Three Essays about Inefficiencies in the Financial Industry

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ABSTRACT

This thesis studies three market inefficiencies that deter the financial industry.

The first one concerns the job market. Jobs in finance are highly paid. I show theoretically that the finance premium is due to inefficient hiring, in an industry with high returns to talent, or talent "scalability". Based on a unique compensation survey among French graduate engineers, and consistent with the model predictions, I find that the level of wages, skewness in the wage distribution, and returns to experience are high in finance compared with other industries. In addition, the finance premium level and evolution in recent decades can be largely attributed to a high elasticity of compensation to size, lead by talent scalability.

In the second paper, I analyze the equilibrium debt structure of small firms when competition between lenders is non exclusive. Lenders simultaneously offer loan contracts, the borrower can accept more than one of them, and the set of contracts that is accepted is not observed. Two categories of lenders compete: banks that monitor their borrowers, and uninformed lenders. The monitoring technology alleviates the moral hazard problem but induces a fixed cost. I find that poorly-capitalized firms are only offered expensive loans by uninformed lenders. The fraction of the loan offered by the lead bank, the interest rate that is charged, and the sum of lenders' profits decrease with the borrower's initial wealth.

The third paper focuses on the market of retail financial products and show how low financial literacy is exploited by banks to escape competition. Using an academically unexploited database that gathers detailed information on all the retail structured products sold on the European market since 1996, we first develop three complementary measures of product complexity. They both exhibit an increasing trend over time. We then argue that complexity is used as a differentiating tool by banks to inflate investor expectations and limit competition. Evidence of strategic structuring and higher complexity in the most competitive markets empirically comforts this hypothesis.

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To Thibaut.

The Finance Compensation Premium: A Talent Scalability Explanation

Claire Célérier *

Abstract

Jobs in finance are highly paid. Based on a unique compensation survey among French graduate engineers, I show that the finance premium is driven by returns to talent, or talent "scalability". To structure the empirical analysis, I first develop a model of the labor market in which firms compete for industry-specific and scalable talent. Publicly observable output induces inefficient hiring and rents. Consistent with the model predictions, I find that the level of wages, skewness in the wage distribution, and returns to experience are high in finance compared with other industries. The finance premium level and evolution in recent decades can be largely attributed to a high elasticity of compensation to size, lead by talent scalability.

Keywords: Finance, compensation, wage distribution, wage structure, incentives, superstars

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1 Introduction

Since the beginning of the 1980s, compensation in the financial sector has been high compared to other sectors. Philippon and Reshef (2009), controlling for education and other characteristics, find that wages in 2006 are 40% higher in finance than in other industries. The recent financial crisis has stirred up the controversy on bankers' pay, and politicians of all stripes have reacted. But the initial question remains: why is compensation in the financial sector so high? To answer the question I use a unique data set on French graduate engineers, which includes the ones working abroad. Since the latter represent a strong share of The City and Wall Street jobs, it allows to draw new results on the finance compensation premium.

To structure the empirical analysis, this paper develops a model in which firm competition for industry-specific talent leads to rents. Unlike standard superstar models (Rosen (1981)), talent is not initially visible. Scarcity arises because only incumbent workers have revealed industry-specific talent (Terviö (2009)). There is ample evidence that firms compete for industry-specific talent in the financial sector. Kostovetsky (2009) shows that the brain drain to hedge funds has led to a higher managerial turnover in the mutual fund industries. Clarke et al. (2007) examine what happens when "*all-star*" analysts move from one investment bank to another. They find that it affects positively the relative market share of the new investment bank for equity underwriting.

In this model, once revealed, talent is publicly observable and portable across firms, and so workers capture all the benefits from the talent discovery process. Talent consists in any specific assets workers can bring with them while moving to another firm within the industry. It can range from technical knowledge to address books and fame. Firms could use two contract features to limit workers' rents: either by making them pay for the job ex ante, or commit to long-term wage contracts. However, financial constraints limit novice workers ability to pay for entering the industry, and the inalienability of human capital implies that long-term wage contracts are not enforceable.

The main assumption of the model is that talent is scalable, which leads to this key result: as talent scalability increases, worker rents increase whereas, somewhat surprisingly, the average talent in the industry decreases. Talent scalability measures the potential of resources and profits to grow with talent. For example, it is maximum in the markets of novel writers or programmers, and low in physically bounded industries in which the level of physical capital is high like the oil one. Discovering a worker's talent is similar to general skill training. It can increase the market value of the worker, but requires an upfront investment consisting in bearing the risk of hiring a novice of lower talent. As talent scalability increases, this opportunity cost increases. Consequently, firms "under-invest", and the talent of the marginal worker in the industry decreases.

Based on a 1983-2010 survey among French graduate engineers, I test the empirical predictions of the model. This survey gathers several unique specificities. First, it focuses on the French educational elite, which is a great opportunity for the identification strategy since the finance premium mainly concerns the top of the wage distribution (Kaplan and Rauh (2009)). Moreover, the French educational system provides a large influx of bankers to The City of London and Wall Street, and individuals working abroad also are included in the data. Second, the survey covers 27 years, from 1983 to 2010, which allows to analyze the emergence of the finance premium (Philippon and Reshef (2009)). Finally, information concerning careers and compensation is very detailed. There is unique information on the amount and structure of compensation, current job and career history, and on the amount of budget and profit and losses per employee.

The first prediction of the model concerns the compensation distribution: as talent scalability increases, level and skewness increase. Controlling for a large set of individual characteristics, I find that finance is the sector in which French graduate engineers are better paid, with a premium of 33% on average from 2005 to 2007. In addition, the compensation distribution is right-skewed. The top 1% of the wage distribution captures 8.5% of the total wage pool, against 3.3% in the rest of the economy. This result is confirmed by a quantile regression: the premium in the top decile is 7 times as high as in the bottom decile of the distribution.

The second set of empirical predictions regards career steepness. Since industry-specific talent is only revealed on the job, earning profile steepness and dispersion increase in talent scalability. Estimating a standard wage equation across sub-samples ranked by years of experience, I find that indeed both the compensation premium and variance increase over years of experience. In a time-series analysis, a Blinder-Oaxaca decomposition shows that nearly half of the premium increase since the 1980s can be related to high returns to experience.

Finally, the model relates compensation to size effects: the compensation premium should be coupled with a high elasticity to size. In the 2010 survey, interviewees are asked the budget they are in charge of. In a cross-sectional analysis, I show that compensation elasticity to size is higher in finance than in other industries. Controlling for this interaction makes the financial sector premium largely disappear. In a time series analysis, the rise in finance compensation since the 1980s can be explained by a fourfold increase in market capitalization per employee of financial institutions.

The recent empirical literature on compensation in the financial sector has mainly focused on two main facts. A first one is the level of compensation relatively to the rest of the economy. Philippon and Reshef (2009) based on data from the Census Population

Survey, Oyer (2008) from a Stanford MBAs survey, and Goldin and Katz (2008) from a Harvard alumni compensation survey, find that there is a finance premium from 40% in Philippon and Reshef (2009) up to more than 100% in Oyer (2008) and Goldin and Katz (2008). The second fact is the increase in relative compensation since the early 1980s. Philippon and Reshef (2009) describe how, since the 1980s, compensation in finance has increased compared to the rest of the private sector. On the other hand, Kaplan and Rauh (2009) for US, Bell and Van Reenen (2010) for UK and Godechot (2011) for France show that the share of the financial sector in top end brackets of the income distribution has significantly increased. I also find an increasing wage premium in the financial industry since the 1980s, and the main contribution of this paper is to justify it.

This paper reconciles various empirical finding related to the finance premium. Oyer (2008) shows that the premium cannot be due to unobserved innate talent. It would more likely be driven by finance specific skills. Kaplan and Rauh (2009) consider that scale effects may have induced the increasing share of Wall Street workers in the top end brackets of the wage distribution they observe. Finally, Philippon and Reshef (2009) find that even if financial deregulation and complexity has increased the demand for high skilled-paid employees, there is no reason why, in a world with perfect mobility across jobs, it should lead to a large excess wage at equilibrium. They observe that steeper and riskier lifetime wages would more plausibly explain a large part of the premium. This paper shows that competition for finance-specific skills combined with scale effects generate both rents and steep wage profiles.

Competing theories on the finance premium can be grouped into two categories. Agency theory models stipulate that moral hazard would be more severe in the finance industry. In Biais et al. (2009), increasing confidence in financial innovations would deter employees willingness to exert effort and raise incentive costs. Axelson and Bond (2009) develops a dynamic model in which the cost to the employer of the employee failure is higher in the financial industry. The use of dynamic incentive devices explains why workers receive rents, enter young in the financial industry, work hard in the beginning of their career, and are fired in case of failure. But it cannot account for the skewness in the wage distribution and size effects. On the other hand, compensating wage differential models consider that the finance premium may pay for hard working conditions or a higher job insecurity. However, unemployment risk in France is lower in the financial sector than in the rest of the economy. Moreover, based on the compensation survey, I find that workers are not less satisfied by working conditions in the financial sector than elsewhere.

The paper proceeds as follows. In the following section I develop a competitive model for industry specific talent with adjustable capital. Section 3 describes the data. Section 4 tests the empirical implications. Section 5 discusses other potential theories for finance the premium. Finally, Section 6 concludes.

2 Model

The model analyzes the labor market outcome when firms compete for industry-specific talent. It describes how talent scalability affects the talent discovery process and rents. It develops implications on the wage distribution, earning profile steepness and size effects. Its predictions will guide my empirical analysis of compensation in the financial sector.

2.1 Set-up

Consider an industry with a continuum of firms of mass 1, equal to the industry workforce. Firms produce output by combining one worker with talent θ and adjustable capital k. The supply of potential workers is infinite, they cannot commit to long-term contracts, and they face an outside wage ω. Talent θ is drawn from a cumulative distribution function T with positive support $[\theta_{min}; \theta_{max}]$. Both workers and firms are risk neutral and there is no discounting.

Workers may work two periods in the industry, a *novice* period and a *veteran* period, and then they cease to be productive. Before the novice period, the worker's talent is unknown to all market participants, including to himself, and has an expected value $\hat{\theta}$. The market wage w_0 of a novice worker is restricted to be non-negative. After the novice period, the worker's talent θ is revealed, publicly observable and portable across firms within the industry. The worker receives a wage offer $w(\theta)$. Then he can decide either to stay in the industry, and earn $w(\theta)$, or to exit the industry and earn the outside wage ω. Let $\underline{\theta}$ denote the talent threshold above which the veteran worker stays in the industry.

Firms are infinitely lived and maximize expected profits. Once matched to a firm, the output of a worker with talent θ is

$$y_s(k, \theta) = f(k)s\theta$$

where $f(k)$ is an increasing and concave function and $s > 0$ quantifies the industry talent scalability. The unitary cost of capital is one. Taken the worker's talent as given, firms adjust capital k_θ to maximize profits:

$$k_\theta = \arg\max_k \{f(k)s\theta - k\}$$

This implies

$$f'(k_\theta) = \frac{1}{s\theta} \tag{1}$$

Note that adjustable capital k_θ increases and is convex both in talent and in talent scalability. Let $\Phi_s(\theta)$ denote the surplus produced by a worker of talent θ, $\Phi_s(\theta) = \max_k \{f(k_\theta)s\theta - k_\theta\}$. Firms' profits are given by

$$\Pi_s(\theta) = \Phi_s(\theta) - w_s(\theta)$$

2.2 Equilibrium

Market equilibrium is defined by the exit threshold $\underline{\theta}$. I first deduce equilibrium wages for a given threshold $\underline{\theta}$, then I derive the equilibrium value of $\underline{\theta}$.

The equilibrium wage of a veteran results from firm competition for talent, since talent is observable and workers cannot commit to long term wage contracts. Firms must be indifferent between hiring the threshold type $\underline{\theta}$ and any veteran with talent θ in the industry, implying

$$\Pi_s(\theta) = \Pi_s(\underline{\theta})$$

The level of wage for a veteran of talent θ satisfies

$$\Phi_s(\theta) - w_s(\theta) = \Phi_s(\underline{\theta}) - w_s(\underline{\theta}) \tag{2}$$

By definition, the threshold type is indifferent between exiting or not the industry and therefore is paid exactly the outside wage

$$w_s(\underline{\theta}) = \omega \tag{3}$$

Introducing (3) in (2), the veteran's wage $w_s(\theta)$ verifies

$$w_s(\theta) = \omega + \Phi_s(\theta) - \Phi_s(\underline{\theta}) \tag{4}$$

The wage of a veteran worker of talent θ is the sum of the outside wage ω and the surplus generated with his talent vis-à-vis the threshold veteran.

The equilibrium wage of a novice is determined by the potential talent rents in the veteran period. Let the function $G_s(\underline{\theta})$ denote the expected surplus of a novice worker for a given exit threshold $\underline{\theta}$. This is the sum of the net wage in the novice period $w_0 - \omega$, and the veteran talent rents: with threshold $\underline{\theta}$, a novice has a probability $1 - T(\underline{\theta})$ of staying in the industry, in which case he gets the revenue $E[w_\theta | \theta \geq \underline{\theta}] - \omega$ as a talent rent.

$$G_s(\underline{\theta}) = \underbrace{w_0 - \omega}_{\text{Net wage in the novice period}} + \underbrace{\Big(1 - T(\underline{\theta})\Big)\Big(E[w_s(\theta)|\theta \geq \underline{\theta}] - \omega\Big)}_{\text{Potential wage premium in the veteran period}} \tag{5}$$

I make the following assumption on the distribution of talent θ that guarantees that the credit constraint is binding (i.e. $w_0 = 0$). I first introduce the threshold value $\underline{\theta}^*$ such that

$$\Phi_s(\underline{\theta}^*) - \Phi_s(\hat{\theta}) = \Big(1 - T(\underline{\theta}^*)\Big)\Big(E[\Phi_s(\theta)|\theta \geq \underline{\theta}^*] - \Phi_s(\underline{\theta}^*)\Big) \tag{6}$$

Lemma 1 *$\underline{\theta}^*$ exists, is unique and in the interval $[\hat{\theta}; \theta_{max}]$.*

Proof. The left-hand side of (6) is strictly increasing in $\underline{\theta}$, with a slope equal to $f(k)s$, whereas the right-hand side is decreasing, with a slope equal to $-(1 - T(\theta))f(k)s$. The left-hand side is equal to zero at $\underline{\theta}^* = \hat{\theta}$ while the right hand side is equal to $E[\Phi_s(\theta)] - \Phi_s(\theta_{min}) > 0$ at $\underline{\theta} = \theta_{min}$ and reaches 0 at $\underline{\theta} = \theta_{max}$. Thus there is a unique solution to (6) in the interval $[\hat{\theta}; \theta_{max}]$. ■

Assumption 1 *The distribution of talent θ satisfies*

$$G_s(\underline{\theta}^*) > 0 \Leftrightarrow$$

$$\Big(1 - T(\underline{\theta}^*)\Big)\Big(E[\Phi_s(\theta)|\theta \geq \underline{\theta}^*] - \Phi_s(\underline{\theta}^*)\Big) > \omega \tag{7}$$

Assumption 1 implies that for any for any $\underline{\theta}$ in $[\hat{\theta}; \underline{\theta}^*]$, the novice surplus $G_s(\underline{\theta})$ is strictly higher than zero. Indeed, $G_s(\underline{\theta})$, with a slope equal to $-(1 - T(\theta))f(k)s$, is decreasing over the interval $[\hat{\theta}; \underline{\theta}^*]$. Therefore, novices are always paid the minimum initial wage $w_0 = 0$. They cannot get more, because they are not scarce, and they cannot get less, by assumption.

In equilibrium, firms must be indifferent between employing a threshold type and a novice. Indeed, the inability to commit to long-term wage contracts causes them to ignore the upside potential of a worker, and base their hiring decision on expected talent alone. Hence, $\underline{\theta}$ solves

$$\underbrace{\Phi_s(\hat{\theta})}_{\text{Expected profit from hiring a novice}} = \underbrace{\Phi_s(\underline{\theta}) - \omega}_{\text{Profit from hiring the threshold veteran}}$$

Proposition 1 *If Assumption 1 is satisfied, the equilibrium exit threshold $\underline{\theta}$ exists, is unique, above the population mean and is* ***decreasing in talent scalability*** *s.*

Proof. I define the function $F_s(\theta) = \Phi_s(\theta) - \Phi_s(\hat{\theta})$. F is an increasing function of θ. Indeed

$$\frac{\partial F}{\partial \theta} = \frac{\partial f}{\partial k_\theta}\frac{\partial k_\theta}{\partial \theta}\theta s + f(k_\theta)s - \frac{\partial k_\theta}{\partial \theta}$$

Introducing (1) and simplifying

$$\frac{\partial F}{\partial \theta} = f(k_\theta)s$$

F is continuous and increasing over the interval $[\hat{\theta};\underline{\theta}^*]$, $F(\hat{\theta}) = 0$ and Assumption 1 implies that $F(\underline{\theta}^*) > \omega$. Therefore, by the intermediate value theorem, there exists a unique $\underline{\theta}$ in the interval $[\hat{\theta};\underline{\theta}^*]$ for which $F_s(\underline{\theta}) = \omega$.

I demonstrate now that $\underline{\theta}$ is a decreasing function of talent scalability s. The function F is an increasing function of s. Indeed

$$\frac{\partial F}{\partial s} = \frac{\partial f}{\partial k_\theta}\frac{\partial k_\theta}{\partial s}\theta s + f(k_\theta)\theta - \frac{\partial k_\theta}{\partial s}$$

Introducing (1) and simplifying

$$\frac{\partial F}{\partial s} = f(k_\theta)\theta$$

Consequently, as s increases, $\underline{\theta}$ decreases.

■

2.3 Testable Predictions

The model makes the following predictions when talent scalability varies.

2.3.1 Wage Distribution Prediction

Workers' limited ability to pay for entering the industry leads to lifetime rents that are increasing in talent scalability. On the one hand, as talent scalability increases, the surplus produced by a veteran worker relatively to the threshold veteran increases, and so wages increase for all levels of talent in the industry. The talent of the threshold veteran, on the other hand, decreases, and so veterans capture a higher fraction of the production surplus. Consequently, skewness in the wage distribution also increases.

Proposition 2 *As talent scalability s increases, wages increase for all levels of talent in the industry, with the highest wage increasing the most. The skewness of the wage distribution increases.*

Proof. Using (5), note that

$$\begin{aligned}\frac{\partial w_s(\theta|\underline{\theta})}{\partial s} &= \frac{\partial \Phi_s(\theta,k)}{\partial s} - \frac{\partial \Phi_s(\underline{\theta},k)}{\partial s} - \frac{\partial \Phi_s(\underline{\theta},k)}{\partial \underline{\theta}}\frac{\underline{\theta}}{\partial s} \\ &= f(k)\theta - f(k)\underline{\theta} - \frac{\underline{\theta}}{\partial s}f(k)s \\ &= f(k)(\theta - \underline{\theta}) - \frac{\underline{\theta}}{\partial s}f(k)s\end{aligned}$$

Proposition 1 implies $\frac{\underline{\theta}}{\partial s} \leq 0$, therefore $\frac{\partial w_s(\theta|\underline{\theta})}{\partial s} \geq 0$: wages are increasing in talent scalability s. In addition $\frac{\partial w_s(\theta|\underline{\theta})}{\partial \theta \partial s} = f(k) \geq 0$, and so highest wages are increasing the most.

■

Empirical Evidence The existence of a wage premium in the finance industry has been well documented in the literature. Philippon and Reshef (2009) use data of the Census Population Survey (CPS) and finds that wages in 2006 are about 40% higher in finance than in the rest of the economy. Oyer (2008), based on a Stanford MBAs survey, and Goldin and Katz (2008) using data 2005 earnings from a survey among Harvard alumni, find that this premium goes beyond 100%. On the other hand, three papers in the literature provide some pieces of evidence on the skewness of the wage distribution. Kaplan and Rauh (2009) finds that, in the U.S., Wall Street individuals comprise a higher percentage of the top income brackets than non-financial executives of public companies. Godechot (2011), based on very detailed data on the private sector in France, finds that in 2008, the share of the financial sector in the top 0.1% of the income distribution is 10 times higher than in the rest of the population. Bell and Van Reenen (2010), with U.K. data, show that the dispersion in the top 1% wages within finance is higher than in the other sectors. This paper shows that the increasing premium in the financial industry since the 1980s has come along with an increasing variance in wages.

2.3.2 Career Dynamics Prediction

Wage level and variance increase with experience. Indeed, since novices' talent is unknown, the latter are ex-ante identical and receive the same starting wage w_0. After having worked one period in the industry, talent is revealed and firms competition for veterans induce wage heterogeneity. This career steepness in the wage profile increases in talent scalability.

The model also makes predictions on the industry turnover, measured by the fraction $i_{\underline{\theta}}$ of novices in the industry. Each period, a fraction $T(\underline{\theta})$ of novices reveals a talent lower than the threshold and exits the industry, and the population of veterans $(1 - i_{\underline{\theta}})$ retires. In equilibrium, this flow of exit must equal the flow of novices entering the industry, implying

$$i_{\underline{\theta}} T(\underline{\theta}) + 1 - i_{\underline{\theta}} = i_{\underline{\theta}} \Rightarrow$$

$$i_{\underline{\theta}} = \frac{1}{2 - T(\underline{\theta})} \tag{8}$$

Proposition 3 *As talent scalability s increases, earning profile steepness and dispersion increase. Turnover in and out the industry is decreased and careers become longer on average.*

Proof. The effects of s on wage profiles comes directly from Proposition 2. Indeed, career steepness can be measured by $w(\theta|\underline{\theta}) - w_0$. In addition, we have

$$\frac{\partial i_{\underline{\theta}}}{\partial s} = \frac{T'(\underline{\theta})}{(2 - T(\underline{\theta}))^2} \frac{\partial \underline{\theta}}{\partial s}$$

Therefore, $\frac{\partial i_{\underline{\theta}}}{\partial s} \leq 0$. ■

Empirical Evidence Philippon and Reshef (2009) find that wage profiles are 2.5% steeper and 8% more dispersed for male workers with less than five years of experience in finance. In addition, they find that earning profiles have become relatively steeper since the 1990s. Concerning the industry turnover, Oyer (2008) shows that careers are persistent in the financial industry. Using the return on the S&P 500 as an instrument, he finds that the probability that a person who starts his career in investment banking will work there in a later year is about 50% higher than someone who starts elsewhere. This paper provides new empirical evidence on career earning profile in the financial industry.

2.3.3 Size Prediction

Firms, taking the worker's talent and compensation as given, adjust capital to maximize profits. In the spirit of Rosen, adjustable capital increases and is convex in talent. In addition, differences in adjustable capital should partly explain differences in compensation. Indeed, a veteran wage is the sum of the outside option and the output surplus he produces relatively to the threshold worker, which increases with adjustable capital. The correlation between wages and size should increase in talent scalability.

Proposition 4 *As talent scalability s increases, the correlation between wages and adjustable capital increases.*

Empirical Evidence A natural proxy for size is the market value per employee at the firm level. Starting with Roberts (1956), many empirical studies (e.g. recently Terviö (2009), Gabaix and Landier (2008)) have documented that CEO compensation increases with firm size. This paper extends these analytics to another market than the one of CEOs and provides a new potential explanation for inter-industry wage differentials.

2.4 The Social Planner's Solution

The social planner maximizes social surplus $S(\underline{\theta})$ by choosing the exit threshold $\underline{\theta}$ maximizing total profits minus the opportunity cost of production. Total profits consists in the sum of profits generated by first, novices, second, veterans. Let $i_{\underline{\theta}}$ denote the fraction of novices in the industry

$$S(\underline{\theta}) = \underbrace{i_{\underline{\theta}}(\Phi(\hat{\theta}) - \omega)}_{\text{Novice Group Surplus}} + \underbrace{(1 - i_{\underline{\theta}})E[\Phi(\theta) - \omega|\theta \geq \underline{\theta}]}_{\text{Veteran Group Surplus}} \tag{9}$$

Introducing (8) and differentiating (9) (detailed computations are in Appendix A), the first order condition is

$$\Phi(\underline{\theta}^*) - \Phi(\hat{\theta}) = (1 - T(\underline{\theta}^*))(E[\Phi_s(\theta)|\theta \geq \underline{\theta}^*] - \Phi_s(\underline{\theta}^*)) \tag{10}$$

The immediate loss in expected output from hiring a novice instead of an optimal threshold veteran equals the expected future gains, assuming that the same rehiring threshold is still used in the future.

