is exponential then $-\frac{E\left(u'\right)}{E\left(u''\right)}$ is a constant and hence independent of r, and, with the same argument as in the previous example, the term on the left hand side of (3.16) is independent of r. The rest of the proof is as for the quadratic utility function.

Discussion

In this thesis we presented two different applications of economic behavior under uncertainty. The first application concerned the information structure in the labor market. We argue that the lack of information from employers can make capital structure implement optimal labor contracts. The problem is that firms cannot commit themselves to the contracts signed ex ante unless a third party is involved in the game. This third party is an external investor who can force the liquidation of the firm in the case of a default in payment. In this situation long term contracts are observed and high ability workers go to firms where ability is more important. As a benchmark we considered the case where information is symmetric. We proved that *spot* contracts are more likely to be observed and separation, if it occurs, takes place only once the firm has updated her believes about workers' performance.

These predictions were tested and empirical evidences show the existence of costs associated to debt financing. Empirical findings also show that more levered firms offer a steeper tenure-earning profile and a lower starting wage.

In Chapters 1 and 2 we reach the following conclusions: *i*) a part of the heterogeneity in compensation policies across firms that was stressed by Abowd et *al.* [1994] can be explained by the difference in the way each firm is financed (equity vs debt financing), and *ii*) firms' capital structure explains the trade-off between starting compensation and wage growth. It seems then appropriate to think that even if we allow the same economic shock for all firms, each firm would respond differently according to its level of leverage. This idea was mentioned in Lamont [1994] who shows that *i*) expectations about the economic performance are crucial in investment decisions, and *ii*) more levered firms, in stagnant economies, are those who suffer the most, leading to a loss in investment decisions. This idea was also stressed in Farmer [1985] who shows that asymmetric information associated to the liquidity constraints caused by debt lead to a larger volatility in labor demand.

In Chapter 3 we looked at another application of economic agents behavior under uncertainty. This application is applied to a standard problem of portfolio choice when

a risk averse agent is looking to allocate his wealth optimally between a risk free asset and two risky assets. We were able to generalize some results in the theory of portfolio choice, namely, if one of the risky asset is actuarially fair, then a necessary and sufficient condition for the agent to invest a positive amount in the other risky asset is the same as in the case of one risky asset and one risk free asset. Since we consider two risky assets, it is straightforward to ask if there exists any kind of hedging in the optimal portfolio. The answer is yes since we prove that the optimal choice is dictated by the correlation between the random returns of the two risky assets and by the agent's risk aversion.

In this last chapter we also studied the comparative statics following a first order distributional shift. We were able to extend the result of Milgrom [1981] with our model. One application of this result is that even in situations where the two-mutual funds applies, following a FSD shift, an investor must first evaluate the variations in the proportions of the risky assets and then decide how to divide his total wealth between risky and safe assets.

Synthèse

Dans cette thèse nous avons présenté deux différentes applications de la théorie de comportement des agents économiques en présence d'incertitude. La première application concerne le marché de travail en présence d'asymétrie d'information sur les types des travailleurs. On a montré que la présence d'asymétrie d'information fait de la structure de capital un choix stratégique de la part des entreprises, et un choix approprié de niveau de dette peut s'avérer optimal puisqu'il permet aux entreprises de mettre en oeuvre les contrats de travail optimaux. Dans cette situation il est dans l'intérêt des entreprises et des travailleurs d'oeuvrer avec des contrats de long terme. Ces contrats de long terme ne peuvent être mis en oeuvre en l'absence de contrainte de liquidité, et la présence d'une troisième partie (investisseur externe) est indispensable puisqu'elle permet de forcer la liquidation de l'entreprise.

Cette étude vient s'ajouter à la théorie existante de choix de structure de capital en présence de problèmes d'agence. La contribution de la thèse va cependant plus loin que de montrer le simple rôle stratégique de la dette pour la mise en oeuvre des contrats de travail optimaux. En effet, on a montré que les contrats de salaire sont directement affectés par le niveau d'endettement des entreprises et que le niveau de spécificité de capital physique est un facteur important dans la détermination du niveau de dette et de la rémunération des travailleurs.

Les prédictions théoriques trouvées ont été testées sur des données françaises et on arrive à, i) identifier les coûts de la dette et les façon avec lesquelles ces coûts varient avec les différents attributs, et ii) montrer que les entreprises les plus endettées offrent des salaires plus faibles en première période et des rendement d'ancienneté plus élevés. Ceci suggère qu'une partie de l'hétérogénéité dans les politiques de compensations entre les entreprises peut être expliquée par des différences de choix de financement. Cette hétérogénéité dans les politiques de compensations a été montrée dans un travail empirique fait aussi sur des données françaises par Abowd, Kramarz et Margolis [1994].

Dans le dernier chapitre on a regardé une autre application du comportement des agents économiques en présence d'incertitude. Plus précisément, on a étudié le choix de portefeuilles optimaux en présence de deux actifs risqués et d'un actif sans risque. On arrive à montrer que ce choix est déterminé par l'aversion au risque qui implique une certaine prudence de la part de l'investisseur (Proposition 11). On est arrivé aussi à généraliser quelques résultats de choix de portefeuilles dans le cas d'un seul actif risqué. En effet, on a montré qu'un investisseur riscophobe investira un montant positif dans un actif risqué si et seulement si l'espérance de rendement de cet actif est supérieure à celle de l'actif sans risque, à condition que l'autre actif risqué offre une espérance de rendement égale à celle de l'actif sans risque. D'un autre coté on a étudié la statique comparée suite à une variation d'un paramètre de la distribution et on est arrivé à étendre le résultat de Milgrom [1981]. Une implication de ce résultat est que même dans les situations où le théorème de séparation à deux fonds mutuels est applicable, une variation du paramètre selon une dominance stochastique de premier ordre fait qu'un investisseur doit évaluer la variation dans le fond mutuel risqué avant de décider comment allouer sa richesse entre les deux fonds.