Proposition 5 *The optimal exit threshold exists, is unique, above the population mean and above the equilibrium threshold.*

Proof. The left-hand side of (10) is strictly increasing in $\underline{\theta}$, with a slope equal to $f(k)s$, whereas the right-hand side is decreasing, with a slope equal to $-(1-T(\theta))f(k)s$. The left-hand side is equal to zero at $\underline{\theta}^* = \hat{\theta}$ while the right hand side is equal to $E[\Phi_s(\theta)] - \Phi_s(\theta_{min}) > 0$ at $\underline{\theta} = \theta_{min}$ and reaches 0 at $\underline{\theta} = \theta_{max}$. Thus there is a unique solution to (10) in the interval $[\hat{\theta}; \theta_{max}]$. Proposition 1 implies that $\underline{\theta}$ is in the interval $[\hat{\theta}; \underline{\theta}^*]$. ■

The competitive equilibrium threshold, when workers are financially constrained, is lower than the optimal one. Consequently, some veteran workers who should not be working in the industry do not exit once their talent is revealed. This causes first, a net welfare loss since the level of production is lower than expected, and second, excessive rents.

3 Data

The data[1] are based on a mailed survey among French graduate engineers lead by the French Engineer and Scientist Council (IESF[2] - Conseil National des Ingénieurs et des Scientifiques de France). The IESF is a federation of 160 alumni organizations of French engineer schools. The timespan between surveys has decreased from five years from 1983 to 1986, to one year from 2004 onwards. Until 2000 the survey is postal, in 2002 the survey is both postal and e-mailed and from 2004 on, the survey is only e-mailed. Each participating alumni organization sends the survey to engineers they have personal information on. Since respondents are not identified over time, these are cross-sectional data. On average, the sample stands for nearly 6% of the total population of French engineers and the response rate amounts to 10%. Table 1 provides summary statistics.

Table 1
Summary Statistics for the French Graduate Engineer Dataset
S1980 = Graduates from the 1983, 1986 and 1989 surveys; S1990 = 1992, 1995, 1998 surveys; S2000 = 2000, 2004, 2005, 2006, 2007, 2008, 2010 surveys. Compensation is in 2005 constant euros.

Variables	**S1980**	**S1990**	**S2000**
Education			
Percent graduated from top 1 engineer school	1.5	3	1.7
Percent graduated from top 10 engineer schools	20.6	24.9	10.6
Percent with a business degree	8.7	8.3	14
Demographics			
Mean age	38.4	38.7	34.8
Percent Female	6.4	11	15.7
Percent Married	77.6	74.2	75.6
Work place			
Percent working abroad	2.8	4.7	12.1
Percent working in Paris area	46.6	42.4	39.4
Career			
Mean experience	14.6	14.3	11.6
Percent team manager	32.3	26.9	20.6
Percent department head	15.4	19.2	17.3
Percent top executive	6.5	9.9	7.4
Compensation			
Mean yearly gross wage	62,858	63,585	57,807
90th centile	101,376	103,698	96,516
99th centile	155,454	175,603	190,414
Industry			
Percent in finance	1.8	1.8	2.3
Percent in the oil sector	0	3	2.5
Percent in consulting	3.1	1.8	0.5
Number of Observations	64,396	55,976	172,537

[1]Data are available from The Réseau Quetelet, which provides researchers with French Data in social sciences, http://www.reseau-quetelet.cnrs.fr

[2]http://www.cnisf.org/

The survey has many unique specificities. First, it provides unique wage data on the French educational elite. [3] Second, French engineers working abroad are included, and so individuals working in The City of London or Manhattan Financial District can be observed. Third, information is very detailed. It can be classified into six groups: personal data, job description, compensation level and structure, firm description, satisfaction, job history. See Appendix C for the year 2000 survey (in French) and Appendix B for more summary statistics on the data.

Respondents are volunteer, half of alumni organizations have taken part in the survey [4], and the survey is sent only to alumni whose name and address they have. However, I find evidence that the selection bias is restricted. On the one hand, when I compare the median gross wage including bonuses in the 2009 survey[5] with the one computed for the same population in a Towers Perrin survey [6], I find no significant difference. On the other hand, I analyze the population of engineers in the 2003 French Employment Survey, for which the sample is randomly selected, to the population of respondents in the 2003 and 2005 IESF surveys. The sample composition is close, except that engineers in the IESF survey are younger.

I observe the yearly gross wage for employees aged more than 20 but less than 65 and in activity. It includes variable compensation in the form of bonuses, but not stock options. Interviewees provide exactly the gross salary declared on the tax declaration, which limits the risk of measurement error. Because there is no information on hours worked, a hourly wage cannot be computed. However, people declare if they work full time or not, and if not, they provide the percentage of a full time job their part time job corresponds to. Hence there are two possibilities: Either to reconstruct full time compensation, or to only work on data concerning full time jobs. To limit measurement errors, the choice made was to work only on full time employees. Hence, 10.8% of the observations are excluded. I also exclude data that do not concern employees (unemployed or inactive), and of workers of less than 1 year of experience. Finally, for each year I stream data in the following way. First, I keep observations with compensation higher than the legal minimum wage. Second, for each sector I drop compensation in the top 1% of the distribution. All nominal quantities are converted into constant 2005euros, using the French National Price Index

[3] If I compare it with the French Employment Survey, from the year 2003 to 2005 there are on average only 3,400 individuals a year graduated from a French engineer school in the French Employment Survey, against 25,000 engineers in the IESF survey, among which 10 on average work in the financial sector, against more than 800 in the IESF survey.

[4] In 2008, whereas 220 schools provided an engineer degree, only 112 alumni organizations participated

[5] I consider engineers working in the private sector, in companies with more than 2000 employees (more likely to be surveyed by Towers Perrin) and with three years of experience

[6] Towers Perrin is a leading compensation consulting company. This survey is conducted among 79 French and foreign companies that have hired on average 500 French newly graduated in 2009.

(IPCN) from INSEE [7].

Based on the official industry classification code provided by the respondents, I define 48 industries. This classification code is either the 2008 five-digit, the 2003 and 1993 four-digit NAF codes and the 1973 NAP codes, depending on the year of the survey. It is equivalent to the U.S. four digit SIC code. The objective is to have a manageable number of industries that cover most of engineer activities. Sectors are described in Appendix A. For engineers working abroad, if the official classification code is not provided, I use the sector they declare working in.

4 Empirical Evidence

The objective of this section is to evaluate empirically the three predictions of the model. The first one relates the finance premium to wage dispersion, the second one to steepness and increased variance in the wage profile and finally, the third one to size effects. Each prediction is first tested in a cross-sectional analysis over the 2005-2010 sample, then in a time-series analysis over the 1983-2010 sample. The finance premium and evolution since the 1980s can be explained by talent scalability.

4.1 Cross-sectional Evidence: 2005-2010

4.1.1 The Finance Premium

Based on the IESF compensation survey, I first show that finance is the sector in which French graduate engineers are better paid. I estimate the following wage equation over the period 2005-2010:

$$w_{i,t} = X_{i,t}\beta + I_{i,t}\gamma + D_t\alpha + \epsilon_{i,t} \tag{11}$$

where $w_{i,t}$ is the log yearly gross wage, $X_{i,t}$ is a vector of individual characteristics, $I_{i,t}$ stands for the vector of industry dummies, and D_t for the vector of year dummies. $\epsilon_{i,t}$ is the error term. Each industry has a dummy variable and I impose that the sum of all the industry dummy coefficients is zero. Hence, the coefficient is the deviation from the weighted mean of wages in other sectors.

The control variables include eight education dummies among which six are indicators of the ranking of the engineer schools. The two other education dummies refer to double degrees in science, and in management. Demographic controls include years of experience, experience squared, experience cubed, sex, marital status and sex $\times$ marital status. I control for occupation with nine dummies standing for production, logistics, develop-

[7] Data are available at http://www.imf.org/external/datamapper/index.php

ment, IT, commercialization, administration, executive, education and else. There are five different dummies for firm type: individual firm, private sector, public firm, public administration and others (non-governmental organization etc.), and four dummies for firm size: less than 20 employees, from 20 to 500, from 500 to 2000, more than 2000. Job characteristics are represented by a working in "Ile de France" dummy (Paris area), a working abroad dummy (together with seven country dummies for the US, UK, Germany, Switzerland, Luxembourg, China and Belgium from 2004 on) and four hierarchical responsibility dummies, from no hierarchical responsibility to chief executive.

Results are displayed in Table B.1. Finance is the industry in which French graduate engineers are better paid, with a premium that amounts to 30%. This premium is considerable: it is more than twice as high as the premium in the second highest-wage industry, the oil one. However, it is lower than in Philippon and Reshef (2009). This difference can be explained by, on the one hand, the homogeneity of the sample - all employees are graduated engineers - on the other hand, the high explanatory power of the controls, confirmed by a R-square of 72%.

4.1.2 Skewness of the Wage Distribution

Proposition 2 in the model implies that a high talent scalability leads to skewness in the wage distribution. To test this prediction, I first draw the Lorenz curves for wages first in finance, second in the rest of the economy. Figure 4.1.2 shows that the distribution of wages is positively skewed in the financial sector, much more than in the rest of the economy. I find that the top 1% of the wage distribution in the financial sector captures 8.5% of the total wage bill against 3.8% in the rest of the economy.

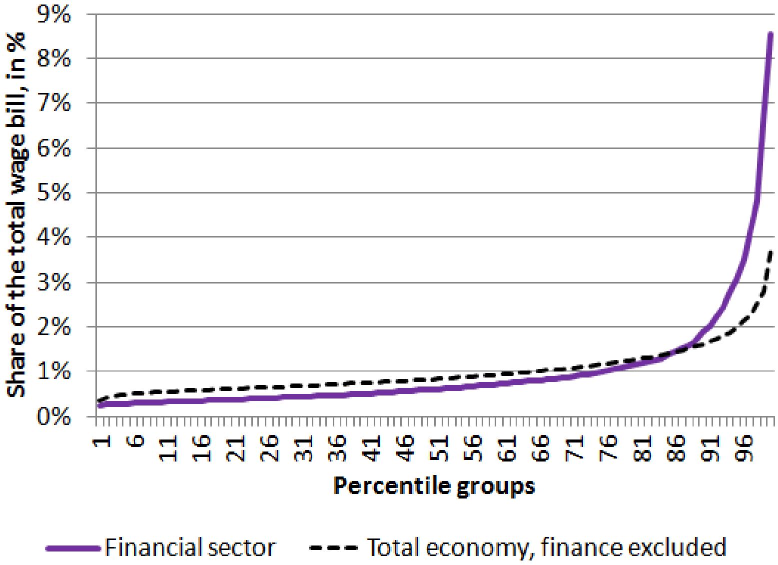

Figure 1
Distribution of the Total Wage Bill by Percentiles of the Wage Distribution in the Financial Sector

Data are from the 2005, 2006, 2007, 2008 and 2010 surveys. There is a total of 92,403 observations with 3,154 observations in the financial sector. Observations within the financial sector are sorted by wages and divided into 100 groups of equal size. The total wage bill is the sum of compensation within the financial sector. The share of the total wage bill is the sum of all wages within each group divided by the total wage bill.

The skewness in the distribution of wages in the financial sector can not be explained by workers' observable characteristics. Indeed, I estimate equation (11) over the same sample and examine the distribution of residuals for each sector. With a standard deviation of residuals and a skewness statistics of respectively 0.56 and 1.6 against an average of 0.25 and 0.8 in the rest of the economy, finance is the sector with the highest variance and skewness in residuals. The estimate of equation (11) by quantile regressions confirms this result (Table B.2). The premium in finance is more than 7 times as high at the top of the wage distribution (0.9 quantile) as at the bottom (0.1 quantile). On the contrary, the premium in the oil industry is lower at the top than at the bottom of the wage distribution.

4.1.3 Career Dynamics Evidence

According to Proposition 3, a high talent scalability is coupled with an increasing wage premium and variance over career. Since data are cross-sectional, the evolution of the premium over an individual's career cannot be directly estimated. However, I use information on worker's years of experience to divide the samples of the 2005-2010 surveys into 5 groups: less than 2 years of experience, from 2 to 4 years, from 4 to 6, from 6 to 8 and more than 8. I then estimate equation (11) by quantile regressions over these five different samples at the 25th, 50th and 75th percentiles[8]. Figure 4.1.3 suggests that the premium in the financial sector increases over years of experience, which is consistent with a talent revelation process. In addition, the increasing gap between the 25th and the 75th percentiles supports the idea of increasing inequalities with experience.

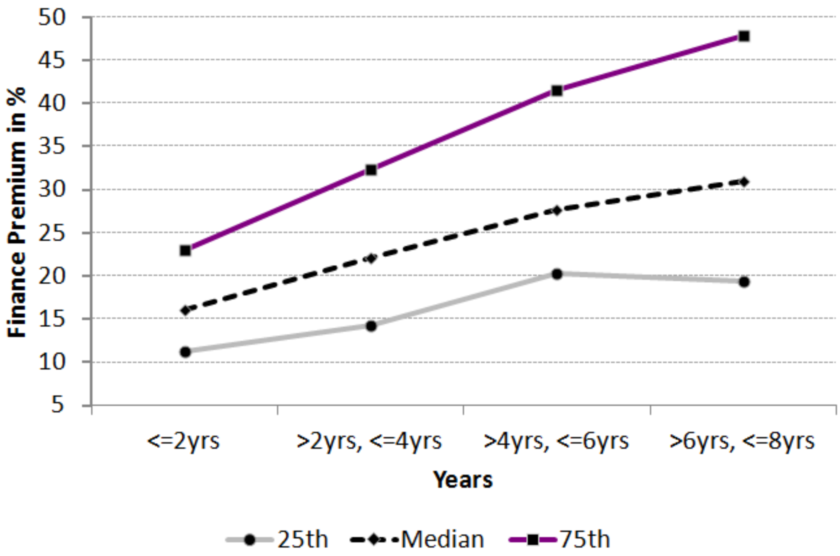

Figure 2
Financial Sector Premium over Years of Experience at the Median, 25th and 75th Wage Percentiles

Boxes represent the coefficient of the financial sector dummy in equation (11) estimated by quantile regression at the 10th, 50th and 90th percentiles over three subsamples. The 1983-1989 sample covers the 1983, 1986 and 1989 surveys, the 1995-2000 covers the 1995, 1998 and 2000 surveys. Finally, the 2005-2010 sample covers the 2005 to the 2010 surveys. The dependant variable is the yearly gross wage. Each regression also controls for education, gender, marital status, occupation, firm type, firm size, hierarchical responsibilities, working abroad, working in Paris area, experience, experience squared and experience cubed.

A Blinder-Oaxaca decomposition confirms the contribution of returns to experience

[8] In order to deal with composition effects, the financial sector is divided in 13 subsectors based on the job description: analyst, asset management, back office, controller, executive, it, merger and acquisition, project finance, quant, retail, risk management, structurer, trading. Each subsectors has a dummy variable. The premium for working in the financial is the sum of each subsector premium weighted by the average share of this subsector in the financial sector.

to the finance premium. Table B.3 in Appendix displays the decomposition for the sample of respondents of less than five years of experience. Whereas less than 30% of the wage differential is explained by difference in observable characteristics, almost 50% is explained by higher returns to experience.

4.1.4 Compensation Elasticity to Size

Proposition 4 relates compensation to size: as talent scalability increases, wage elasticity to size increases. The question is: what can be used as a proxy for size? In the literature, competition for talent has been analyzed in the market for CEOs using the firm's total market value (Gabaix and Landier (2008), Terviö (2008)). The assumption is that a CEO's talent would have a permanent impact on the firms' future earnings. But the impact of an employee's talent is expected to be lower. In the model it varies with first, the amount of adjustable capital, second talent scalability. In order to build a proxy for size, I use a key question of the 2010 survey: Interviewees are asked whether they manage a budget and if yes, its amount. The information is provided by almost 30% of the interviewees, which are 1.5 years more experienced than the average. Table 2 provides some summary statistics on this proxy across sectors. The distribution of the budget variable is right skewed, with a median of 2 millions euros, versus a mean of 16.2 million euros.

Table 2 Budget per Employee in Million Euros- Summary Statistics

Sectors	Mean	Sd	p10	p50	p90
Total Sample	16.18	47.18	0.14	2.00	35.00
Finance	20.65	42.08	0.25	5.00	60.00
Oil	15.49	39.30	0.17	3.25	27.50
Consulting	5.33	25.38	0.11	0.55	5.00
Drugs	26.11	73.03	0.20	3.00	60.00
Holding	30.02	67.01	0.30	5.00	80.00
Mining	47.57	99.50	0.54	8.00	150.00

I verify whether the budget amount is a good proxy for size, regressing the logarithm of compensation on the logarithm of these size proxy, controlling for the same variables as in wage equation (11).

Table 3 shows that one standard deviation increase from the mean in the budget managed per employee has a 25% impact on compensation.

The model predicts that compensation elasticity to size varies across sector. Consequently, I estimate (11) introducing interaction effects between size and industry

$$w_{i,t} = c + \beta X_{i,t} + \eta ln(Y_{i,t}) + \gamma I_{i,t} + \lambda ln(Y_{i,t}) \times I_{i,t} + \epsilon_{i,t} \tag{12}$$

Table 3. Elasticity of Compensation to Size

The dependant variable is the log of the yearly gross wage.

Variable	**Coefficient**	**(Std. Err.)**	
Ln(Budget)	0.057***	(0.003)	
Year Dummies	YES		
Industry Dummies	YES		
Control Variables	YES		
N		6086	
R-squared		0.73	
Significance levels :	$*$: 10%	$**$: 5%	$***$: 1%

where $w_{i,t}$ is the log yearly gross wage, $X_{i,t}$ is the vector of individual characteristics described above, $I_{i,t}$ stands for the vector of industry dummies, $Y_{i,t}$ the size proxy and D_t the vector of year dummies. $\epsilon_{i,t}$ is the error term. I drop individuals in sectors in which the number of observations is lower than 40. η captures the average compensation elasticity to size, whereas λ captures the elasticity differential for each sector.

Table 4 reports the estimation of the industry coefficients first, without the interaction terms (Model 1) then including them (Model 2). Results are consistent with the model predictions: compensation elasticity to size is three times as high in finance as in the rest of the economy. Moreover, size effects largely explains the finance premium (more than 60%). To extend the analysis to other sectors, size effects also explain most of the premium in the holding, consulting and media industries, in which jobs seem scalable. Oppositely, elasticity to size is low in real estates, mining, and utilities.

Table 4. Compensation Elasticity to Size

The dependant variable is the log of the yearly gross wage - Each 33 industry has a dummy variable. The model includes a female dummy, a married dummy, a female × married dummy, a Paris area dummy, 7 education dummies, a working abroad dummy, years of professional experience and its square, 4 hierarchic responsibility dummies, 9 occupation dummies, 4 firm size dummies, 4 firm type dummies.

	Model 1		Model 2			
	Gross Differences		Interaction Coef		Industry Dummy Coef	
Industry	**Coef.**	**(Std. Err.)**	**Coef.**	**(Std. Err.)**	**Coef.**	**(Std. Err.)**
Ln(Size)	0.056	(0.003)	0.053	(0.004)		
Aerospace	-0.08	(0.018)	-0.023	(0.012)	-0.056	(0.025)
Auto	-0.065	(0.016)	-0.019	(0.011)	-0.036	(0.023)
Chemicals	0.031	(0.019)	-0.006	(0.014)	-0.04	(0.031)
Construction	-0.113	(0.015)	-0.003	(0.011)	-0.11	(0.027)
Consulting	0.170	(0.026)	0.164	(0.040)	0.06	(0.035)
Drugs	0.066	(0.029)	0.002	(0.020)	0.053	(0.046)
Education	-0.192	(0.068)	0.03	(0.15)	-0.22	(0.11)
Electric Equipment	-0.0319	(0.022)	0.031	(0.017)	-0.07	(0.032)
Electricity and gas	0.096	(0.023)	-0.033	(0.015)	0.17	(0.034)
Electronic	-0.046	(0.016)	-0.011	(0.012)	-0.034	(0.023)
Engineering	-0.054	(0.012)	-0.021	(0.010)	-0.032	(0.017)
Finance	**0.320**	**(0.022)**	**0.095**	**(0.015)**	**0.108**	**(0.039)**
Food	0.007	(0.021)	0.001	(0.015)	0.002	(0.032)
Holding	0.120	(0.021)	0.03	(0.013)	0.06	(0.035)
IT	-0.019	(0.017)	0.039	(0.017)	-0.07	(0.025)
Machin	-0.025	(0.019)	0.011	(0.014)	-0.044	(0.028)
Media	0.064	(0.038)	0.11	(0.04)	-0.085	(0.062)
Metal	-0.047	(0.026)	0.001	(0.02)	-0.05	(0.04)
Mining	0.073	(0.035)	-0.04	(0.022)	0.17	(0.065)
Misc. Services	0.087	(0.041)	-0.009	(0.026)	0.09	(0.06)
Oil	0.026	(0.046)	-0.06	(0.040)	0.11	(0.077)
Organization	-0.079	(0.037)	0.063	(0.12)	-0.15	(0.16)
Plastic	-0.003	(0.028)	0.06	(0.02)	-0.10	(0.04)
Public	-0.040	(0.100)	0.02	(0.08)	-0.07	(0.12)
Realestate	-0.075	(0.048)	-0.056	(0.028)	0.05	(0.08)
Ship building	-0.065	(0.033)	-0.04	(0.021)	0.002	(0.05)
Soap	0.075	(0.031)	0.043	(0.021)	-0.008	(0.047)
Steel	-0.005	(0.027)	0.005	(0.019)	-0.015	(0.040)
Telecom	-0.015	(0.025)	-0.032	(0.02)	0.32	(0.041)
Transportation	-0.037	(0.029)	-0.035	(0.021)	0.024	(0.043)
Utilities	-0.108	(0.035)	-0.069	(0.027)	0.023	(0.059)
Wholesale	0.026	(0.018)	0.025	(0.013)	-0.011	(0.029)
Observations	**5,755**				**5,755**	
R^2	*0.72*				*0.73*	

4.2 Time-series Evidence: 1983-2010

4.2.1 The increase in the Finance Premium

The model predicts that the finance premium should increase in line with job size. The question remains: what is a good proxy for size? Since any cross-sectional size proxy is not available over the whole period, I use one proxy for size in each industry. I compute the average firm's total market value per employee over the largest 50 firms of each sector over the period 1982-2010, based on Compustat data for the U.S. economy. The formula is

$$mktvalue = data199 * abs(data25) + data6 - data60 - data74$$

All nominal quantities are converted in constant 2005 dollars, using the GDP deflator from the Bureau of Economic Analysis. Sectors are defined in Appendix.

In addition, I estimate wage equation (11) over the 1983-2010 period. Detailed results for the periods 1983-1989, 1995-2000 and 2005-2007 are presented in Table B.4. Figure 3 shows first, the average market value per employee in finance, second, the coefficients of the finance dummy over years. The financial sector premium has increased along with size per employee, from below 10% in the 1980s up to 33% in 2007.

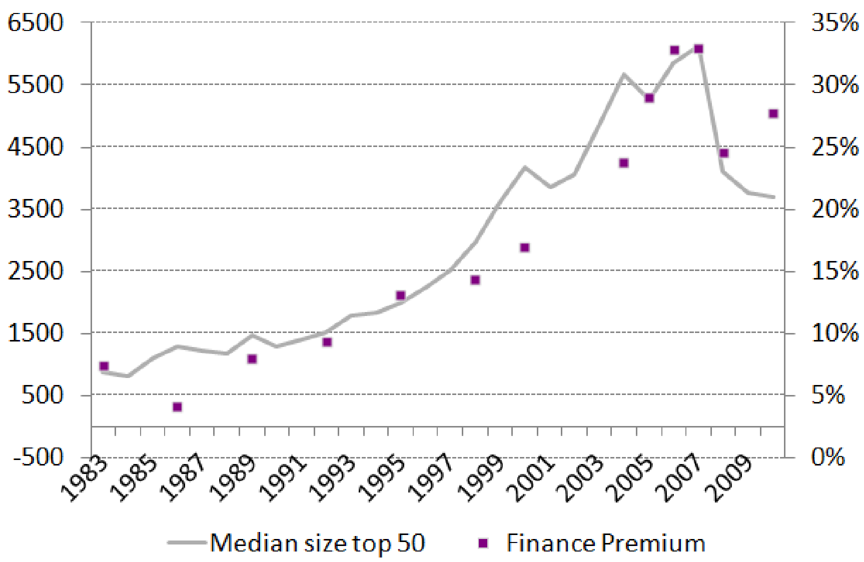

Figure 3
Average Market Value per Employee in million 2005dollars in the Financial Sector and Evolution of the Premium (1983 - 2008)

Firm size is the median market value of the top 50 firms in the U.S. financial sector in billion 2005$, computed using Compustat. Boxes represent the coefficient of the financial sector dummy in equation (11) estimated over each survey from 1983 to 2010 (205,585 observations). The dependent variable is the yearly gross wage. There are 48 industry dummies, and the estimation is constrained such that the sum of all the industry dummy coefficients is zero. Each regression also controls for education, gender, marital status, occupation, firm type, firm size, hierarchical responsibilities, working abroad, working in Paris area, experience, experience squared and experience cubed.

I now estimate (11) over the sample 1983-2010 introducing interaction effects between size and industries

$$w_{i,t} = c + \beta X_{i,t} + \eta \times ln(mktvalue_{j,t}) + \gamma I_{i,t} + \lambda \times ln(mktvalue_{j,t}) \times I_{i,t} + \epsilon_{i,t} \quad (13)$$

$mktvalue_{j,t}$ stands for the proxy for size per employee for industry j in year t. Again, results are consistent with the model. I find that the interaction coefficient is six times as high in finance as in the rest of the economy. In addition, the increase in the premium from 5% in 1983 up to 33% in 2007 is totally explained by the fourfold increase in market capitalization per employee. Once again, elasticity to size is low in the oil, utilities and real estate industries, and high in the consulting one.

4.2.2 Increasing Wage Dispersion

In a time-series analysis, the model predicts that the rise in the finance premium should come along with an increasing wage dispersion. Figure 4 displays quantile regression estimates of the finance wage premia in equation (11) at the 10th, 50th and 90th percentile over three samples: 1983-1989, 1995-2000 and 2005-2010. For each period, wage dispersion is captured by the difference between the 10th and 90th percentiles. It shows that the increase in the wage premium is much higher at the 90th percentile than at the 10th or 50th percentile. In addition, the 90-50 gap has increased much more than the 10-50 gap, which provides some evidence of increasing inequality in the upper tail within the financial sector.

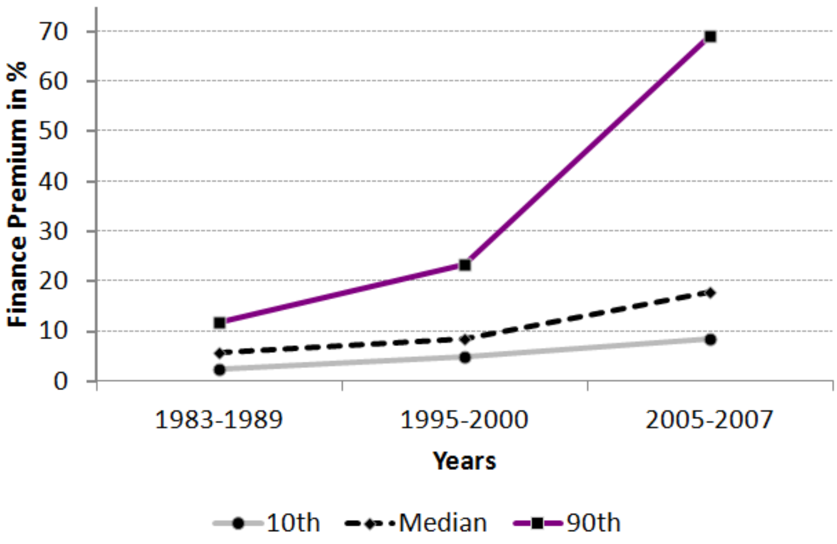

Figure 4
Evolution of the Finance Premium at the 10th, 50th and 90th Centiles of the Wage Distribution

Boxes represent the coefficient of the financial sector dummy in equation (11) estimated by quantile regression at the 10th, 50th and 90th percentiles over three subsamples. The 1983-1989 sample covers the 1983, 1986 and 1989 surveys, the 1995-2000 covers the 1995, 1998 and 2000 surveys. Finally, the 2005-2010 sample covers the 2005 to the 2010 surveys. The dependant variable is the yearly gross wage. Each regression also controls for education, gender, marital status, occupation, firm type, firm size, hierarchical responsibilities, working abroad, working in Paris area, experience, experience squared and experience cubed.

5 Discussion

To summarize, the financial sector premium can be attributed to a high talent scalability in an industry in which firms compete for industry-specific talent. In this section, I discuss two other strands of theories that have been developed to explain inter-industry wage differentials: the moral hazard and the compensating wage differential ones.

5.1 Moral Hazard and Industry Rents

In standard moral hazard models, variable compensation is used as an incentive device. When possible, it should vary with the idiosyncratic individual performance. But when individual performance is not observable, it could be linked to the overall firm performance. However, relative performance measures should be favored (Holmström (1982)).

In talent retention models, on the opposite, variable compensation increases jointly across firms and workers to keep wages in line with workers' outside option (Oyer 2004).

I use a specific question of the IESF survey to observe the patterns of variable compensation. Interviewees are asked to provide the percentage of total compensation which is variable from the year 2000 survey onwards. Since stock options are not included in total compensation, the variable share includes only bonuses and firm specific incentive schemes. I drop values higher than 80% of the total annual compensation (1% of the sample) and lower than 0. Whereas 41% of individuals declare variable compensation in the total economy, they are 65% in the financial sector. When I regress the probability of declaring variable compensation over individual characteristics, I find that working in the financial sector increases the probability by 0.11 pp. Table 4 describes the evolution of the share of variable compensation with deciles of revenue within the financial sector and in the rest of the economy. Deciles are computed in 2000, 2004, 2005, 2006, 2007 and 2008. It suggests that part of the premium of top wages is paid through variable compensation, more in the financial sector than in the rest of the economy.

Table 5

Ratio of variable compensation to total compensation across wage deciles

Decile	Financial Sector	Rest of the economy
1	11.2%	9.6%
2	12.1%	8.4%
3	14.3%	8.4%
4	15.9%	8.7%
5	18.1%	9.3%
6	21.8%	9.7%
7	28.3%	10.5%
8	30.2%	11.6%
9	42.4%	13.3%
10	58.1%	19.9%

However, I also find that variable compensation is highly correlated with bank profits. Figure 5.1 shows that, from 2000 to 2008, they have evolved in line. This result is in favor of talent retention motives for the use of variable compensation in the financial sector.

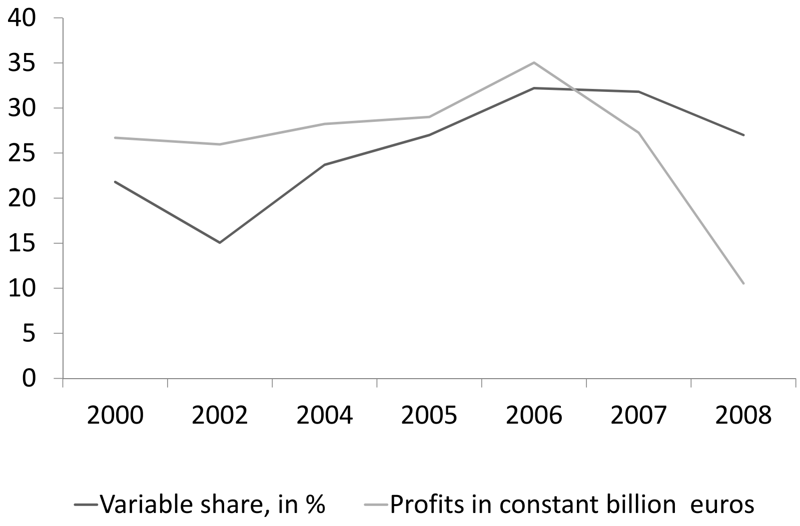

Figure 5

The evolution of the variable share (in %) and profits in the financial sector (in billion of constant euros) - 2000-2008 - Data are from the French Commission Bancaire

5.2 Compensating Wage Differential

Another potential explanation for the financial sector premium is a compensating differential for either hard working conditions or unemployment risk. Based on the IESF compensation survey, I can test empirically this explanation.

On the one hand, using data on job satisfaction and hours worked, I control for both stress and workload in wage equation (11) with two dummy variables that are coded 1 if the interviewee declares suffering from them, 0 if not. In addition, a variable indicates if the engineers work overtime occasionally, 5 to 10 hours or more than 10 hours. I do not find any significant downward impact of these variables on the finance premium.

On the other hand, I also control for unemployment risk using two different strategies. First, I observe the fraction of layoffs on the total population of employees per sector (from the 2009 labor turnover data from the French Ministery of Labor, Employment and Health) as a measure of unemployment risk. I find that there is a negative correlation between wages and industry unemployment risk, that from 1999 on unemployment risk has been constant in the financial sector (layoff rate of 1.7%), and that the financial sector is one of the sectors with the lowest layoff rate (average: 2.9%). The second strategy consists in using a specific question of the survey asking interviewees if they suffer from job insecurity. Results are similar: the coefficient of this variable in the wage equation (11) is significantly negative.

6 Conclusion

I find that the financial sector premium can be explained by talent scalability and competition for industry-specific talent. In a historical perspective, technological progress and finance deregulation would have made skills in the financial sector more general within the sector but more industry-specific, increasing competition for the best employees in the sector. In addition, talent scalability has increased. This result has implications concerning wage inequalities, talent allocation, risk taking and their impact on growth. It predicts that regulating the structure of compensation in the financial sector, restricting bonuses for example, may have no impact on the level of compensation.

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Appendix A Computations

To maximize social surplus $S(\theta)$

$$S(\underline{\theta}) = \underbrace{i_{\underline{\theta}}(\Phi(\hat{\theta}) - \omega)}_{\text{Novice Group Surplus}} + \underbrace{(1 - i_{\underline{\theta}})E[\Phi(\theta) - \omega|\theta \geq \underline{\theta}]}_{\text{Veteran Group Surplus}}$$

I introduce $i_{\underline{\theta}} = \frac{1}{2-T(\theta)}$ and I take the first order condition

$$\frac{\partial}{\partial\underline{\theta}}S(\underline{\theta}) = \frac{T'(\underline{\theta})}{(2-T(\underline{\theta}))^2}(\Phi(\hat{\theta}) - \omega) - \frac{T'(\underline{\theta})}{(2-T(\underline{\theta}))^2}E[..] + \frac{1-T(\underline{\theta})}{2-T(\underline{\theta})}\frac{\partial}{\partial\underline{\theta}}E[..] \tag{14}$$

By definition

$$E[\Phi(\theta) - \omega|\theta \geq \underline{\theta}] = \int_{\underline{\theta}}^{\theta_{max}} \Phi(x)T'(x) \times \frac{1}{1-T(\underline{\theta})}$$

The derivative is

$$\frac{\partial}{\partial\underline{\theta}}E[..] = -\Phi(\underline{\theta})T'(\underline{\theta}) \times \frac{1}{1-T(\underline{\theta})} + E[..] \times \frac{T'\underline{\theta}}{1-T(\underline{\theta})} \tag{15}$$

Hence multiplying (14) by $(2 - T(\underline{\theta}))^2$, simplifying by $T'(\theta)$ and introducing (15), it becomes

$$\begin{aligned}\frac{\partial}{\partial \underline{\theta}} S(\underline{\theta}) &= \Phi(\hat{\theta}) - \omega - E[..] + (2 - T(\underline{\theta}))(E[..] - \Phi(\underline{\theta})) \\ &= \Phi(\hat{\theta}) - \Phi(\underline{\theta}) + (1 - T(\underline{\theta}))(E[\Phi(\theta)|\theta > \underline{\theta}] - \Phi(\underline{\theta}))\end{aligned}$$

Appendix B Empirical Results

Table B.1. Estimated Inter-industry Wage Differentials: 2005-2010

The dependant variable is the log of the yearly gross wage - Each industry has a dummy variable - Decomposition in 48 sectors - The model includes a female dummy, a married dummy, a female × married dummy, a Paris area dummy, 8 education dummies, a working abroad dummy, seven country dummies, experience, experience squared and experience cubed, 4 hierarchic responsibility dummies, 9 occupation dummies, 4 firm size dummies, 4 firm type dummies .

Variable	Coefficient	(Std. Err.)
Financial Sector	0.30**	(0.01)
Oil Sector	0.13**	(0.01)
Mining	0.13**	(0.02)
Electricity and gas	0.12**	(0.01)
Consulting	0.12**	(0.00)
Holding	0.10**	(0.01)
Cement	0.06**	(0.01)
Paper	0.06**	(0.01)
Insurance Sector	0.04**	(0.01)
Realestate	0.04**	(0.01)
Miscellaneous services	0.04**	(0.01)
Chemical	0.04**	(0.01)
Drugs sector	0.04**	(0.01)
Wholesale trade	0.03**	(0.00)
Steel and iron	0.03**	(0.01)
Soap and Cosmetics	0.02**	(0.01)
Alcohol	0.02	(0.02)
Glass products	0.01	(0.01)
Rubber and plastic products	0.01†	(0.01)
Telecommunications	0.01	(0.01)
Media	0.01	(0.01)
Ship building	0.00	(0.01)
Miscellaneous goods	0.00	(0.02)
Information technologies	-0.01*	(0.00)
Transportation	-0.01	(0.01)
Car trade	-0.01	(0.02)
Car industry	-0.01**	(0.00)
Food products	-0.01*	(0.01)
Textile sector	-0.02†	(0.01)
Machinery	-0.03**	(0.00)
Electric equipment	-0.03**	(0.01)
Printing	-0.03	(0.02)
Non food retail	-0.03*	(0.01)
Metal industry	-0.04**	(0.01)
Electronic products	-0.04**	(0.00)
Engineering	-0.04**	(0.00)
Aerospace	-0.05**	(0.00)
Construction	-0.06**	(0.00)
Air transport	-0.06**	(0.01)
Public sector	-0.06**	(0.01)
Non profit organization	-0.06**	(0.01)
Furniture	-0.06**	(0.01)
Hotels and restaurants	-0.06*	(0.03)
Public utilities	-0.08**	(0.01)
Health sector	-0.10**	(0.02)
Food retail	-0.14**	(0.02)
Agriculture sector	-0.15**	(0.02)
Education sector	-0.17**	(0.01)
N	82229	
R-squared	0.71	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table B.2. Quantile Regression - 2005-2010

The dependant variable is the log of the yearly gross wage - Each industry has a dummy variable - Decomposition in 48 sectors - 2005-2010. The model includes a female dummy, a married dummy, a female × married dummy, a Paris area dummy, 8 education dummies, a working abroad dummy, 6 country dummies, experience level, squared and cubed, 4 hierarchic responsibility dummies, 9 occupation dummies, 4 firm size dummies, 4 firm type dummies .

	0.1q		**0.5q**		**0.9q**	
Industry	**Coef.**	**(S. E.)**	**Coef.**	**(S. E.)**	**Coef.**	**(S. E.)**
Aerospace	0.028**	-0.011	-0.026***	-0.008	-0.070***	-0.014
Agriculture sector	-0.122***	-0.023	-0.157***	-0.017	-0.085***	-0.029
Air transport	-0.033*	-0.019	-0.042***	-0.014	0.007	-0.024
Alcohol	0.037	-0.023	0.015	-0.017	0.038	-0.029
Car industry	0.059***	-0.01	0.012	-0.008	-0.025*	-0.013
Car trade	0.007	-0.024	-0.006	-0.018	-0.007	-0.031
Cement	0.027	-0.02	0.058***	-0.015	0.182***	-0.025
Chemical	0.089***	-0.012	0.080***	-0.008	0.028*	-0.015
Construction	-0.022**	-0.011	-0.034***	-0.008	-0.039***	-0.014
Consulting	0.036***	-0.011	0.095***	-0.008	0.282***	-0.014
Drugs sector	0.067***	-0.013	0.056***	-0.01	0.051***	-0.016
Education sector	-0.183***	-0.018	-0.166***	-0.013	-0.123***	-0.023
Electric equipment	0.018	-0.012	-0.020**	-0.009	-0.031**	-0.015
Electricity and gas	0.123***	-0.012	0.124***	-0.008	0.158***	-0.014
Electronic products	0.016	-0.01	-0.019**	-0.008	-0.048***	-0.013
Engineering	-0.023**	-0.01	-0.033***	-0.007	-0.026**	-0.013
Financial Sector	**0.099***	**-0.011**	**0.200***	**-0.008**	**0.769***	**-0.014**
Food products	-0.029**	-0.012	-0.004	-0.008	0.017	-0.015
Food retail	-0.214***	-0.029	-0.125***	-0.022	-0.078**	-0.037
Furniture	-0.002	-0.018	-0.051***	-0.013	-0.050**	-0.022
Glass products	0.051***	-0.02	0.02	-0.014	0.002	-0.025
Health sector	-0.116***	-0.026	-0.070***	-0.02	-0.034	-0.034
Holding	0.059***	-0.011	0.094***	-0.008	0.183***	-0.014
Insurance Sector	0.007	-0.016	0.043***	-0.012	0.129***	-0.02
Information Tech.	-0.041***	-0.01	-0.013*	-0.007	0.042***	-0.013
Machinery	0.019*	-0.011	-0.01	-0.008	-0.024*	-0.014
Media	-0.025*	-0.014	0.012	-0.01	0.072***	-0.018
Metal industry	-0.014	-0.012	-0.020**	-0.009	-0.030*	-0.015
Mining	0.088***	-0.022	0.084***	-0.016	0.210***	-0.028
Miscellaneous services	-0.004	-0.014	0.055***	-0.01	0.122***	-0.018
Miscellaneous goods	0.012	-0.022	0.002	-0.016	-0.037	-0.027
Non food retail	-0.044**	-0.021	0.009	-0.015	0.013	-0.026
Oil Sector	0.208***	-0.015	0.153***	-0.011	0.123***	-0.019
Non profit organization	-0.050***	-0.018	-0.075***	-0.013	-0.080***	-0.022
Paper	0.082***	-0.019	0.062***	-0.014	0.048**	-0.023
Rubber	0.053***	-0.013	0.023**	-0.009	0.014	-0.016
Printing	-0.019	-0.026	-0.047**	-0.019	-0.008	-0.032
Public sector	-0.037**	-0.018	-0.048***	-0.012	-0.012	-0.022
Realestate	0.024	-0.019	0.051***	-0.014	0.097***	-0.023
Hotels and restaurants	-0.054	-0.035	-0.004	-0.026	-0.012	-0.044
Ship building	0.049***	-0.015	0.011	-0.011	-0.004	-0.019
Soap and Cosmetics	0.027**	-0.013	0.023**	-0.009	0.028*	-0.016
Steel and iron	0.076***	-0.013	0.051***	-0.01	0.025	-0.017
Telecommunications	0.011	-0.012	0.022***	-0.008	0.058***	-0.014
Textile sector	-0.027	-0.018	-0.018	-0.013	0.025	-0.022
Public utilities	-0.069***	-0.014	-0.072***	-0.011	-0.047***	-0.018
Wholesale trade	-0.004	-0.011	0.039***	-0.008	0.086***	-0.014
Transport (ref)						

Table B.3. Blinder-Oaxaca Decomposition of the Finance Premium

The dependant variable is the log of the yearly gross wage - Each industry has a dummy variable - 2005-2010. Employees of less than five years of experience. The model includes a female dummy, a married dummy, a female × married dummy, a Paris area dummy, 8 education dummies, a working abroad dummy, 6 country dummies, experience level, squared and cubed, 4 hierarchic responsibility dummies, 9 occupation dummies, 4 firm size dummies, 4 firm type dummies.

Total Wage Gap (log)	**0.49**	
Decomposition	**Endowments**	**Coefficients**
Sexe	0.00	-0.02
Married	-0.00	0.00
Married*female	0.00	-0.03
Working abroad	0.06	0.16
Experience	-0.00	0.22
Paris	0.01	0.09
Top Engineer School	0.01	0.03
Prep years	0.00	0.05
Double degree in management	0.01	-0.03
Double degree in science	0.00	0.05
Team manager	0.00	0.03
Director	-0.00	-0.00
Top executive	-0.00	-0.00
Private sector	0.00	-0.01
Large firm	0.02	0.03
Subtotals	**0.14**	**0.34**
Total Observations	24,016	
Financial Sector	827	
Rest of the economy	24,277	
R squared	0.34	

Table B.4. Finance Premium Evolution: 1983 - 2010

The dependant variable is the log of the yearly gross wage - Each industry has a dummy variable - Decomposition in 48 sectors. The model includes a female dummy, a married dummy, a female × married dummy, a Paris area dummy, 7 education dummies, a working abroad dummy, years of professional experience and its square, 4 hierarchic responsibility dummies, 9 occupation dummies, 4 firm size dummies, 4 firm type dummies .

	1986-1989		1995-2000		2005-2007	
Industry	**Coef.**	**(Std. Err.)**	**Coef.**	**(Std. Err.)**	**Coef.**	**(Std. Err.)**
Aerospace	-0.003	(0.005)	-0.034	(0.008)	-0.044	(0.007)
Agriculture	-0.146	(0.011)	-0.102	(0.022)	-0.179	(0.021)
Air transportation	0.062	(0.016)	0.060	(0.017)	-0.027	(0.018)
Alcohol	0.037	(0.016)	-0.037	(0.031)	-0.006	(0.022)
Auto	0	(0.005)	0.001	(0.006)	0.001	(0.005)
Carsale	0.014	(0.027)	0.116	(0.038)	0	(0.026)
Cement	-0.009	(0.008)	-0.008	(0.022)	0.045	(0.019)
Chemicals	0.072	(0.005)	0.089	(0.010)	0.034	(0.007)
Construction	-0.028	(0.004)	-0.044	(0.007)	-0.068	(0.006)
Consulting	-	-	0.162	(0.009)	0.125	(0.006)
Drugs	0.05	(0.010)	0.096	(0.015)	0.046	(0.010)
Education	-0.1	(0.021)	-0.193	(0.015)	-0.162	(0.015)
Electric equipment	-0.056	(0.005)	-0.026	(0.008)	-0.033	(0.008)
Electricity and gas	0.036	(0.005)	0.062	(0.008)	0.109	(0.009)
Electronic	-0.03	(0.004)	-0.02	(0.005)	-0.033	(0.005)
Engineering	0.021	(0.003)	-0.035	(0.005)	-0.04	(0.004)
Finance	**0.070**	**(0.008)**	**0.157**	**(0.009)**	**0.320**	**(0.006)**
Food products	0.015	(0.007)	0.005	(0.011)	-0.022	(0.007)
Food retail	-0.003	(0.027)	-0.148	(0.034)	-0.158	(0.026)
Furniture	-0.097	(0.020)	-0.053	(0.019)	-0.047	(0.015)
Glass	0.009	(0.012)	-0.005	(0.018)	0.012	(0.019)
Health	-0.064	(0.026)	-0.145	(0.024)	-0.098	(0.026)
Holding	0.114	(0.018)	0.111	(0.009)	0.095	(0.007)
Insurance	0.02	(0.012)	0.054	(0.014)	0.044	(0.014)
It	-	-	0.013	(0.006)	0.007	(0.005)
Machin	-0.012	(0.004)	-0.026	(0.007)	-0.033	(0.006)
Media	-0.052	(0.028)	-0.056	(0.026)	-0.011	(0.016)
Metal	-0.052	(0.006)	-0.052	(0.009)	-0.031	(0.009)
Mining	0.137	(0.017)	0.101	(0.021)	0.049	(0.031)
Misc. services	-0.017	(0.017)	0.04	(0.015)	0.027	(0.011)
Misc. goods	0.021	(0.011)	-0.023	(0.043)	0.024	(0.027)
Non food retail	-0.013	(0.018)	0.001	(0.028)	-0.049	(0.020)
Oil	0.168	(0.006)	0.119	(0.011)	0.138	(0.013)
Organizations	-	-	-0.138	(0.014)	-0.056	(0.015)
Paper	0.073	(0.010)	0.099	(0.013)	0.069	(0.016)
Plastic and rubber	0.001	(0.007)	0.015	(0.009)	0.015	(0.009)
Printing	-0.022	(0.016)	-0.045	(0.028)	-0.023	(0.024)
Public adminsitration	-0.095	(0.005)	-0.111	(0.011)	-0.057	(0.015)
Realestate	0.01	(0.012)	0.022	(0.020)	0.056	(0.017)
Restaurant and hotel	-0.053	(0.034)	-0.031	(0.038)	-0.091	(0.037)
Ship building	0.011	(0.016)	-0.015	(0.022)	-0.014	(0.015)
Soap and cosmetics	0.014	(0.007)	0.028	(0.011)	0.023	(0.010)
Steel	0.042	(0.005)	0.017	(0.009)	0.024	(0.011)
Telecom	-0.079	(0.010)	0.041	(0.009)	0.028	(0.008)
Textile	-0.033	(0.010)	-0.034	(0.015)	-0.018	(0.016)
Transportation	-0.005	(0.007)	0.01	(0.010)	-0.005	(0.011)
Utilities	0.009	(0.012)	-0.041	(0.015)	-0.071	(0.012)
Wholesale	0.008	(0.006)	0.049	(0.007)	0.034	(0.006)
N	42,619		35,792		52,098	

Sectors

I use 5 digit 2008, 4 digit 2003 and 1993 NAF codes, and 1973 NAP codes to assigne engineers to 48 industries. NAF (NAP) is the French official industry classification, equivalent to the two digit SIC code. The following table gives the industry names and codes.

		2008 NAF	2003 NAF	SIC
1 **Aero**	Aircraft	3030Z	353A, 353B, 353C	372
	Aircraft Maintenance and Repair	3316Z		
2 **Agriculture**	Crops and Livestock Production	0111-0116Z, 0119Z, 0121-0129Z, 0130Z, 0141-0147Z, 0149Z, 0150Z, 0161-0164Z, 0170Z	011A-G, 012A-J, 013Z, 014A-Z	01, 02, 07
	Forestry	0210Z, 0220Z, 0230Z, 0240Z	020A, 020B, 020D	08
	Fishing	0311Z, 0312Z, 0321Z, 0322Z	050A, 050C	09
3 **Air Transportation**		5110Z, 5121Z	621Z, 622Z	451, 452, 458
	Aircraft Rental	7735Z	712E	
4 **Alcoholic Beverage**		1101Z, 1102A, 1102B, 1103Z, 11B04Z, 1105Z, 1106Z, 1107A-B	159A-Q	2080, 2082, 2083, 2084, 2085
	Wine growing	0121Z	011G	
5 **Automobile and Trucks**	Motor vehicles	2910Z	341Z, 342B	371, 379
	Car bodies	2920Z	342A	
	Motocycles	3091Z	354A	
	Motor Vehicles Equipment	2931Z, 2932Z	343Z	
6 **Car Sales Services and Rental**	Car Sales		455Z, 501Z, 502Z	551, 552, 553, 559
	Car Rental		711A, 711B, 712A	751
7 **Cement, Concrete and Stone Products**		2351Z-2388Z	265A-E, 266A-L, 267Z, 268A-C	321, 322, 323, 324, 325, 326, 327, 328, 329
8 **Chemicals**	Industrial Gaz	2011Z	241A	
	Paints	2012Z, 2030Z,	241C, 243Z	
	Industrial Inorganic Chems (includes nuclear)	2013A, 2013B, 2446Z	241E, 233Z	281
	Industrial Organic Chems	2014Z	241G	286
	Agricultural Chemicals	2015Z, 2020Z,	241J, 242Z	287
	Plastic Material and Synthetic Resin and textile	2016Z, 2017Z, 2060Z	241L, 241N, 247Z	282
9 **Construction**	Building Contractors, general and residential	4110A-D	452A-V	152, 154
	Operative Builders	4120A, 4120B	453A-H	153
	Heavy Construction	4211Z, 4212Z, 4213A, 4213B, 4221Z, 4222Z, 4291Z, 4299Z		161, 162
	Special Construction	4311Z, 4312A-B, 4313Z, 4321A-B, 4322A-B, 4329A-B, 4331Z, 4332A-C, 4333Z, 4334Z, 4339Z, 4391A-B, 4399A-E	454A-M, 451A-D	171 - 179
	Equipment Rental for construction	7732Z		
10 **Consulting**	Management Consulting	7022Z	741G	874
	Accounting	6920Z	741A	872
	Market study	7320Z	741C	873
	Law	6910Z	741E	811
	Advertising Consulting	7311Z	744B	731
	Public Relation	7021Z		
11 **Drugs**	Pharmaceutical Preparations	2110Z	244A	283
	Drugs	2120Z	244C, 244D	
12 **Education Services**	Primary Education	8510Z, 8520Z	801Z	820 - 829
	Secondary Education	8531Z, 8532Z, 8541Z	802A, 802B	
	Higher Education	8542Z	803Z	
	Other	8559A, 8559B		
13 **Electric Equipment**	Motors	2711Z, 2712Z	311A-C, 312A-B	
	Storage Batteries	2720Z	314Z	362
	Electric Wires	2731Z, 2732Z, 2733Z	313Z	361
	Lighting Equipment	2740Z	315A-C	364
	Electrical Appliances	2751Z, 2752Z	297A	
	Other Electrical Equipment	2790Z	316A-D	369
	Electrical Equipement Repair	3314Z		
14 **Electricity and Gas**	Electric Production	3511Z	401A	491
	Electric Distribution	3512Z, 3513Z	401C, 401E	
	Gas Production	3521Z	402A	492
	Gas Distribution	3522Z, 3523Z	402C	493
	Steam Supply	3530Z	403Z	496
15 **Electronic Equipment**	Chips	2611Z-2612Z	321A,321C,321D	367
	Computers	2620Z	300A-300C	357
	Communication Equipment	2630Z	322A,322B,323Z	366
	Eectronic Goods	2640Z	332A-B, 333Z	365, 363
	Measuring Systems	2651A-B, 2652Z	335Z	381, 382
	Lab Analytical Instruments	2660Z	331A,331B	384
	Optical Instruments	2670Z-2680Z	334A-B	385
	Electronic Industry Services	3313Z, 3320C, 3320D		
16 **Engineering**	Engineering	7112A, 7112B	742B, 742C	871
	Industrial Control	7120A, 7120B	743A, 743B	
	Research and Development	7211Z, 7219Z	731Z	
	Scientific Experts	7490A, 7490B		
17 **Finance**	Commercial Banks	6419Z	651C, 651D, 651E, 651F	60
	Funds	6430Z		
	Credit	6491Z, 6492Z	652A, 652C, 652E, 652F	61
	Other	6499Z		
	Stock Exchange	6611Z	671A	62
	Portfolio Management	6612Z	671C	
	Fund Management	6630Z	671E	
18 **Food Products and tobacco**	Meat Products	1011Z, 1012Z, 1013A, 1013B, 1020Z	151A-F, 152Z	201 - 207
	Canned Peserved Fruits and Veg	1031Z, 1032Z, 1039A, 1039B	153A-F, 152Z	
	Fat and Oils	1041A, 1041B, 1042Z	154A-E	
	Dairy Products	1051A, 1051B, 1051C, 1051D, 1052Z	155A-F	
	Bakery Products	1061A, 1061B, 1062Z, 1071A-D, 1072Z, 1073Z	156A-D, 158A-F	
	Sugar et al	1081Z, 1082Z, 1083Z	158H-P	
	Other Food Products	1084Z, 1085Z, 1086Z, 1089Z, 1091Z, 1092Z	158R-V	209
	Non alcoholic Beverage	1107A, 1107B	159S-T	2086-2087
	Tobacco		160Z	21
19 **Retail Food Trade**		4711A-F, 4721-29Z	521A-F	54
20 **Furniture, Lumber**	Furniture	3101Z, 3102Z, 3103Z, 3109A, 3109B	361A-M	25
	Lumber	1610A-B, 1621Z-29Z	201A-B, 202Z, 203Z, 204Z, 205A-C	24
21 **Glass Products**		2311Z-2349Z	261A-K, 262A-L, 264A-C, 263Z	321, 322, 323
22 **Healthcare**	Health Services	8610Z-8690E	851A-L	80
	Nursing and Social Home	8710A-8790B	853A-E	
	Social Services	8810A-8899B	853G-K	83

23 **Holding Management Activities**		741J	6420Z, 7010Z	67
24 **Insurance**	Life Insurance	6511Z	660A	63
	Other Insurance	6512Z	660E, 660G	64
	Reinsurance	6520Z	660F	
	Insurance agents	6622Z		
	Evaluation	6621Z		
	Relative Services	6629Z	672Z	
Information Technology				
25 **Services**	Computer Programming	6201Z	722A-C	737
	Computer Consulting	6202A-B	721Z	
	Computer Maintenance and Repair	6203Z	725Z	
	Other Computer Related Services	6209Z	726Z	
	Data Processing	6311Z	723Z, 724Z	
	Computer rental	7733Z		
	Internet Services	6312Z		
	Information Related Services	6399Z		
26 **Machinery**		2811Z-2899B	291A-300A	351-356
	Machin Industry Services	3312Z, 3320A, 3320B		359
27 **Entertainment and media**	Publishing	5811-21Z, 5821Z, 5829A-C	221A-E	
	Motion Picture	5911A-5914Z	921A6J	78
	Music	5920Z	221G	79
	Advertising Agency	7312Z	744A	731
	Radio-TV Broadcaster	6010Z, 6020A-B	922A-F	483, 484
	Theatre	9001Z-9004z	923A-K	
28 **Metal Products**		2521Z-2599B	281A, 281C,282C-287Q	34
	Metal products repair and maintenance	3311Z		
29 **Mining**	Metal Mining	0710Z, 0721Z, 0729Z	120Z, 131Z, 132Z	10
	Non Metalic Minerals	0811Z, 0812Z, 0891Z, 0892Z, 0893Z, 0899Z	141A-E, 142A-C, 143Z, 144Z	14
	Mining Relative Services	0910Z, 0990Z		
30 **Miscellanous Business Services**	Business Services	82	748A-K	733, 734, 738
	Cleaning and Maintenance	81	747Z	
	Security and investigation	80	746Z	
	Job Agency	78	745A,B	
Miscellanous Industry and				
31 **Cosumer Goods**	Money	3211Z	362A	39
	Jewelry	3212Z	362C, 366A	
	Musical Instruments	3220Z	363Z	
	Toys	3240Z	365Z	
	Sport Equipement	3230Z	364Z	
	Medical Equipement	3250A, 3250B		
	Other	3291Z, 3299Z	366C,E	
32 **Non Food Retail Trade**		4719A-B, 4741-43Z, 4751Z-4799B	522A-P, 523A-526H	53, 56, 57
33 **Oil**	Oil Extraction	0610Z	111Z	14
	Oil Field Services	0910Z	112Z	
	Petroleum Refining	1920Z	232Z	29
	Coking	1910Z	231Z	
34 **Membership Organization**				86
35 **Paper and Paperboard Mills**		211A-C, 212A-L		26
36 **Plastic and Rubber Products**	Rubber Products	2211Z, 2219Z	251A-E	30
	Plastic Products	2221Z, 2222Z, 2223Z	252A-C	
	Misc Plastic Products	2229A, 2229B	252G-H	
37 **Printing**		1811Z, 1812Z, 1813Z, 1814Z, 1820Z	221A-J, 222A-G, 223A-E	27
38 **Public Administration**	General Public Administration	8411Z, 8412Z, 8413Z	751A-G	
	Specific Administrations	8421Z-8425Z	752A-J	
	Welfare	8430A-C	753A-C	
	Cultural Activities	9101Z-9104Z	925A, 925C, 925E, 926A	
39 **Real Estate**	Real Estate Operators	6810Z, 6820A, 6820B	701A-F, 702A-C	65
	Real Estate Agents and Managers	6831Z, 6832A, 6832B	703A-D	
40 **Hotel and eating places**	Hotels	5510Z-5590Z	551A, 552F	70
	Eating and Drinking places	5610A-5630Z	553A-602B	58
Ship Building, Railroad				
Equipment and ot transp				
41 **equipment**	Shipbuilding and repair	3011Z, 3012Z	351B-C-E	373
	Railroad Equipment	3020Z	352Z	374
	Tanks	3040Z	351A	376
	Bicycles	3092Z	354C	375
	Repair	3315Z, 3317Z		
	Other	3099Z	354E-Z	379
42 **Parachemicals, Cosmetics**	Soap and other detergents	2041Z	245A	284
	Perfumes and Cosmetics	2042Z	245C	
	Paints	2030Z	243Z	285
	Other Chemical Products	2051Z, 2052Z, 2053Z, 2059Z	246A, 246C, 246E, 246G, 246J, 246L	
43 **Steel Works etc**	Primary Metal Industry	2410Z, 2420Z	271Y, 271Z	33
	Steel Works	2431Z-2434Z	272A-C, 273A-G	
	Non Ferrous Industry	2442-2445Z	274C-M	
	Foundries	2451Z-2454Z	275A-G	
44 **Telecommunications and mail**	Telecommunications	6110Z, 6120Z, 6130Z, 6190Z	642A, 642B, 642C	481, 482, 489
	Mail	5310Z, 5320Z	641A, 641C	
45 **Textiles and Apparel**	Textile Mill Products	1310Z, 1320Z, 1330Z, 1391Z-1396Z, 1399Z	171A-P, 172A-J, 173Z, 174A-C, 175A-G, 176Z, 177A-C,	22
	Apparel and other Textile Products	1411Z-1414Z, 1419Z, 1420Z, 1431Z, 1439Z	181Z, 182A-J, 183Z, 191Z, 192Z, 193Z	23, 24
46 **Transportation**	Railroad Passenger Transportation	4910Z	601Z	401
	Railway Freight	4920Z		
	Bus Transp	4931Z, 4939A-B	602A-B	41
	Taxicabs	4932Z	602E, 602G	
	Road Freight	4941A-C, 4942Z	602L,M,N,P	
	Pipelines	4950Z	603Z	46
	Water Transport	5010Z, 5020Z, 5030Z, 5040Z	601A-B, 612Z, 621Z, 622Z	44
	Storage	5210A, 5210B		
	Related Services	5221Z, 5222Z		
	Handling	5224A-B		
	Freight	5229A		42
	Travel Agencies	7911Z, 7912Z, 7990Z		47
47 **Utilities**	Water Supply	3600Z, 3700Z	410Z	494
	Sanitary Services	3811Z, 3812Z, 3821Z, 3822Z, 3831Z, 3832Z, 3900Z	900A-G	495
48 **Wholesale**		46	50-51	

CONSEIL NATIONAL DES INGÉNIEURS ET DES SCIENTIFIQUES DE FRANCE

14e enquête du CNISF
sur la situation socio-économique des ingénieurs

Code CNISF (ne rien inscrire) | | | | | | | | | Codes pour le CNISF

I Signalétique personnelle

N° compl.

1. Êtes-vous membre de l'association des anciens élèves de votre école ?

1 Oui 2 Non 3 Il n'en existe pas — MASS

2. Année de naissance : 19 |__|__| — GEN

3. Sexe : 1 Homme 2 Femme — SX

4. Utilisez-vous un e-mail ? 1 Oui, personnel 2 Oui, au bureau 3 Oui, aux deux 4 Non — EM

Si la prochaine enquête se faisait à l'aide d'internet, y participeriez-vous ? 1 Oui 2 Non — EMP

II Formation d'ingénieur

5. Votre diplôme d'ingénieur a-t-il été obtenu par :

1 Formation initiale (de base) 2 Apprentissage 3 Formation continue* — FORM

(*) Si réponse **3** : Depuis combien d'années travailliez-vous quand vous avez entrepris ce diplôme ? |__|__|__|__| — ANFC

6. Votre formation à l'entrée en école d'ingénieur :

1 Bac (prépas intégrées) 2 Classes préparatoires

3 Bac + 2 ou 3 (DUT, BTS, Licence) 4 Bac + 4 (Maîtrise) ou plus 5 Autre — FOPR

7. Diplôme d'ingénieur : *(Ne rien inscrire dans la case grisée)*

Première école : Sigle .... Ville .... Année de sortie |__|__|__|__| |__|__|__|__| — ASS1 PROMO 1

Deuxième école : Sigle .... Ville .... Année de sortie |__|__|__|__| |__|__|__|__| — ASS2 PROMO 2

8. À l'issue de votre formation d'ingénieur, quelle était votre spécialité de sortie ?

Reprenez les chiffres de la liste ci-dessous : Spécialité 1 |__|__| Spécialité 2 |__|__| — SPE 1 SPE 2

1 Généraliste, sans spécialité dominante
2 Agronomie, sciences de la vie, agro-alimentaire
3 Chimie, génie des procédés
4 Électronique, télécommunications
5 Électrotechnique, automatique, électricité
6 Génie civil , BTP, mines, géologie
7 Informatique, génie logiciel, math. appliquées
8 Mécanique, production, productique
9 Physique, matériaux
10 Autre

III L'entreprise qui vous employait au 31-12-2000

9. Secteur d'activité :

Code APE au 31-12-2000 *(ce code en 3 chiffres et une lettre figure sur vos bulletins de salaire)* **:** |__|__|__|__| — NAF

SEC

1 Agro-alimentaire, agriculture
2 Industrie, énergie
3 BTP/construction
4 Sociétés de conseil, audit, études non techn.
5 SSII, sociétés de services informatiques
6 Bureaux d'études techniques, ingénierie
7 Finance, banque, assurance
8 Télécommunications
9 Commerce, ditribution, transport
10 Fonction publique : État, territoriale ou hospitalière
11 Autre

Travaillez-vous dans le secteur de la nouvelle économie (télécoms, e-business) **?** 1 Oui 2 Non — EBU

(Codes CNISF)

10. Nature de l'entreprise au 31-12-2000 NATEM

1 Travailleur indépendant
2 Secteur privé
3 Secteur nationalisé, d'économie mixte, EPIC
4 État, collectivités locales, autre secteur public

11. Taille de l'entreprise (nombre de salariés) au 31-12-2000 TAILE

1 Pas de salarié
2 1 à 20 salariés
3 21 à 499 salariés
4 500 à 4 999 salariés
5 5 000 salariés et plus

12. Lieu de travail *(indiquez : le numéro à 2 chiffres du département ; DOM : 97 ; TOM : 98 ; étranger : 99)* |_|_| DT

13. Pour l'étranger : *indiquez le code postal international (D, CH, UK, USA...)* |_|_|_| ETR

14. S'agit-il d'une entreprise que vous avez créée ? 1 Oui **Ou d'une reprise ?** 2 Oui CRE

Depuis combien d'années |_|_| Dans quel secteur d'activité *(cf. les codes d'activité de la question 9)* |_|_| ACRE SCRE

IV Caractéristiques de votre activité principale au 31-12-2000

15. Situation professionnelle au 31-12-2000 *(choix unique)* SITU

1 Fonctionnaire
2 Salarié en contrat à durée indéterminée
3 Salarié en contrat à durée déterminée
4 Salarié à employeurs multiples
5 Intérim, vacations ou contrat précaire
6 CSN
7 Travailleur indépendant
8 Gérant ou dirigeant majoritaire
9 Contrat lié à une thèse : CIFRE, ATER...
10 Demandeur d'emploi
11 Pré-retraité ou retraité
12 Autre (étudiant, congé sans solde, service national...)

16. Temps partiel. Si cette activité est à temps partiel, indiquez-en le pourcentage : |_|_| % TPS

17. Activité dominante au 31-12-2000 ACTD

(Un seul choix : cochez la case correspondant à l'activité que vous avez exercée directement ou celle dont vous aviez la responsabilité)

1 **Production, fabrication, chantiers**

2 **Approvisionnement, logistique, qualité, sécurité, organisation, maintenance, environnement...**

3 **Études, recherche, projets :**
3.1 Recherche fondamentale
3.2 Recherche, essais, développement
3.3 Projet, ingénierie, études techniques
3.4 Conseil, audit, études non techniques
3.5 Management de projets techniques

4 **Informatique, systèmes d'information, réseaux :**
4.1 Exploitation, production
4.2 Études, projets et développement
4.3 Administration, maintenance, support
4.4 Technico-commercial, commercial, marketing

5 **Technico-commercial, marketing, vente :**
5.1 Technico-commercial (sauf informatique)
5.2 Commercial, vente, marketing (sauf informatique)

6 **Administration des entreprises : finances, juridique, communication, ressources humaines...**

7 **Direction générale**

8 **Administration dans la Fonction publique**

9 **Enseignement, formation**

10 **Autre**

18. Si vous êtes informaticien, est-ce dans le domaine de : INF

1 Informatique industrielle
2 Informatique des systèmes et réseaux
3 Informatique des systèmes d'information
4 Internet

(Codes CNISF)

19. Niveau hiérarchique au 31-12-2000 PH

1 Pas encore cadre
2 Cadre sans responsabilité hiérarchique
3 Responsable d'une équipe
4 Responsable d'un service ou d'un département
5 Directeur de fonction centrale, d'établissement, de division, de branche
6 PDG ou DG

20. Nombre de salariés sous votre responsabilité hiérarchique : └┴┴┴┘ RESS

21. Si vous n'êtes pas dans la ligne hiérarchique, avez-vous un titre professionnel (expert…) conféré par votre entreprise ? 1 Oui 2 Non EXP

V Ressources professionnelles en 2000

*Il s'agit du **revenu complet** lié à l'activité que vous venez de décrire, primes et avantages en nature compris.*
Si vous n'avez pas travaillé à temps plein ou toute l'année, merci de calculer le revenu en équivalent année pleine.

22. Revenu professionnel brut annuel 2000 (en kF) **:** └┘└┴┴┘ kF REVA0
Sur ce total, quel pourcentage représente la part variable : └┴┘ % VAR

23. Bénéficiez-vous en outre de stock-options ? 1 Oui 2 Non STOC

24. Revenu professionnel brut annuel 1999 (pour rappel) **:** └┘└┴┴┘ kF REVA9

25. Revenu professionnel brut annuel prévisible pour 2001 (en kF) **:** └┘└┴┴┘ kF REVA1

VI Parcours professionnel

26. En quelle année avez-vous commencé à travailler comme ingénieur ? └┴┴┴┘ ANCE

27. Nombre d'années d'ancienneté. Dans l'entreprise : └┴┘ ; dans l'activité dominante : └┴┘ ANCP

28. Parcours professionnel :
Indiquez vos trois derniers emplois caractérisés par une activité dominante et un niveau hiérarchique.

NOP		PINT	PACTD	PPH	PDM	
	Vos 3 derniers emplois	Intitulé du poste en clair	Activité dominante *(utilisez les codes de Q17)*	Position hiérarchique *(utilisez les codes de Q19)*	Durée *(en mois)*	NOP
1	Aujourd'hui	....	└┴┘	└┴┘	└┴┴┘	PACTD
2	Emploi *n* – 1	....	└┴┘	└┴┘	└┴┴┘	PPH
3	Emploi *n* – 2	....	└┴┘	└┴┘	└┴┴┘	PDM

Combien d'emplois avez-vous occupés au total depuis que vous êtes ingénieur ? └┴┘ NBPST
Dans combien d'établissements au total ? └┴┘ NBETB

VII Réduction du temps de travail (RTT)

29. La RTT a-t-elle été mise en place dans votre entreprise ? 1 Oui 2 Non 3 Ne sait pas RTTE

30. Que comporte l'accord de RTT pour vous *(plusieurs réponses possibles)* **:** ART

1 Réduction quotidienne
2 Réduction par 1/2 journées ou journées sur une courte durée
3 Des jours de congés supplémentaires
4 Mise en place d'un Compte épargne temps
5 Modulation, annualisation
6 Autre modalité
7 Non concerné (cadre dirigeant)
8 Autres

31. Estimez-vous que, pour vous, la RTT se traduit réellement par :
1 Une réduction de votre durée hebdomadaire de travail ; 2 Une réduction de votre nombre de jours de travail ERT

32. Êtes-vous satisfait de ces modalités ? 1 Oui 2 Non SAT

VIII Travail à l'étranger (hors CSN)

33. Quand vous avez quitté la France pour la 1re fois, quelles étaient vos motivations ?

(Choix multiples possibles) — MOTET

	Rôle déterminant	Rôle accessoire	Aucun rôle
1 Liens familiaux, personnels	1	2	3
2 Perfectionner la langue	1	2	3
3 Déroulement de carrière, demande de l'employeur	1	2	3
4 Vous n'avez pas trouvé de travail en France	1	2	3
5 Création d'entreprise plus facile	1	2	3
6 Après un stage durant vos études	1	2	3
7 Après un séjour en coopération (VSN, CSN)	1	2	3
8 Poursuite d'étude ou post doc	1	2	3
9 Niveau de rémunération plus élevé	1	2	3
10 Recherche de dépaysement, autre culture	1	2	3
11 Recherche d'autonomie dans le travail	1	2	3
12 Projet humanitaire	1	2	3

34. Quel a été le premier pays étranger où vous avez travaillé *(indiquez le code postal international)* **:** |_|_|_| — TETA

35. S'agissait-il aussi de votre premier emploi ? 1 Oui 2 Non — PETR

36. Depuis que vous êtes ingénieur, combien de mois avez-vous travaillé à l'étranger ? |_|_|_| — TTR

37. Le cas échéant, votre conjoint(e) travaille-t-il (elle) à l'étranger ? 1 Oui 2 Non — CJET

Si vous travailliez à l'étranger au 31-12-2000 (hors CSN) :

38. Quel était votre statut ? — TETST

1 Salarié du privé sous contrat local
2 Salarié du privé de droit français
3 Contrat de chantier ou CDD
4 Fonctionnaire international ou français
5 Fonctionnaire local
6 Travailleur indépendant
7 Bénévole
8 Autre : ....

39. Depuis combien de mois travaillez-vous dans ce pays ? |_|_|_| mois — TETAP

40. Combien de temps encore pensez-vous travailler à l'étranger ? |_|_| années *(si vous ne savez pas, notez 99)* — TETEN

41. Travaillez-vous pour une entreprise française ? 1 Oui 2 Non — TREF

Si vous résidez en France, faites-vous des déplacements à l'étranger ? 1 Oui 2 Non — DPL

42. Combien de semaines avez-vous passé hors de France en 2000 : |_|_| — SEME

IX Renseignements complémentaires

43. Vivez-vous en couple ? 1 Oui 2 Non — COUP

44. Votre conjoint(e) a-t-il (elle) une activité professionnelle ? 1 Oui 2 Non — CJAP

45. Combien d'enfants vivent dans votre foyer ? |_|_| — ENF

46. Lorsque vous avez commencé vos études d'ingénieur, quelle était la profession de vos parents ? — PRM PRP

père	*mère*
1 Cadre ou profession intellectuelle supérieure	1 Cadre ou profession intellectuelle supérieure
2 Profession intermédiaire (technicien, instituteur, contremaître)	2 Profession intermédiaire (technicien, institutrice, infirmière)
3 Employé	3 Employée
4 Ouvrier	4 Ouvrière
5 Travailleur indépendant	5 Travailleuse indépendante
6 Autre (retraité...)	6 Autre (femme au foyer, retraitée...)

Merci pour votre collaboration

Visitez le site du CNISF **(http://www.cnisf.org)** *à partir du 30 juillet 2001 pour découvrir les premiers résultats de l'enquête.*

Non-Exclusive Competition and the Debt Structure of Small Firms

Claire Célérier[1]

Abstract

This paper analyzes the equilibrium debt structure of small firms when competition between lenders is non exclusive. Lenders simultaneously offer loan contracts, the borrower can accept more than one of them, and the set of contracts that is accepted is not observed. Two categories of lenders compete: banks that monitor their borrowers, and uninformed lenders. The monitoring technology alleviates the moral hazard problem but induces a fixed cost. I find that the equilibrium debt structure of small firms depends on their initial wealth: poorly-capitalized ones are only offered expensive loans by uninformed lenders. Richer ones can be financed at a lower price by banks. The fraction of the loan offered by the lead bank, the interest rate that is charged, and the sum of lenders' profits decrease with the borrower's initial wealth.

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1 Introduction

Understanding the financial choices of small firms is key in corporate finance. However, the literature has mostly focused on firms that are already well established. In the U.S., entrepreneurs are increasingly relying on credit cards to finance their businesses. The National Small Business Association reports that in December 2009, 49 percent of small business owners were using credit cards to finance their firms. Petersen and Rajan (1994), based on data from the Small Business Survey, show that firms first use relatively cheap sources of financing when available, and then resort to more expensive informal credits. The objective of this paper is to address the following question: Why do small firms largely rely on expensive informal finance such that credit cards or trade loans? This paper starts from the assumption that there is a fixed cost to be monitored by traditional banks. Consequently, small firms are financed through informal loans. But informal lenders may lack of information on the borrowing patterns of these small firms: they cannot observe the set of contracts accepted by the borrower and ensure that there is no multiple contracting. In the presence of moral hazard, this problem of non exclusivity can lead to inefficiencies and rents.

There is ample evidence that non exclusivity is prevalent in credit markets. Consumers and small firms typically hold several credit cards and are often given incentives to open new accounts. More generally, exclusivity clauses are rare in debt contracts, and information sharing does not exist for small firms in most countries. This paper presents an incentive model of non exclusive competition in which the strategic interactions between lenders affect the borrower's financing choices. Non exclusivity refers to the borrower's ability to accept more than one loan offer without lenders observing the set of contracts that is accepted.

Non exclusive competition combined with moral hazard can generate externalities. Consider that a borrower's unobservable effort can impact the return to a loan and that the cost of this effort is increasing with the loan amount. In this case, any lender must consider other lenders' offers as they can mitigate the borrower's incentive to exert effort. This restricts quantities offered and so, the Bertrand competition mechanism does not work. For example, if the borrower is better off taking twice the first best loan amount and shirking rather than investing the first best amount and exerting effort, competition between two lenders cannot generate the first best level of investment.

In this model, two categories of lenders compete: monitoring and non monitoring ones. The monitoring technology alleviates the moral hazard problem, but induces a fixed cost: the minimum investment required in branch network, human capital, and relationship building. For simplicity, the variable cost of monitoring is normalized to 0. Non monitoring lenders consist mainly in credit card issuers/informal lenders. Monitoring ones are traditional banks. One of the contributions of the paper is to explain financing choices under non exclusive competition between bank loans and uninformed finance.

Monitoring has two opposite effects on borrowers' surplus. On the one hand, it reduces incentives to shirk and hence increases debt capacity. On the other hand, it is costly, which lowers borrowers' payoff in case of success. Since the cost of monitoring is fixed, access to monitored finance depends on the borrower's self-financing capacity. I find that as the latter increases, the use of traditional bank loans increases whereas interest rates decrease.

When competition is non-exclusive, in the presence of moral hazard, equilibria with positive profits for active lenders arise Parlour and Rajan (2001). To alleviate the moral hazard problem, borrowers can either invest some of their own capital or turn to financial intermediaries. As in Hölmstrom and Tirole (1997) monitoring is a partial substitute for self-financing, and it increases borrower's debt capacity. However, departing from Hölmstrom and Tirole (1997), in this model monitoring affects the competitive game between lenders. With monitoring, the distribution of surplus varies in favor of borrowers and lenders' profits decrease.

Monitoring also affects the borrower's debt structure. By assumption, monitoring decreases a borrower's incentives to shirk in any of his loan relationships. Hence, his project can be financed first, by a traditional bank then, by uninformed lenders. However, to ensure that the borrower takes the loan with monitoring, the bank loan should be large enough, so that the borrower surplus is higher taking this contract and paying the fixed monitoring cost than accepting only non monitoring contracts. In other words, given that the set of loans accepted by the borrower is not observable, the monitoring lender is forced to retain a larger share of the loan when the borrowers require more intense due diligence to be sure that he is not going to free ride on the monitoring lender's offer. This has the following key empirical implication: the lead bank finances a larger portion of the project when moral hazard increases.

This paper is related to two disjoint bodies of literature. The first one analyzes the consequences of non exclusive relationships under moral hazard. This literature has been pioneered by Bizer and DeMarzo (1992) and Kahn and Mookherjee (1998). They consider that agents take their contractual decisions sequentially. More recently, Parlour and Rajan (2001), Martimort and Stole (2002) and Attar et al. (2011) have focused on models of competition in which intermediaries post their offers simultaneously. The second one focuses on the role of lenders as delegated monitors. This literature uses the term monitoring with three different meanings. Ex ante, monitoring can refer to lenders' activity of screening out "bad" loan applicants (see for instance Broecker (1990)). During the realization of a project, it may consist in preventing the borrower's opportunistic behavior (see, for instance, Hölmstrom and Tirole (1997)). Ex post, monitoring refers to lenders' activity of auditing borrowers who failed to meet contractual obligations (see, for instance, Diamond (1984)). As in Hölmstrom and Tirole (1997), I assume that monitoring reduces borrower's benefit of shirking.

This paper extends from Hölmstrom and Tirole (1997) in two directions. First, it models the financing choices of small firms. Whereas in Hölmstrom and Tirole (1997) poorly capitalized firms have no access to the credit market, in this paper the latter can have access to "uninformed loans". This result is in line with Robb and Robinson (2009) who find that small firms in the U.S. have a large access to external finance. Second, in this model monitoring and non monitoring lenders compete and competition is non exclusive, which implies new results in terms of the cost of borrowing, the debt structure, and latent contracts.

The next section develops the basic model. The case of exclusivity is described in Section 3. Section 4 analyzes the equilibrium of the model under non exclusive competition. Empirical implications are presented in Section 5. Finally, Section 6 concludes.

2 The Basic Model

The model has two types of agents: borrowers and lenders. Both are risk neutral and borrowers are protected by limited liability. There are three periods. At time 1 lenders offer simultaneously loan contracts. At time 2, each borrower chooses a subset of offered contracts and makes an investment decision. At time 3, cash flows are realized and payments are made. The analysis focuses on subgame-perfect equilibria in which lenders play pure strategies.

2.1 Borrowers

Each borrower can invest in a project of variable size I that yields a verifiable return of either $G(I)$ in case of success or 0 in case of failure. The function $G : R_+ \to R_+$ is increasing and strictly concave in I, and satisfies the Inada conditions.

The probability of success of the project is affected by an unobservable effort of the borrower e, $e = \{H, L\}$. Let p_e denote the probability of success depending on the level of effort. I assume that $p_H = p > 0$ and p_L is normalized to 0.

When a borrower chooses $e = L$, he enjoys a private benefit BI. This private benefit implies an opportunity cost of providing effort. I make the following assumption

Assumption 1 *The investment project has a positive net present value if and only if the borrower selects* $e = H$*:*

$$pG(I) - I > 0 > BI - I$$

There is a continuum of borrowers with initial wealth A. If $A < I$ the borrower needs to borrow at least $I - A$. A is observable to all lenders.

A contract has the following structure: (i) because of the borrower's limited liability, neither lenders nor the borrower are paid if the investment fails; (ii) if the project succeeds, the borrower pays $R > 0$ to lenders; (iii) if the project succeeds, the borrower receives $G(I) - R$. Therefore, a borrower's expected utility is:

$$U_A\left(I, R, e\right) = \begin{cases} p(G(I) - R) - A & \text{if } e = H \\ BI - A & \text{if } e = L \end{cases}$$

2.2 Lenders

There are two types of lenders: uninformed lenders and intermediaries. Uninformed lenders include financial institutions offering unmonitored personnel loans or credit card firms. They are considered as uninformed since they do no monitor borrowers. Intermediaries are endowed with a monitoring technology that alleviates the moral hazard problem.

Both types of lenders compete with each other by simultaneously offering loan contracts denoted C_u for uninformed lenders, and C_m for intermediaries, where

$$C_i = (L_i, R_i) \in R^2$$

where L_i is the loan amount and R_i is the promised repayment.

2.2.1 Uninformed Lenders

An uninformed lender i's expected utility is:

$$V_u\left(L_i, R_i, e\right) = \left\{ \begin{array}{cc} pR_i - L_i & \text{if } e = H \\ -L_i & \text{if } e = L \end{array} \right\}$$

2.2.2 Intermediaries

Intermediaries offer contracts with monitoring. The function of monitoring is to reduce the borrower's opportunity cost of being diligent from BI to bI. This monitoring technology involves a fixed cost c, and a variable cost that is normalized to 0.

Given that monitoring does not increase the probability of success, for a given loan amount, the borrower will always prefer not to be monitored and receive a private benefit B rather than b. Hence, monitoring must allow more capital to be raised. Therefore, the monitoring technology is coupled with a loan contract and intermediaries always invest in the project.

An intermediary i's expected utility is:

$$V_m(L_i, R_i, e) = \left\{ \begin{array}{cc} pR_i - L_i - c & \text{if } e = H \\ -L_i - c & \text{if } e = L \end{array} \right\}$$

3 The Case of Exclusivity

This section describes the impact of monitoring in the standard framework of exclusive competition.

3.1 Uninformed Finance

This section analyzes the possibility of financing a project without monitoring. First, suppose that there is no moral hazard problem, i.e. $B = 0$. In this case, the borrower is offered the contract $C^* = (L^*; R^*)$ such that $L^* = I^* - A$ and $R^* = \frac{I^* - A}{p}$ where I^* is the first best level of investment. I^* maximizes the total surplus from production, implying $I^* = \arg\max_I \{pG(I) - I\}$. The first order condition is

$$pG'(I^*) = 1$$

Now consider that the borrower receives a private benefit $B > 0$ from shirking and let $\widehat{I^u}$ denote the level of investment. $\widehat{I^u}$ maximizes the borrower's surplus, subject to the incentive compatibility constraint

$$p(G(I) - R) \geq BI$$

Hence, the borrower must be paid at least $\frac{BI}{p}$ in case of success. A necessary and sufficient condition for the lender to earn non-negative profits is

$$pR - I + A \geq 0$$

The lender's participation constraint is binding. Therefore, the borrower exerts effort if and only if

$$p(G(I) - \frac{I - A}{p}) \geq BI$$

Defining

$$A_u^* = I^* - p\left(G(I^*) - \frac{BI^*}{p}\right)$$

implies that only borrowers with $A \geq A_u^*$ can achieve the first best level. I make the following assumption

Assumption 2

$$A_u^* > 0$$

Assumption 2 is satisfied if B is large enough, i.e. $BI^* > pG(I^*) - I^*$. It simply states that any borrower cannot achieve the first best level of investment without some amount of self finance.

Let $\overline{I_A^u}$ be the investment level that uniquely satisfies

$$p\left(G(\overline{I_A^u}) - \frac{B\overline{I_A^u}}{p}\right) - \overline{I_A^u} + A = 0$$

Borrowers with $A < A_u^*$ invest $\overline{I_A^u}$. Hence, the second best level of investment is

$$\widehat{I_A^u} = Min\left[\overline{I_A^u}, I^*\right]$$

and the repayment is

$$\widehat{R_A^u} = \frac{\widehat{I_A^u} - A}{p}$$

Proposition 1 *In the standard case of exclusivity, the investment level is the second best level of investment* $I = \widehat{I_A^u}$ *such that*

- *Borrowers with* $A \geq A_u^*$ *invest* $\widehat{I_A^u} = I^*$
- *Borrowers with* $A < A_u^*$ *invest* $\widehat{I_A^u} = \overline{I_A^u}$
- *Uninformed lenders earn zero profit whereas the borrower's surplus is maximized subject to the incentive compatibility constraint*

3.2 Monitoring

Monitoring reduces the benefit from shirking from BI to bI at a fixed cost c, and so can allow more external capital to be raised. The borrower's incentive constraint with monitoring becomes

$$G(I) - R \geq \frac{bI}{p}$$

And the participation constraint of a single intermediary is

$$pR \geq I - A + c$$

Defining A_m^*, with $0 < A_m^* < A_u^*$, such that

$$A_m^* = I^* - p\left(G(I^*) - \frac{bI^*}{p}\right) + c$$

We make the following assumption

Assumption 3

$$bI^* + c < BI^*$$

Assumption 3 simply implies that $A_m^* < A_u^*$. Only borrowers with $A \geq A_m^*$ can achieve the first best level of investment with monitoring.

Defining $\overline{I_A^m}$ the level of investment satisfying

$$p\left(G(\overline{I_A^m}) - \frac{b\overline{I_A^m}}{p}\right) - \overline{I_A^m} + A - c = 0$$

$\overline{I_A^m}$ exists if A high enough. Indeed, a minimum level of wealth $\underline{A_m}$ is required to convince intermediaries to finance the project

$$\underline{A_m} = \min\{A|\exists I \geq 0 \text{ s.t. } A = bI + c + I - pG(I)\}$$

I make the following assumption

Assumption 4

$$\underline{A_m} \geq 0$$

Assumption 3 states that any project cannot be financed by intermediaries without a minimum amount of own capital. It is satisfied if for any $I \geq 0$

$$pG(I) - I < bI + c$$

Let $\widehat{I_A^m}$ denote the second best level of investment with monitoring. It verifies

$$\widehat{I_A^m} = Min\left[\overline{I_A^m}, I^*\right]$$

At the second best, repayment is

$$\widehat{R_A^m} = \frac{\overline{I_A^m} - A + c}{p}$$

Proposition 2 *In the standard case of exclusivity, when one lender monitors, the investment level is* $\widehat{I_A^m}$ *such that*

- *Borrowers with* $A \geq A_m^*$ *invest* $\widehat{I_A^m} = I^*$
- *Borrowers with* $\underline{A_m} \leq A \leq A_m^*$ *invest* $\widehat{I_A^m} = \overline{I_A^m}$
- *Borrowers with* $A < \underline{A_m}$ *cannot be financed by intermediaries, implying* $\widehat{I_A^m} = 0$

3.3 Debt Structure

Monitoring is socially valuable only if the surplus generated from alleviating the moral hazard problem is higher than the monitoring cost c. Let $S(A)$ define the monitoring surplus

$$S(A) = \underbrace{pG(\widehat{I_A^m}) - \widehat{I_A^m} - c}_{\text{Production surplus with monitoring}} - \underbrace{\left(pG(\widehat{I_A^u}) - \widehat{I_A^u}\right)}_{\text{Production surplus without monitoring}}$$

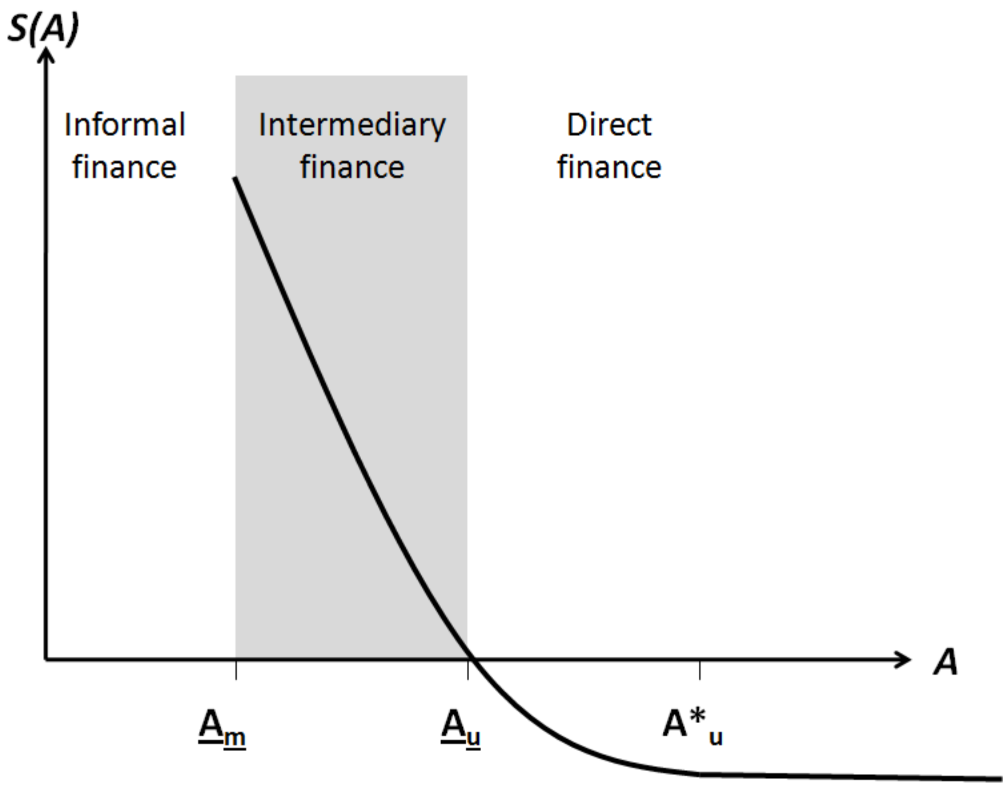
I prove that the monitoring surplus $S(A)$ is decreasing in A in the interval $[\underline{A_m}; A_u^*]$ (Proof of Proposition 3). In addition, $S(\underline{A_m}) > 0$ and $S(A_u^*) < 0$. As a result, there exists a unique $\underline{A_u}$, with $\underline{A_m} \leq \underline{A_u} \leq A_u^*$ such that

$$S(\underline{A_u}) = 0$$

Figure 1 describes this threshold value $\underline{A_u}$.

Figure 1

Threshold value $\underline{A_u}$



This leads to the following proposition

Proposition 3 *In the standard case of exclusivity, borrowers fall into three categories*

1. *Borrowers with $A \geq \underline{A_u}$ invest without the help of monitoring. If $A \geq A_u^*$, they achieve the first best level of investment without monitoring.*

2. *Borrowers with $\underline{A_m} \leq A \leq \underline{A_u}$ invest with the help of monitoring. If $A \geq A_m^*$ they achieve the first best level of investment with monitoring.*

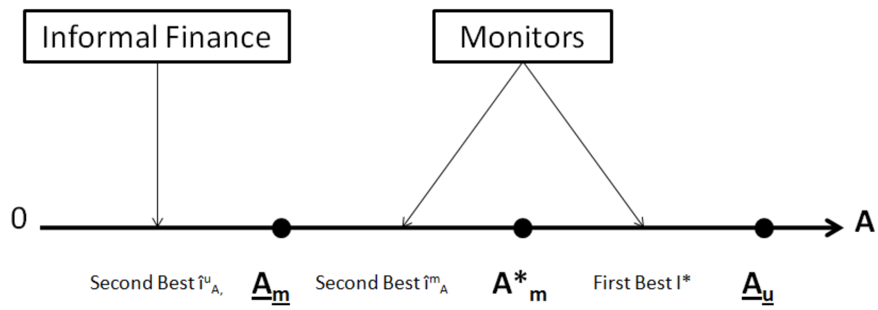
3. *Poorly-capitalized borrowers, with $A \leq \underline{A_m}$, cannot invest with the help of monitoring since they cannot convince intermediaries to finance the project. They achieve the second best level of investment without monitoring.*

Proof. Let demonstrate first that $S(A)$ is a decreasing function of A. If $A \geq A_u^*$, the first best can be financed by uninformed lenders, and so $S(A) = -c$. If $A_m^* \leq A < A_u^*$, the competitive allocation with monitoring is the first best level of investment, whereas the competitive allocation without monitoring is constrained and is increasing in A. Therefore, $S(A)$ is decreasing in A. If $\underline{A_m} \leq A \leq A_m^*$, the first best cannot be financed neither with nor without monitoring. $B > b$ implies that $\widehat{I_A^u}$ increases at a higher rate than $\widehat{I_A^m}$. In addition, due to G concavity, if $\widehat{I_A^m} - \widehat{I_A^u}$ decreases, the difference in net present value decreases even more. And so $S(A)$ is decreasing in the interval $[\underline{A_m}; A_u^*]$. In addition, $S(\underline{A_m}) > 0$ and $S(A_u^*) = -c < 0$. As a result, there exists a unique $\underline{A_u}$, with $\underline{A_m} \leq \underline{A_u} \leq A_u^*$ such that $S(A) = 0$ ■

Figure 2 summarizes the results. Compared to Hölmstrom and Tirole (1997) in this model any firm can be financed with external funds. However, only a fraction of them can have access to intermediate finance.

Figure 2

Firm Debt Structure - Exclusive Competition



4 Non Exclusive Competition

This section describes the competitive game when competition is non exclusive.

4.1 The Competitive Game

The competitive game unfolds as follows. At time 1, lenders compete by offering non-exclusive loan contracts. At time 2, each borrower can simultaneously accept more than one offer. Let $C^{\mathcal{O}} = (L^{\mathcal{O}}, R^{\mathcal{O}})$ denote the set of all contracts offered and $C^{\mathcal{A}} = (L^{\mathcal{A}}, R^{\mathcal{A}})$ the set of all contracts accepted. The size of the investment for a borrower with initial wealth A is

$$I = L^{\mathcal{A}} + A$$

A lender is *active* if his contract is accepted, *latent* if not.

In equilibrium, lenders offer profit maximizing contracts given the moral hazard problem and the strategy of other lenders. In turn, the consumer accepts an optimal set of contracts and decides to exert effort or not.

In this model, moral hazard is *severe*; the borrower's surplus in case of low effort is strictly increasing in I. This has the important implication that if the borrower decides to exert low effort, the strategy of accepting all offered contracts is optimal. Hence, he ultimately chooses between two options:

- To accept a subset of offered contracts and exert high effort ($L^{\mathcal{A}} \leq L^{\mathcal{O}}$), or
- To accept all contracts and exert low effort ($L^{\mathcal{A}} = L^{\mathcal{O}}$)

Assumption 1 implies that in any equilibrium, the borrower exerts high effort. Hence, under non exclusive competition, the borrower's incentive compatibility constraint is

$$p(G(L^{\mathcal{A}} + A) - R^{\mathcal{A}}) \geq B(L^{\mathcal{O}} + A)$$

In addition, since the total surplus from production is decreasing if $I > I^*$, the level of investment is at most I^*.

Finally, note that monitoring reduces the borrower's opportunity cost of being diligent from BI to bI for *all* his loan relationships. Therefore, the fixed cost of monitoring implies that only one lender monitors.

Lemma 1 *Under non exclusive competition, any equilibrium has the following properties*

1. *The aggregate contract accepted $L^{\mathcal{A}}$ verifies $L^{\mathcal{A}} \leq I^* - A$ where I^* is the first best level of investment.*

2. *The borrower's incentive compatibility constraint without monitoring is*

$$p(G(L^{\mathcal{A}} + A) - R^{\mathcal{A}}) \geq B(L^{\mathcal{O}} + A)$$

3. *There is at most one active lender that monitors*

Proof. By contradiction, assume that $L^{\mathcal{A}} \geq I^* - A$. Hence, the level of investment I verifies $I \geq I^*$. If $I > I^*$, the total surplus from production $pG(I) - I$ is strictly decreasing. Consequently, reducing the size of the investment results in an increase in the surplus. So, the aggregate contract accepted is at most $L^{\mathcal{A}} = I^* - A$, where I^* is the first best level of investment. ■

4.2 Poorly Capitalized Borrowers

This section characterizes equilibria in which borrowers are financed only through non monitoring loans. It concerns poorly-capitalized borrowers, with $A < \underline{A_m}$, for which the cost of the monitoring technology is too high (Proposition 2). Since $\underline{A_m} < A_u^*$, the incentive compatibility constraint is binding, and the aggregate amount offered $L^{\mathcal{O}}$ is at most the second best $\widehat{I_A^u} - A$. Indeed, if $I \geq \widehat{I_A^u}$ the borrower will be better off taking all contracts and shirking.

Furthermore, in any equilibrium allocation with poorly capitalized borrowers i) there is no *latent* contracts, ii) the incentive compatibility constraint is binding and iii) lenders get positive profits.

Consider first the set of offered contracts $L^{\mathcal{O}}$. A *latent* lender, whose offer is not taken, can reduce the offered loan amount and the repayment so that the borrower accepts his offer. The incentive to shirk is decreasing with the aggregate loan amount, and so the borrower behaves. Since $I \leq \widehat{I_A^u}$, the production surplus is increasing in I, and this deviation is profitable.

Second, suppose by contradiction that the incentive constraint is not binding. Any active lender has an incentive to deviate: he can increase the total loan amount and keep the borrower's surplus constant until the incentive constraint is binding. Since the borrower is indifferent he will accept the offered contract, and behave. In addition, since $I < I^*$ the total surplus from production is increasing in I, and so the deviation is profitable. A direct implication concerns the repayment amount $R^{\mathcal{A}}$, which verifies

$$R^{\mathcal{A}} = G\left(L^{\mathcal{A}} + A\right) - \frac{B}{p}(L^{\mathcal{A}} + A)$$

Finally, suppose that there exists an equilibrium allocation in which lenders get zero profit. In such an allocation $I = \widehat{I_A^u}$ since the incentive compatibility constraint is binding. If $I = \widehat{I_A^u}$, any decrease in the level of investment has a lower impact on the total surplus from production than on the agency cost. Indeed, $G'(I_A^u) - \frac{1}{p} < \frac{B}{p}$. Therefore, any equiproportional decrease in the level of investment and the borrower's payoff will increase profits without inducing default and so, an *active* lender has always an incentive to deviate.

With poorly capitalized borrowers, if moral hazard is severe enough and if a lender is offering that maximizes its profits, the *monopolist* contract, no inactive lender can compete without inducing shirking: the borrower will be better off accepting both contracts and shirking. Since the incumbent lender maximizes its profit, he has no incentive to deviate. Therefore, an equilibrium can emerge with a unique active lender offering a *monopolist* contract.

Proposition 4 *If the borrower is poorly-capitalized, i.e. if $A < \underline{A_m}$, in any equilibrium*

1. *The total amount of debt offered is at most the second best level of investment $\widehat{I_A^u}$*
2. *There is no monitoring*
3. *There is no zero profit equilibrium. A credit allocation maximizing lenders' profits can even emerge in equilibrium*
4. *There is either a unique active lender, or N symmetric active lenders*

Proof. See in Appendix ■

4.3 Intermediate Borrowers

Intermediate borrowers, with $\underline{Am} < A < \overline{A_m}$, can invest with the help of monitoring, but cannot achieve the competitive allocation with monitoring. Two equilibria can emerge: a monopoly allocation with monitoring and a limit pricing equilibrium, in which the offered loan amount is the first best whereas lenders get positive profits that are limited by the presence of competing latent contracts.

4.3.1 Monopoly Allocation with monitoring

If the initial wealth of the borrower is high enough, i.e. if $A > \underline{A_m}$ then the borrower can be financed with monitoring. However, if $\underline{A_m} < A < A_m^*$ the aggregate amount offered $L^{\mathcal{O}}$ is at most the second best $\widehat{I_A^m} - A$. Indeed, since if $I = \widehat{I_A^m}$ the incentive compatibility constraint is binding, if $I \geq \widehat{I_A^m}$ the borrower is better off taking all contracts and shirking.

Lemma 2 *The total amount of debt offered $L^{\mathcal{O}}$ to intermediate borrowers, with $\underline{A_m} < A < A^*_m$, is at most the second best level of investment $\widehat{I^m_A} - A$.*

Therefore, the offered loan amount is constrained to be lower than the first best level, and so in any equilibrium allocation i) there is no *latent* contracts, ii) the incentive compatibility constraint is binding and iii) lenders get positive profits iv) an allocation maximizing lenders' profit can emerge in equilibrium.

Proposition 5 *With intermediate borrowers, if $\underline{A_m} < A < A^*_m$, there exists an equilibrium with the following properties*

1. *The investment level is rationed and equal to the amount a single monopolist would offer*
2. *The borrower is monitored*
3. *There is a unique active lender*
4. *The credit allocation maximizes the lender's profit subject to the borrower's incentive compatibility constraint*

Proof. See Appendix. ■

4.3.2 Limit Pricing Equilibrium with Monitoring

Let consider borrowers with $A > A^*_m$. In that case, the offered loan amount is $L \geq I^*$. Indeed, assume by contradiction that there is an equilibrium such that $L^{\mathcal{O}} < I^*$. In this case, there is no latent contracts, because a latent lender could always decrease the total loan amount and interest rates such that his contract is accepted. Indeed, the surplus from production will decrease at a lower rate than the benefit from shirking, and so it will no induce shirking. In addition, the incentive compatibility constraint is binding. If not, an active lender has always an incentive to deviate by increasing the total loan amount and keeping the borrower's surplus constant until the incentive constraint is binding. I show that an active lender has always an incentive to deviate and so this allocation cannot be considered as an equilibrium. This leads to the following proposition

Let $\overline{A_m}$ denote the wealth threshold above which two intermediaries can compete offering the first best with monitoring without inducing shirking. Each lender observe A, and offers the contract $(I^* - A; \frac{I^*-A}{p})$. If the borrower takes only one contract and behaves, his payoff is

$$pG(I^*) - I^* - c$$

In contrast, the borrower can choose to take both contracts and shirk. His payoff becomes:

$$b(2I^* - A) - A$$

Hence, the borrower behaves if and only if

$$pG(I^*) - I^* - c \geq b(2I^* - A) - A$$

$\overline{A_m}$ verifies

$$\overline{A_m} = \frac{1}{1+b}\left(2bI^* - pG(I^*) + I^* + c\right)$$

Therefore, if $A_m^* < A < \overline{A_m}$, two intermediaries cannot compete offering first best contracts without inducing shirking.

If $A_m^* < A < \overline{A_m}$ a limit pricing equilibrium can emerge. In this equilibrium an active lender offers the first best level of investment, and a latent lender offers a zero-profit contract such that the incentive compatibility constraint is binding. The interest rate charged by the active lender is such that the borrower is indifferent between accepting its contract, or the contract from the uninformed lender. The active lender cannot deviate by increasing rents without his offer being rejected in favor of the inactive lender's one, the inactive lender cannot increase or decrease the loan amount without inducing shirking and, finally, any contract offered by a third uninformed lender would induce shirking.

Proposition 6 *With intermediate borrowers, if $A_m^* < A < \overline{A_m}$, there exists an equilibrium with the following properties*

1. *The investment amount is the first best I^**
2. *The borrower is monitored*
3. *Profits are positive*
4. *There is a unique active lender and a latent contract is offered by an uninformed lender*

Proof. See Appendix. ∎

4.4 Well-Capitalized Borrowers

Borrowers with $\overline{A_m} < A < \overline{A_u}$ can have access to the competitive allocation with monitoring. Indeed, by definition, $\overline{A_m}$ is high enough to relax the constraint on quantities in the competition game: two lenders can compete offering the first best level of investment without inducing shirking.

Let α denote the fraction of the investment financed by the lead monitoring lender. Uninformed lenders offer contracts knowing that the borrower is going to be monitored. However, since the borrower's benefit from shirking is higher without monitoring, the latter has an incentive to take all contracts from uninformed lenders and shirk. Consequently, the fraction of the loan offered by the lead bank satisfies

$$pG(I) - I - c + A \geq bI(1-\alpha)$$

$$\alpha \geq 1 - \frac{1}{bI}(pG(I) - I - c + A)$$

When A increases α decreases.

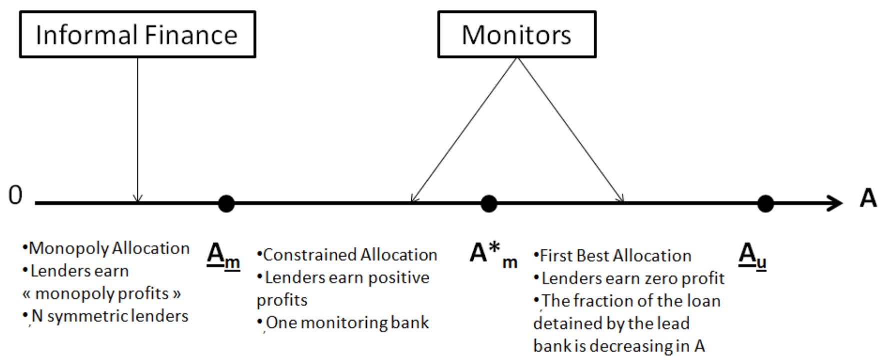
Proposition 7 *If the borrower is well-capitalized, with $\overline{A_m} < A < \overline{A_u}$, there is a unique equilibrium such that*

1. *The investment level is the first best I^**
2. *The borrower is monitored*
3. *Lenders earn zero profits*
4. *There may be multiple active lenders and the fraction of the loan offered by the lead one is decreasing in the borrowers' initial wealth*

Proof. See Appendix. ■

Figure 3

Firm Debt Structure - Non Exclusive Competition



5 Empirical Implications

The model makes the following empirical predictions on the debt structure of small businesses.

Sources of borrowing

Proposition 4 predicts that poorly-capitalized borrowers will have access to external finance, but not to monitoring. They can be financed by "informal lenders": credit cards, family or trade loans. Proposition 5, 6 and 7 imply that intermediately and well-capitalized borrowers can be financed with traditional bank loans.

Cost of Capital

Proposition 4 and 5 predict that small firms are charged non competitive interest rates. Lenders' rents decrease with the financing capacity of the borrower. Proposition 7, on the contrary, predict that well-capitalized firms can have access to zero-profit loans.

Multiple contracting

Proposition 4 predicts that multiple symmetric contracting emerge with poorly-capitalized borrowers. Proposition 5 and 6 imply that intermediately-capitalized borrowers are financed mainly by a unique monitoring bank. Concerning well-capitalized borrowers, Proposition 7 states that the fraction of the loan amount retained by the lead bank is decreasing with the firm financing capacity.

6 Data

The objective is to test the empirical implications of our model with the National Survey of Small Business Finance Data. This survey collects information on small businesses in the United States by interview. The information collected includes the use of financial services among which credit cards. The survey is available for the years 1987, 1993, 1998 and 2003.

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A Proofs

A.1 Proof of Proposition 4

If the borrower is poorly capitalized, i.e. if $A < \underline{A_m}$***, in any equilibrium***

1. $L^{\mathcal{O}} \leq \widehat{I_A^u}$

By definition, $A < \underline{A_m} \Rightarrow A < A_m^*$ and Assumption 3 implies that $A_m^* < A_u^*$. Consequently, $\widehat{I_A^u} = \overline{I_A^u}$.

2. There is no monitoring

By definition of $\underline{A_m}$, $A < \underline{A_m}$ implies that for any $I \geq 0$

$$A < bI + c + I - pG(I)$$

and so, a contract with monitoring cannot be offered without inducing shirking.

3.a. There is no zero profit equilibrium

By contradiction, assume that there exists a zero profit equilibrium. I show that an active lender, unique or not, has always an incentive to deviate, which contradicts the assumption.

First, consider any lender i offering $L > 0$. If there is no other active lender $j \neq i$ offering $L' > 0$, lender i will offer the monopolist contract (L_M^u, R_M^u) and hence deviate. A unique active lender has always an incentive to deviate

Suppose now that in addition to lender i offering $L > 0$ there exists at least one other active lender $j \neq i$ offering (L', R'), with $L' > 0$.

As by assumption we are in a zero profit equilibrium, it must be the case that $R' = \frac{L'}{p}$. Since $I^{\mathcal{O}} \leq \widehat{I_A^u}$, this implies

$$L + L' \leq I_A^u - A$$

$$\Rightarrow L' + A < I_A^u$$

This implies:

$$B(L' + A) < pG\left(L' + A\right) - L'$$

Introducing $I' = L' + A$, we have:

$$BI' - A < pG\left(I'\right) - I'$$

Since $pG(I') - I'$ is increasing on the interval $[0; I^*]$, there exists $\epsilon > 0$ such that:

$$\begin{cases} pG(I') - I' & < & pG(I' + \epsilon) - (I' + \epsilon) \\ B(I' + \epsilon) - A & < & pG(I' + \epsilon) - (I' + \epsilon) \end{cases}$$

Therefore, there exists $\delta > 0$, such that:

$$pG(I' + \epsilon) - (I' + \epsilon + \delta) > \max[B(I' + \epsilon) - A; pG(I') - I']$$

Thus, the contract $\left(\epsilon, \frac{\epsilon+\delta}{p}\right)$ is a profitable deviation for lender i, which contradicts the premise that there exists a zero-profit equilibrium.

3b. An allocation maximizing lenders' profits can emerge as an equilibrium

Suppose now that a lender offers the monopolist contract $C_M^u = (I_M^u, R_M^u)$ without monitoring. This allocation maximizes the lender's profit when the incentive compatibility constraint is binding, an so a unique active lender offering this allocation has no incentive to deviate. I_M^u verifies

$$I_M^u = \arg\max_I \{G(I) - \frac{BI}{p} - I + A\}$$

which implies $G'(I_M^u) = \frac{1+B}{p}$, and $R_M^u = G(I_M^u) - \frac{BI_M^u}{p}$. An inactive lender has two options.

First, the inactive lender can offer a contract (L', R') accepted in conjunction with the monopolist one. The borrower's incentive constraint becomes

$$G(I_M^u + L') - R_M^u - R' \geq \frac{B(I_M^u + L')}{p}$$

Introducing $R_M^u = G(I_M^u) - \frac{BI_M^u}{p}$, the no default condition becomes

$$G(I_M^u + L') - G(I_M^u) - R' \geq \frac{L'B}{p}$$

Using G concavity and introducing $G'(I_M^u) = \frac{1+B}{p}$

$$L'\frac{1+B}{p} - R' \geq \frac{L'B}{p}$$

which implies

$$R' < \frac{L'}{p}$$

However, the necessary condition for this deviation to be profitable is $R' \geq \frac{L'}{p}$. Therefore, this deviation cannot be profitable without inducing shirking.

Second, the deviating lender can offer a contract (L', R') that is preferred to the monopolist one. The borrower's incentive constraint is

$$p\left(G(L'+A) - R'\right) \geq B(L' + I_M^u)$$

And the deviating lender's profit π'

$$\pi' = pR' - L' \tag{1}$$

Profits are maximum when the incentive constraint is binding, implying

$$R' = \frac{1}{p}\left[pG(L') - B(L' + I_M^u)\right] \tag{2}$$

Introducing (2) and differentiating (1), the FOC is

$$G'(L'+A) = \frac{1+B}{p}$$

This implies $L' + A = I_M^u$. This deviation neither is profitable if and only if

$$pG(I_M^u) - B(2I_M^u - A) - I_M^u - A \geq 0$$

Therefore, if moral hazard is severe enough, this deviation neither is profitable.

4. There is either a unique active lender, or N symmetric lenders

First, at any equilibrium allocation, the borrower's surplus is such that the incentive compatibility constraint is binding. Suppose by contradiction that it is not the case:

$$R^{\mathcal{A}} < G\left(L^{\mathcal{A}} + A\right) - \frac{B}{p}(L^{\mathcal{O}} + A)$$

I show that any active lender has a profitable deviation. Let $C_i = (L_i, R_i)$ be the equilibrium offer of an active lender i, and suppose he deviates offering the contract $C_i' = \left(L_i + \epsilon, R_i + \frac{\epsilon}{p} + \epsilon^2\right)$ for some strictly positive number ϵ. I define $C_{-i}^{\mathcal{A}} = (L_{-i}^{\mathcal{A}}; R_{-i}^{\mathcal{A}})$ the aggregate contract accepted by the borrower in equilibrium excluding contract C_i, $C_{-i}^{\mathcal{A}} = \sum_{j \neq i} C_j^{\mathcal{A}}$. For ϵ small enough:

$$p\left[G\left(L_{-i}^{\mathcal{A}} + L_i + A + \epsilon\right) - \left(R_{-i}^{\mathcal{A}} + R_i + \frac{\epsilon}{p} + \epsilon^2\right)\right] \geq p\left[G\left(L_{-i}^{\mathcal{A}} + L_i + A\right) - R_i - R_{-i}^{\mathcal{A}}\right]$$

Therefore, since the net present value is increasing in ϵ for $I + \epsilon < I^*$, the borrower has an incentive to accept contract C_i'. Let $\bar{L} = L^{\mathcal{O}} - L^{\mathcal{A}}$ denote the aggregate loan amount offered by *latent* lenders. Following this deviation, the borrower strictly prefers $e = h$ if and only if:

$$p\left[G\left(L^{\mathcal{A}} + A + \epsilon\right) - \left(R^{\mathcal{A}} + \frac{\epsilon}{p} + \epsilon^2\right)\right] > B\left(L^{\mathcal{A}} + A + \epsilon + \bar{L}\right)$$

$$G\left(L^{\mathcal{A}}+A+\epsilon\right) > \frac{B}{p}\left(L^{\mathcal{A}}+A+\epsilon+\bar{L}\right)+\left(R^{\mathcal{A}}+\frac{\epsilon}{p}+\epsilon^2\right) \tag{3}$$

The function G's concavity implies:

$$G\left(L^{\mathcal{A}}+A+\epsilon\right)-G'\left(L^{\mathcal{A}}+A+\epsilon\right)\epsilon \;>\; G\left(L^{\mathcal{A}}+A\right)$$

Hence, condition (3) is true if $\exists\epsilon>0$ such that

$$G\left(L^{\mathcal{A}}+A\right)+G'\left(L^{\mathcal{A}}+A+\epsilon\right)\epsilon > \frac{B}{p}\left(L^{\mathcal{A}}+A+\epsilon+\bar{L}\right)+\left(R^{\mathcal{A}}+\frac{\epsilon}{p}+\epsilon^2\right)$$

$$G\left(L^{\mathcal{A}}+A\right)-\frac{B}{p}\left(L^{\mathcal{A}}+A+\bar{L}\right)-R^{\mathcal{A}} > -G'\left(L^{\mathcal{A}}+A+\epsilon\right)\epsilon+\frac{B\epsilon}{p}+\left(\frac{\epsilon}{p}+\epsilon^2\right) \tag{4}$$

I define δ such that:

$$\delta = G\left(L^{\mathcal{A}}+A\right)-\frac{B}{p}\left(L^{\mathcal{A}}+A+\bar{L}\right)-R^{\mathcal{A}} > 0$$

By definition, $\delta>0$. Then, condition (4) holds if $\exists\epsilon$ small enough such that

$$\delta > \left[-G'\left(L^{\mathcal{A}}+A+\epsilon\right)+\left(\frac{B+1}{p}+\epsilon\right)\right]\epsilon$$

Hence, the offer C_i' is accepted and the borrower exerts effort. In addition, the deviation is profitable. Indeed:

$$p\left(R_i+\frac{\epsilon}{p}+\epsilon^2\right)-(L_i+\epsilon) = pR_i-L_i+p\epsilon^2 > pR_i-L_i$$

Second, at any equilibrium allocation, I show that there is no *latent* contract. By contradiction, let consider a lender i whose offer (L_i,R_i) is not taken. It implies that:

$$p\left(G(L^{\mathcal{A}}+A)-R^{\mathcal{A}}\right) \geq p\left(G(L^{\mathcal{A}}+A+L_i)-R^{\mathcal{A}}-R_i\right)$$

Suppose that i deviates offering the contract $(\epsilon;\frac{\epsilon}{p}+\epsilon^2)$, with $\epsilon<L_i$. As $\epsilon<L_i$, we have:

$$p\left(G(L^{\mathcal{A}}+A+\epsilon)-R^{\mathcal{A}}-\frac{\epsilon}{p}-\epsilon^2\right) > B(L^{\mathcal{O}}+A-L_i+\epsilon)$$

As a result the borrower will accept the contract and exert effort. Therefore, this is a profitable deviation for lender i.

Third, at any positive profit equilibrium, excluding monopoly profit ones, the borrower must be indifferent between accepting N or $N-1$ contracts whatever the contract that is not taken

Let consider a positive profit equilibrium with a unique lender $\Rightarrow$ monopoly allocation.

Let consider a positive profit equilibrium with N active lenders offering contracts $C_i = (L_i, R_i)$ for $i = 1....N$. The borrower's surplus is the one at which the incentive compatibility constraint is binding and there is no *latent* contracts. The borrower's surplus is higher than at the monopoly profit allocation if and only if:

$$L^{\mathcal{A}} + A > I_M^u$$

For this allocation to be an equilibrium, no lender should have an incentive to deviate. We show that a lender has no incentive to deviate only if the borrower is indifferent between taking N or $N-1$ contracts, whatever the deviating one.

Let consider that lender i offers the contract $C_i' = (L_i - \epsilon, R_i - \frac{\epsilon - \epsilon^2}{p})$. We show that this is a profitable deviation **(a)**, that except if the borrower is indifferent between taking N or $N-1$ contracts, whatever the deviating one, he is going to accept the contract **(b)**, without shirking **(c)**.

(a). This is a profitable deviation for lender i if the borrower takes the contract and exerts high effort. Indeed, let π_i and π_i' be respectively lender i's profit when the contracts i and i' are accepted without shirking. We have:

$$\pi_i\prime = p\left[R_i - \epsilon\frac{1-\epsilon}{p}\right] - I_i + \epsilon$$

$$\pi_i\prime = \pi_i + \epsilon^2$$

So the contract i' is a profitable deviation for lender i if the borrower accepts it and behaves.

(b). Now we show under which conditions the borrower accept the contract. Let denote as $C_{-i}^{\mathcal{A}} = (L_{-i}^{\mathcal{A}}; R_{-i}^{\mathcal{A}})$ the aggregate contract that is accepted exclusing the contract C_i. We consider three cases covering all possibilities.

First, let assume that we have:

$$pG\left(L_{-i}^{\mathcal{A}} + A\right) - pR_{-i}^{\mathcal{A}} > pG\left(L^{\mathcal{A}} + A\right) - pR^{\mathcal{A}}$$

In this case, the borrower would never have taken contract i at equilibrium, which contradicts the first assumption.

Second, let assume that we have:

$$pG\left(L_{-i}^{\mathcal{A}} + A\right) - pR_{-i}^{\mathcal{A}} < pG\left(L^{\mathcal{A}} + A\right) - pR^{\mathcal{A}}$$

In this case, there exists ϵ small enough such that:

$$pG\left(L_{-i}^{\mathcal{A}} + A\right) - pR_{-i}^{\mathcal{A}} \leq pG\left(L^{\mathcal{A}} + A - \epsilon\right) - pR^{\mathcal{A}} + \epsilon - \epsilon^2$$

As a result, the borrower is better off accepting the deviating contract.

Third, let assume that we have:

$$pG\left(L_{-i}^{\mathcal{A}} + A\right) - pR_{-i}^{\mathcal{A}} = pG\left(L^{\mathcal{A}} + A\right) - pR^{\mathcal{A}}$$

In this case only we cannot find an ϵ small enough such that the borrower is going to take the offer.

(c). Second, we show that if the borrower accepts the deviating contract he behaves. If it were an equilibirum for the borrower to accept $C_{\mathcal{A}}$, then from Proposition 3.2., we know that:

$$pG\left(I^{\mathcal{A}}\right) - pR^{\mathcal{A}} = B\left(I_i + \sum_{j \in N|\{i\}} I_j\right)$$

Let $C'_{\mathcal{A}} = (I^{\mathcal{A}\prime}, R^{\mathcal{A}\prime})$ be the aggregte offer after the deviation. We know that $I^{\mathcal{A}} > I^m$, as a result, for ϵ small enough, we also have $I^{\mathcal{A}\prime} > I^m$. As on the interval $[I^m; I^*]$, the function $pG(I) - I - BI$ is strictly decreasing, we can write that:

$$pG\left(I^{\mathcal{A}} - \epsilon\right) - pR^{\mathcal{A}} + \epsilon > B\left(I_i + \sum_{j \in N|\{i\}} I_j - \epsilon\right)$$

As a result, for ϵ small enough, we have:

$$pG\left(I^{\mathcal{A}\prime}\right) - pR^{\mathcal{A}\prime} > B\left(I'_i + \sum_{j \in N|\{i\}} I_j\right)$$

Hence, the contract (I'_i, R'_i) is accepted and the borrower exerts high effort.

As a result, lender i has an incentive to deviate and the allocation such that $I^{\mathcal{A}} > I^m$ is not an equilibrium.

A.2 Proof of Proposition 5

Same demonstration as in proposition 4, except that due to the monitoring technology, there is no symmetric equilibrium since only one lender monitors. Therefore, the unique equilibrium is the monopolist one.

A.3 Proof of Proposition 6

Let define the function F such that $F(L) = p(G(L+A)) - L - b(L+I^*)$. By definition, for any $A < \overline{A_m} - pc$, $(I^* - A) < 0$. There exists A_l such that $F(I_M^m - A) = 0$. I show that for any A, $A_l < A < \overline{A_m}$, there exists an equilibrium in which lender i

offers the contract $(I^* - A; \frac{I^*-A-c}{p} + \lambda)$ that is taken, lender j offers the contract $(L'; \frac{L'-A}{p})$ that is not taken where L' and λ verify:

$$F(L') = 0 \tag{5}$$

$$\lambda = p(G(I^*)) - I^* + A - c - pG(L' + A) - L' \tag{6}$$

No deviation for the latent lender.

Suppose that lender j decreases the loan amount. The borrower's payoff from accepting contract j is strictly less than $pG(L' + A) - L'$, which can be obtained by accepting and repaying contract i alone. Hence, contract j is not accepted. Suppose now that j increases the loan amount he offers. Since $L' > I^m_M$ the benefit from shirking increases at a higher rate than the production surplus. Hence, the borrower will accept both contract and shirk. Consequently, there is no profitable deviation for lender j.

No deviation for the active lender.

Lender i can not increase or decrease the loan amount without his contract being rejected, since the surplus is maximized at I^*. In addition, he cannot increase interest rates since the borrower's surplus must be at least the one he gets accepting contract j.

No deviation for any inactive lender.

Any contract that would be preferred must offer a payoff of at least $pG(L') - L'$ to the borrower; However, in this case, the borrower will be better off taking the three contracts and shirking.

A.4 Proof of Proposition 7

Consider lender i offering the following contract $(I^* - A, \frac{I^*-A+c}{p})$ with monitoring.

No deviation for any latent lender.

An inactive lender cannot offer a contract that will be strictly preferred to the one offered by lender i, since it maximizes the borrower payoff.

No deviation for the active lender.

Suppose that lender i deviates offering a contract $\left(I^* - A, \frac{I^*-A}{p} + \epsilon, 1\right)$. Then, another lender can offer the following contract with monitoring to compete $\left(I^* - A, \frac{I^*-A}{p} + \frac{\epsilon}{2}, 1\right)$. This contract will be strictly preferred by the borrower without inducing shirking, since $2BI^* < pG(I^*) - I^* + A$. Therefor, lender's i deviation is not profitable.

What Drives Financial Innovation? A Look into the European Retail Structured Products Market

Claire Célérier, Boris Vallée *

Abstract

Complexity has dramatically increased in the market of retail financial products over the last twenty years. What drives this innovation in retail finance? We focus on the market of retail structured products to answer this question.

Using an academically unexploited database that gathers detailed information on all the retail structured products sold on the European market since 1996, we first develop two complementary measures of product complexity. They both exhibit an increasing trend over time. We then argue that complexity is used as a differentiating tool by banks to inflate investor expectations and limit competition. Evidence of strategic structuring and higher complexity in the most competitive markets empirically comforts this hypothesis.

Keywords: Household Finance, Financial Literacy, Complexity

JEL codes:

*HEC Paris

1 Introduction

Complexity has dramatically increased in the market of retail financial products over the last twenty years. Innovative products have constantly been introduced, famously in the mutual fund and the credit card industries. In the meanwhile, financial literacy and sophistication seems to remain low (Lusardi et al. (2009), Lusardi et al. (2010)). What drives this financial innovation in retail finance? Complexity may add value for households, for instance by completing product offers and thus markets, or by optimally and automatically implementing certain financial decisions. However it could also have negative effects, by increasing search costs and/or strategically exploiting consumer low financial literacy. To answer this research question, we focus on a specific market that has met phenomenal growth and innovation in the last decade: the retail structured products market. We establish two complementary measures of products complexity, that we apply to an exhaustive data base of all the retail structured products that have been sold in Europe since inception 15 years ago. We subsequently develop and test a theoretical framework to explain the observed increase in complexity.

Rationale for studying the market of retail structured products is strong. First, its economic significance is high: in Europe alone it represents more than EUR700bn assets under management and is growing fast. More generally passive strategy funds are the fastest growing segment of household finance and the development of the structured retail market is part of this global trend in asset management. For example, Exchange Traded Funds have now reached $1.5 trillion of assets under management, catching up with hedge funds. Second, consumer disclosure and protection is key in this market, as information asymmetry is maximal between innovators, investment banks structuring the products, and the final consumer, the mass-market retail investor. The former must reconcile two simultaneous objectives: addressing customers demand while maximizing its profit. The latter may face limited rationality when processing information on the complex products. This potentially leads to exploiting customers' behavioral biases/low sophistication. Third, some structured products seem well suited for pension savings, as they offer exposure to stock markets while guaranteeing a minimum capital at maturity. They may play an increasing role in this market. Fourth, the organization of supply in this market is of key interest in itself. The entity in charge of structuring the products is distinct from the one in charge of its commercialization. This creates potential agency issues. This organizational structure is widespread in financial instruments markets, such as traditional asset management. Finally this market illustrates a major public policy issue: individual financial decisions are becoming increasingly complex, meanwhile financial literacy/sophistication has made little to no progress.

Our empirical analysis is largely based on a lexicographic analysis of a data set that gathers detailed information on all retail structured products that have been sold in Europe since market inception (1996). This market represents more than 700 billion euros in Europe, which stands for 2% of total financial savings in the continent. This database has several unique critical advantages characteristics one looks for in any empirical industrial organization study. It covers 18 countries and 16 years of data. A detailed pay-off descriptive, information on providers and volume sold are available at issuance level. We develop a simple algorithm to precisely identify and analyze payoff structures for all products. In addition, this academically unexploited data set has been matched with data on providers (Bankscope), macroeconomic data (World Bank), and market conditions (Datastream).

This paper offers two innovative and complementary measures for apprehending the structure and dynamics of the retail structured product market. The first one, based on the lexicographic analysis, takes the provider point of view. It builds a decision algorithm describing the required steps in developing a structured retail product: in addition to the choice of an underlying and a primary payoff structure a product provider mandatorily faces, 7 types of exotic features can be added, ranging from early maturity option to path dependant ones. This algorithm allows to classify products along a tree like structure, and to measure their complexity by capturing features piling. The second approach takes the retail investor point of view. Indeed, for the latter, product complexity cannot be reduced to the number of payoff features a formula combines. It also depends on how tractable each feature is, and how the product marketing and the underlying type have been chosen. Based on the behavioral literature, we define an exhaustive list of cognitive biases that retail structured products fit, and we match each product to a subset of these biases. Both measures of complexity show the same increasing trend over time.

This paper subsequently formulates and tests a theoretical framework for the observed complexity in the structured retail products market. Under this hypothesis, providers add complexity to inflate investors' expectations about product performance, exploiting their low financial literacy and behavioral biases. Competition increases banks incentive to develop complexity for obfuscation and differentiation purpose. Two alternative hypotheses may challenge this explanation. The first one, "Market Completeness", presents product complexity as a way to complete markets. Structured retail products would be increasingly complex to better fit consumer demand thanks to lower structuring costs and financial innovation. The second one, "Learning Reset", considers a dynamic relationship between complexity and consumers sophistication. Investors learn to assess products, but innovation "resets" this learning, keeping the fraction of unsophisticated investors low enough to capture rents from them.

We test direct implications from our main hypothesis and its alternatives on our dataset. First, we show that banks time the market when adding specific features to the products they offer. For example some features are more relevant to inflate investor expectations when volatility is high. At the extreme, retail structured products may be used by banks to offload some risks from their books. These results reject the "market completeness hypothesis": complexity improves banks welfare at the expense of retail investors' one. Second, using the number of competitor at the country level, we find that complexity increases as competition increases. Third, we find that products distributed by private banks are more complex than products targeted at less wealthy clients, which challenges the "Learning Reset" alternative while comforting our research hypothesis. A next step will be to test whether mark-ups increase with complexity. We will use Monte-Carlo simulations to estimate the mark-ups on a representative subset of products.

Theoretical literature has tried to answer the following question: Why complexity does not decrease when competition increases? Two papers show how inefficient product complexity may emerge in equilibrium, whatever the competitive pressure: Ellison (2005) and Gabaix and Laibson (2006). In these models, firms offer products to two categories of investors: "sophisticated" and "unsophisticated" ones. In equilibrium, only unsophisticated investors buy the complex products. By providing clear information a firm would only attract sophisticated investors (Ellison (2005)), or decrease the fraction of unsophisticated investors (Gabaix and Laibson (2006)) and so reduce markups. To account for the increase in complexity in financial products, Carlin (2009) and Carlin and Manso (2011) develop models in which the fraction of unsophisticated investors is endogenous and increases with product complexity. In Carlin (2009), if competition intensifies, the probability to capture a sophisticated investor decreases, whereas the probability to capture an unsophisticated investor is constant, since they choose products randomly. Consequently, when competition increases, incentives to increase product complexity increase. In Carlin and Manso (2011), financial institutions capture relatively higher rents from unsophisticated investors. However, in a dynamic learning process, the fraction of unsophisticated investors decreases. Banks face a trade-off between incurring a fixed cost for innovating and thus reset learning, and decreasing future rents extracted from unsophisticated investors. Our paper is the first one to test empirically implications from these models.

Hens and Rieger (2008) show that the most represented structured products do not bring additional utility to investors in a rational framework, which theoretically rejects the "Market Completeness" alternative hypothesis. We aim at validating empirically this conclusion.

Our project also complements the literature on the role of financial literacy in consumer financial choices and bank strategies. It analyzes how the supply of structured products may fit cognitive biases for marketing purposes, or select investors along their financial sophistication. Bucks and Pence (2008) and Bergstresser and Beshears (2010) explore the relationship between cognitive ability and mortgage choice. Lusardi and Tufano (2008) find that people with low financial literacy are more likely to have problems with debt. Finally, our work builds on recent interest in the role of financial intermediaries in providing product recommendations to potentially uninformed consumers (Anagol and Cole (2011)).

Empirical papers on the market of structured retail products focused so far on the pricing of specific products. Henderson and Pearson (2011), on the basis of a detailed analysis of 64 issues of popular retail structured products, identify overpricing by banks of almost 8%. Our paper further develops knowledge of this market providing a comprehensive analysis of its dynamics of innovation.

2 Background: The Market of Retail Structured - Products

Structured retail products (SRP) regroup any investment products marketed to retail investors whose payoff is determined following a formula defined ex-ante. They leave no place for discretionary investment decision along the life of the investment. We exclude pay-offs that are a linear function of a given underlying performance, e.g. ETFs. SRP are typically structured with embedded options. Although they largely rely on equities, the exposure one can achieve with them is very broad: commodities, fixed income or other alternative underlyings, with some example of products even linked to the Soccer World Cup results.

Below is an example of a product commercialized by Banque Postale (French Post office Bank) in 2010:

> *Vivango is a 6-year maturity product whose final payoff is linked to a basket of 18 shares (largest companies by market capitalization within the Eurostoxx50). Every year, the average performance of the three best-performing shares in the basket, compared to their initial levels is recorded. These three shares are then removed from the basket for subsequent calculations. At maturity, the product offers guaranteed capital of 100%, plus 70% of the average of these performances recorded annually throughout the investment period.*

This illustrates the current gap between the complexity of a popular structured product and the level of financial of sophistication of the average client of Banque Postale. The biased underlying dynamic selection and the averaging of performance across time makes the product complex to assess in terms of expected performance.

The market of SRP has emerged in 1996 and has been steadily growing from then on. In 2011, SRP assets under management stand for 700 billion euros in Europe, which is nearly 3% of all European financial savings. Europe, with a share of global assets under management of 64%, is clearly the biggest market. However, the US and Asia are catching up, with markets developing now faster. Regulation, as well as higher access to stock markets by US retail investors could explain the difference in market development between the two continents. The growth of this market has been fostered by an increasing demand for passive products, as active management added value has become challenged (Jensen (1968); Grinblatt and Titman (1994)) on one side, and the profitability of these products for the banks structuring and distributing them, on the other side Henderson and Pearson (2011). Indeed on top of disclosed fees, some profits are hidden in the payoff structure that is hedged at better conditions than offered to investor. In addition, SRP can offer a funding alternative for some banks, and a way to get rid-off of some category of risks through the sale of options included in the payoff structure.

Market structure of SRP is interesting in itself. Since these products are very complex to structure, only large investment banks have the exotic trading platform it requires. On the other hand, distribution is diverse. Consequently, products distributors are often distinct from banks structuring them. These products have been marketed by a large range of financial institutions from commercial banks, saving banks and insurance, to wealth management and private banking. Many providers market themselves on their expertise in structuring whereas they do not actually structure the product themselves but only select them and implement a back to back transaction with an entity that can manage the market risk.

Finally, another key aspect of this market is the regulation framework. European regulators, grouped in the Committee of European Securities Regulators (CESR), have kept a keen eye for protecting retail investors. They developed a regulatory framework defined by the UCITSs directives. However, until 2010, they mainly focused on disclosure requirements, which may have amplified asymmetry issues by providing too abundant or technical information to clients. Regulators have traditionally been reluctant to limit pay-off innovations. This approach is starting to change: the UCITS 4 directive, implemented in July 2011, simplifies the key information document addressed to retail investors. In addition, several countries have shown some concerns about the degree of complexity of these products.

3 Data

Our "raw" data consists mainly in a commercial database that gathers detailed information on all products that have been sold in Europe since market inception (1996). We only look at tranche products, i.e. having a limited offer period, usually 4 to 8 weeks, and a maturity date, as they have the largest investor base. For these products, in October 2011, volume and numbers of outstanding tranche products were respectively of EUR 660bn [TBC] and 47,012 in Europe. Data are available for 18 countries in Europe. Cumulated volumes per country since market inception are given in Table 1. Italy, Spain, Germany, France and Switzerland dominate the market in terms of volume sold, totaling more than 65% of total volume sold. This issuance data has been matched with information on providers (Bankscope and manual collection), market conditions (Datastream) and macro-economic country variables (World Bank) at the time of issuance.

INSERT TABLE 1

Since inception, 15 years ago, the market of retail structured products has met two major trends: volume sold has exploded (Figure 1) and number of distributors has significantly increased (from 68 in 2000 to 193 in 2010) (Table 2).

INSERT FIGURE 1

INSERT TABLE 2

The number of competitors has significantly increased over time. New entrants are diverse: from High Street Institutions to independent financial firms. However 20 major groups capture half of the market in terms of number of issuance (Table 3).

INSERT TABLE 3

4 Measuring Complexity

This section develops two complementary measures to apprehend the structure and dynamics of the retail structured product market. This is key to 1) identifying whether there is a complexity trend 2) explaining complexity and its dynamics.

The first measure breaks down and classifies all pay-off structures along a tree-like algorithm. It corresponds to the decision strategy a provider faces when structuring a product. The second one matches each product with a set of exploited behavioral biases to determine how difficult it is for the investor to fairly assess it.

4.1 Classifying Pay-offs and Measuring their Complexity

A high diversity in pay-off formula is observed across SRP products, each one being potentially unique. To overcome this challenge, we exploit pay-off information from our dataset with a lexicographic approach. Each product description is scanned by an algorithm that lookq for combinations of given group of words (see appendix for examples).

The objective is to pinpoint the exact combination of payoff features for each product, based on an exhaustive list of all the possible choices. It allows us to 1) classify products in a relevant manner, to account for pay-off features piling 2) quantify how complex each product is. Horizontally classifying products would not allow capturing offer diversity.

The decomposition tree (Figure 2) illustrates the algorithm that we developed to apprehend exhaustively the design of each product. It has two levels: three mandatory stages, and four optional ones. At each node, features representing less than 1% have been aggregated into the category "other feature". For each product the underlying, and the primary pay-off structure must be defined. On top of that, pay-off formula can include an exotic condition, a secondary pay-off structure, an underlying selection feature and an early redemption feature. With each node offering on average five branches more than 70,000 distinct classes of products can be identified through this algorithm. Our dataset exhibits more than 1500 of them.

INSERT FIGURE 2

Table 4 shows statistics for each nodes of the tree over time. The fraction of call products has decreased over time, from 63% in 2002 down to 21% in 2010, whereas coupon products share has increased. Optional features have been increasingly added from 2002 to 2010.

INSERT TABLE 4

Finally, Table 5 reports summary statistics on the total number of features per product. Capital protected and non private banking products exhibit less optional features. In addition, the number of payoff features has increased over time. More importantly Fig 3 illustrates that complexity, measured as the number of pay-offs features, is an increasing function of time.

INSERT TABLE 5

4.2 Quantifying behavioral biases use

From the investor point of view, a single pay-off can be more complex than the sum of several others. Indeed, complexity does not only result from the combination of multiple pay-off features, but also from how tractable each feature is, and how the product marketing and the underlying type have been chosen. Our assigned objective is to develop a second complexity measure that accounts for these caveats, by quantifying how hard it is for the investor to fairly assess the product performance.

A large body of the literature has shown how behavioral biases influence investment decisions and can account for mispricing. We build on this literature to analyze the strategic use of specific behavioral biases in our data.

Behavioral biases can be divided into three categories: the ones that arise when people form *beliefs*, the ones that determine people's *preferences*, and the ones that impact their *decision making*. Since we concentrate on passive strategy products, we will only focus on the two first categories of biases. The objective is to draw an exhaustive list of the behavioral biases that are potentially included in the literature and that could be included in the design of structured financial products. The higher the number of behavioral bias the product fits, the more complex it is for the investor to fairly assess the product. We define our second measure of complexity by the number of investor biases that a given product exploits.

Table 6 lists the biases relevant to our study, their definition and references, and the features that allow associating them with a given issuance.

INSERT TABLE 6

This complexity measure exhibits a similar trend to the number of pay-off features: it is an increasing function of time, which comforts our previous result.

INSERT TABLE 7

INSERT FIGURE 3

4.3 Robustness Checks

The robustness of the complexity proxies is tested using the number of characters included in the payoff description.

5 Explaining Complexity

We have established in the previous section that the market for structured retail products exhibits an increasing complexity. This section develops our main research hypothesis for explaining the increase in complexity, as well as two alternative ones.

5.1 Differentiating Complexity

Complexity inflates investors' expectation about product performance, which allows overpricing

Payoff features inflate investors' expectation about product performance by fitting their behavioral biases. Inflated investors expectations lead to a complexity premium that is captured by the bank (lower ex ante rate of return than what should be offered), creating a strong incentive for the bank to innovate and increase complexity.

Prediction 1 *In a cross-sectional analysis, markups should increase with complexity. In addition, "strategic structuring", defined as timing market conditions to maximize expectations inflation, should be observed.*

The role of Competition

Under a Bertrand framework, competition should lower price for comparable complex products, or lead to the introduction of simpler and cheaper products. However, banks have a strong incentive to maintain or develop complexity in a competitive market to differentiate their offer and maintain their margin. Complex payoff features follow a differentiation rationale. They typically vary across products, thus inhibiting product comparison. Perloff and Salop (1985), among others, show that product differentiation can lead to positive markups if consumers face random taste shocks. Gabaix and Vries (2010) extend this result in a random utility model. They interpret noise as evaluation errors by the consumer regarding the true value of product. By diversifying products, producers can increase this noise, thus affecting consumer choice and market equilibrium toward less competitive pressure. If the kurtosis in taste shocks is high enough then markups and differentiation increase as the number of firms in the industry increases.

Prediction 2 *As competition increases, product complexity and more importantly heterogeneity increases, as new payoff features are introduced to add some product differentiation and maintain markups*

5.2 Alternative 1: Market Completeness

The increasing complexity of retail structured products may reflect a better fit to consumer demand thanks to lower structuring costs and new products development.

Before the end of the 1990s retail investors' access to options was almost inexistent. Even today, trading options, especially in short position, remains difficult for individual investors. The emergence of retail structured products would have helped complete markets for retail investors. The large sample of complex products may therefore cater investor demand for market completeness. However, developing new structured products is costly. It requires innovative pricing and trading tools that have been only progressively developed since the end of the 1990s by the main investment banks. At the distribution level, sales force training also take some time and efforts Hence, the increasing complexity in the market for retail structured products would reflect an improving fit to retail investor need for sophisticated financial products thanks to structuring innovation. This "Market Completeness" hypothesis offers the following cross sectional prediction. Adding payoff features is costly, and its benefit stands in diversify a portfolio already invested in traditional assets. Therefore financial products should be more complex for "high net worth" individuals,. In addition, each new payoff feature should be introduced first to this category of investors. "Low type" investors, oppositely, would have access to new payoff features only when they become less costly.

Prediction 3 *In a cross sectional analysis, as complexity increases, markups on complex products should keep constant*

Prediction 4 *The introduction of new payoff features should improve the utility of investors, by allowing to gain a new exposure, by having different pay-off structure better matching utility curve, etc.*

Prediction 5 *The sample of offers should increase in diversity while complexity increases. More simple products should not disappear, as they allow cheap access to interesting exposure.*

5.3 Alternative 2: Learning Reset

Product complexity increases search/processing costs. Investors learn, but adding new payoff features ("innovation resets") keeps the fraction of unsophisticated investors low enough.

Investor sophistication has lagged far behind the growing complexity of financial products. With low sophistication, investors may have high search costs. A number of papers have developed models in which consumer search costs affect market efficiency and firm profits. If we consider two categories of investors, sophisticated and unsophisticated ones, a fairly reasonable assumption would be that firms captures higher rents from low sophisticated ones. Carlin and Manso (2011) develop a dynamic model of strategic obfuscation in retail financial markets. In this model, the fraction of sophisticated investors increases over time through learning. However, the provider can introduce new financial products with complex attributes in order to "refresh" the population of investors. In this case, the fraction of sophisticated investors is reset at its initial level. In this model, providers face a tradeoff between the fixed cost of adding complexity and the extra rents gained from unsophisticated investors. As the rent that is gained from unsophisticated investors increases, price obfuscation increases. A first implication deals with the relationship between provider types and product complexity: low type providers should offer more complex products. Concerning the role of competition, the model predicts that as competition increases, expected rents from low sophisticated investors decrease, and so obfuscation decreases. Indeed, unsophisticated investors buy products from any provider chosen randomly. This strong assumption cancels a new entrant incentive to attract only sophisticated investors. (Weak part of the model: it works better without free entry)

Prediction 6 *In a cross sectional analysis, markups would increase with complexity Strategic structuring should be observed (lower cost of complexity)*

Prediction 7 *In a time series analysis, innovative payoff features are introduced when profitability/ provider market shares decrease (due to learning).*

Prediction 8 *In a cross country analysis, as competition increases, price obfuscation should decrease*

6 Empirical Results

This section presents empirical results validating our research hypothesis. We provide evidence that banks use complexity to inflate investors' expectations and show how complexity is an increasing function of competition. We also rejects our two alternative hypotheses by showing that 1) product offer is largely driven by factors exogenous to demand (contradicts A1), 2) banks sells more complex products to more sophisticated investors (contradicts A2).

6.1 Strategic Structuring

We test whether products are structured in order to inflate investors' expectation using market conditions at the time of issuance. Indeed inflating expectations is made easier by given market conditions, e.g. high implied volatility or recent under-performance. Implied volatility is of key interest. Investors are usually unaware/indifferent towards it, while it has a significant impact on product pricing. We use the implicit volatility index (VIX) as an explanatory variable in our test.

Figure 4 illustrates the evolution of issuance of two types of products: reverse convertible and call products. They are respectively the most represented "long volatility" and "short volatility" products in our sample. Call products are based on the purchase of call option, which are more expensive when volatility is high. Reverse convertible are implicitly selling a call option, therefore offering subjectively more attractive levels when implicit volatility is high if investor keep its volatility estimate constant. We observe a decrease in the fraction of call products and an increase of reverse convertible just after the hike of implicit volatility in August 2008. Moreover call products are capital-guaranteed, whereas reverse convertible are not. Issuance evolution is therefore unlikely to be driven by higher loss aversion following the crisis, and appear to be timing the market.

INSERT FIGURE 4

Using several Probit specifications, we estimate the impact of implicit volatility on the use of "short volatility" features, controlling for interest rate levels. The propensity of providers to sell reverse convertible and capped products increase when volatility increase, which confirms our initial observation that banks strategically structure products to inflate investor expectations.

INSERT TABLE 8

6.2 Complexity and Competition

An important implication of the research hypothesis is that competition has a positive impact on complexity as it allows product differentiation to limit comparison. The following equation is estimated:

$$Complexity = f(NCompetitors_{i,t}, Term, G, D_t) \tag{1}$$

Where *Complexity* is the complexity measure, $NCompetitors_{i,t}$ the number of competitors in the SRP market in country i and year t, D_t stands for year dummies. Finally, we also control for the product term and capital guarantee, with respectively *term* the length in years and G a dummy with value 1 if the capital is 100% guaranteed.

Table 9 shows that both measures of complexity are indeed positively correlated with competition intensity, even controlling for year fixed effects. It validates our research hypothesis, while rejecting an important implication of our second alternative.

INSERT TABLE 9

6.3 Financial Literacy

Assuming that investors in private banks are more sophisticated than in commercial and savings ones, we introduce a dummy variable with a value of 1 if the provider is a private bank, 0 if not. Regressing the complexity measures on this variable, we establish that products targeted at wealthy investors are more complex than the ones for standard retail investors. It backs up our research hypothesis as a higher complexity should be needed to confuse more sophisticated investors. It also challenges our second alternative. However a more precise identification of the dynamic should be found.

INSERT TABLE 10

6.4 Next Step: Mark-ups and Complexity

We aims at testing whether markups increase when complexity increases. Using Monte-Carlo simulation we will calculate ex ante mark ups for a representative sub-sample of our products, and regress them on complexity measures.

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A The Payoff Algorithm

Name	Description
	Step 1: Underlying
Equity (Single Index)	In frequency order: Eurostoxx50, FTSE100, SP500, DAX, Ibex35, OMSX30, Nikkei225, CAC40, BRIC40
Equity (Single Stock)	In frequency order: Deutsche Bank, Credit Suisse, Daimler, Zurich Finance, Roche, Abb, BASF, UBS, Siemens, Allianz, Nestle
Commodity	Physical commodities such as energy products, metals or agricultural products. In frequency order: gold, brent, electricity, silver, corn
Foreign Exchange	In frequency order: Euro/USD, PLN/Euro, CSK/Euro, CHF/Euro
Credit Default	The risk of default of a company or a country
Interest Rates	In frequency order: Euribor, Libor, Swap rate
Other	Inflation, Funds etc.
	Step 2: Primary Structure
Altiplano	The product offers a capital return of 100%, plus a series of fixed coupons on each sub periods if the underlying is above a predefined barrier.
Floater	The product offers a capital return of 100% plus a series of coupons that rise when the underlying reference rate rises.
Pure Income	The product offers a capital return of 100% plus a series of fixed coupons.
Digital	The product offers a capital return of 100%, plus a fixed coupon paid at maturity if the underlying is above a predefined barrier.
Call	The product offers a capital return of 100% plus a fixed participation in the rise of the underlying.
Put	The product offers a capital return of 100% plus a fixed participation in the absolute value of the fall of the underlying.
Spread	The product offers a capital return of 100% plus a participation related to the spread between the performances of different underlyings (shares, rates.).
Bull Bear	The final return is based on a percentage of the absolute performance of the underlying at maturity.
	Step 3: Initial Subsidy
Discount	
Guaranteed Rate	
Bonus	
	Step 4: Underlying Selection
Best of Option	The return is based on the performance of the best performing underlying assets.
Worst of Option	The return is based on the participation in the performance of the worst performing underlying assets.
Himalaya	A pre-selected number of best-performing assets are permanently removed from the basket, or frozen at their performance level, at the end of each period until the end of the investment.
Kilimanjaro	The lowest performing assets as well as the best performing assets have been progressively eliminated, or ignored from subsequent calculations, during the investment period.
Rainbow	Best performing assets are weighted more heavily than those which perform less well.

Name	Description
	Step 5: Exposure Modulation: Increased Downside
Reverse Convertible	The product is capital guaranteed unless a performance criterion is not satisfied. In this case, the capital return is reduced by the percentage fall in the underlying, or the product pays back a predefined number of shares/bonds.
Precipice	The product is capital guaranteed unless a performance criterion is not satisfied. In this case, the final return is 0.
	Step 6: Exposure Modulation: Limited Upside
Cap	The return is based on the participation in the performance of the worst performing underlying assets.
Fixed Upside	The best performances of a basket of stocks or of a set of subperiod returns are replaced by a predetermined fixed return.
Flip Flop	The coupons are fixed in the first periods, and the provider has the right to switch you into floating.
	Step 7: Path Dependence
Cliquet	The final return is determined by the sum of returns over some pre-set periods.
Asian Option	The final return is determined by the average underlying returns over some pre-set periods.
Parisian Option	The value of the return depends on the number of days in the period in which the conditions are satisfied.
Averaging	The final index level is calculated as the average of the last readings over a given period (more than one month).
Delay	Coupons are rolled up and paid only at maturity.
Catch-up	If a coupon is not attributed in a given period because the condition required for the payment is not met, then that missed coupon and any subsequently missed coupon will be rolled-up and attributed the next period when the condition is met.
Lookback	The initial/final index level is replaced by the lowest/highest level over the period.
	Step 8: Exotic Condition
American Option	The conditions must be satisfied during the whole considered period.
Range	The performance of the underlying is within a range.
Target	The sum of the coupon reaches a predefined level.
Moving Strike	The conditional levels are moving.
Bunch	The top barrier/cap concerns each asset whereas the bottom barrier concerns the whole basket.
Podium	The underlying is a basket and the final returns depend on the number of shares satisfying the conditions.
Annapurna	The condition must be satisfied for any security in the underlying basket.
	Step 9: Early Redemption
Knockout	The product matures early if specific conditions are satisfied.
Callable	The issuer can terminate the product on any coupon date.
Puttable	The investor can terminate the product on any coupon date.

B Figures

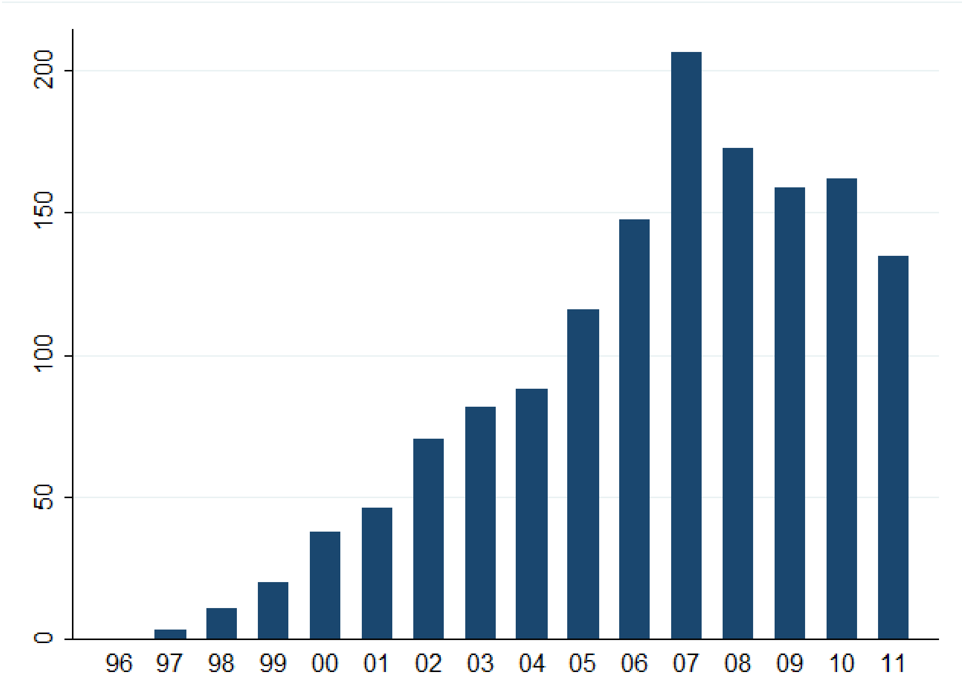

Figure 1. Volume Sold per Year, in billion euros

This figure shows volume issuance of tranche products over the period 1996-2011 in the European market, in billion Euros. Included countries are the following: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK.

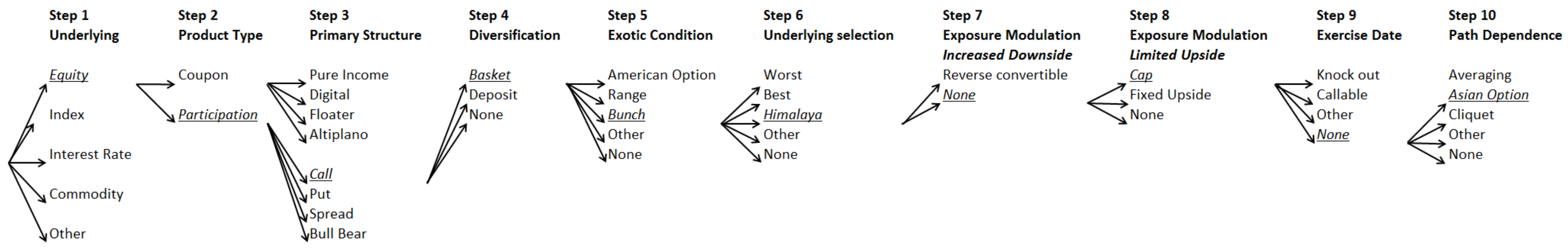

Figure 2. Structured Product Algorithm

This diagram summarizes the main steps in developing a structured product. It gives a formal structure that fits any retail structured products. Each product is defined by the choice of an underlying, a payoff type, and a primary structure. Diversification, exotic condition, underlying selection, exposure modulation, downside and upside, early maturity and path dependance features are optional. All these features are defined in Appendix.

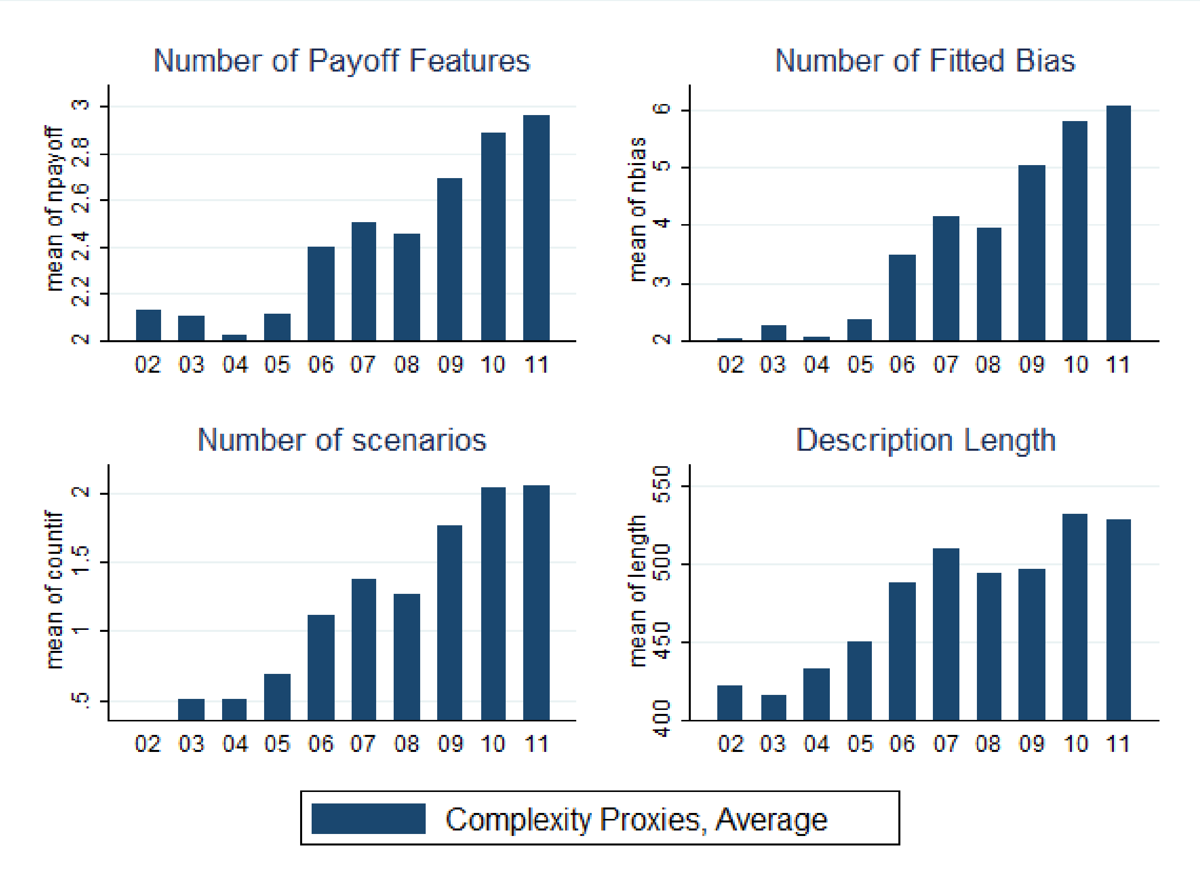

Figure 3. Evolution of Complexity over Years

This figure shows the coefficient estimates of the year dummies in a standard OLS regression of the complexity proxies with country fixed effects.

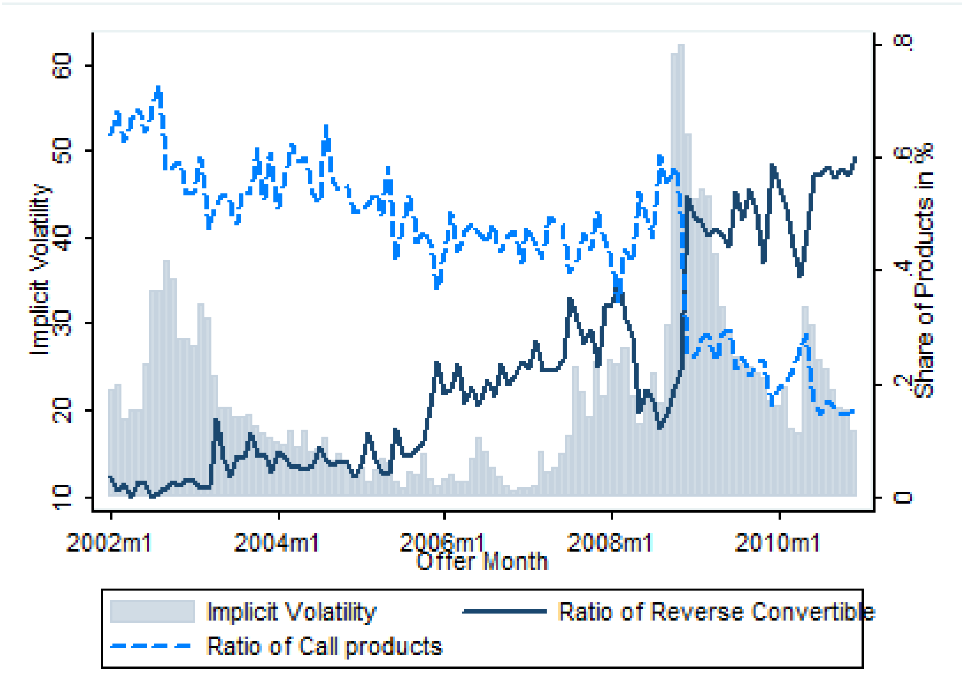

Figure 4. Strategic Structuring

This figure illustrates the evolution of issuance of two types of products: reverse convertible and call products and of the Implicit Volatility Index.

C Tables

Table 1 . Country-Level Summary Statistics

This tables reports the sum of total volume sold since market inception, outstanding volumes in 2010, number of products sold in 2010, and the average product size in 2010. The last column shows the penetration rate of retail structured products defined as the share of financial savings invested in this category of financial products.

Country	**Total Issue** Since 1996 Billion Euros	**Volumes** 2010 Billion Euros	**N. of Products** 2010 Number	**Average Size** 2010 Million Euros	**% Fin. Savings** 2010 Percent
Italy	343	98	676	145	2.8
Spain	204	50	663	75	2.8
Germany	162	109	2685	41	2.3
France	158	78	275	283	2
Switzerland	150	55	4997	11	3.8
Belgium	135	78	486	160	8.5
UK	110	57	871	65	1.1
Netherlands	37	18	173	107	1.1
Sweden	34	14	779	18	2
Portugal	24	13	181	70	3.2
Austria	20	17	767	22	3.3
Denmark	17	4.8	55	87	.82
Ireland	16	6.5	164	40	2.1
Norway	15	.92	52	18	.28
Finland	9	5.1	267	19	2.1
Poland	8	4.2	443	9.4	1.5
Czech Republic	6	3.3	196	17	2.8
Hungary	2	2	73	28	1.9
Total	*1450*	*613*	*13803*	*44*	*3*

Table 2 . Provider Types - Summary Statistics

This tables reports the distribution of providers by specialization across countries in 2010. Providers are divided into 4 categories: Commercial and Savings Banks (Comm./Sav.), Private Banking (P. B.), Insurance (Insurance) and Other (Other)

	Provider Specialization									
Country	**Comm./Sav.**		**P. B.**		**Insurance**		**Other**		**Total**	
	No.	Col %	No.	Col %	No.	Col %	No.	Col %	No.	Col %
Italy	24	68.6%	6	17.1%	3	8.6%	2	5.7%	35	100.0%
Spain	28	82.4%	6	17.6%	-	-	-	-	34	100.0%
Germany	18	69.2%	8	30.8%	-	-	-	-	26	100.0%
France	7	18.4%	22	57.9%	5	13.2%	4	10.5%	38	100.0%
Switzerland	18	58.1%	11	35.5%	1	3.2%	1	3.2%	31	100.0%
Belgium	14	53.8%	8	30.8%	4	15.4%	-	-	26	100.0%
UK	6	60.0%	4	40.0%	-	-	-	-	10	100.0%
Netherlands	7	50.0%	7	50.0%	-	-	-	-	14	100.0%
Sweden	9	47.4%	10	52.6%	-	-	-	-	19	100.0%
Portugal	10	76.9%	3	23.1%	-	-	-	-	13	100.0%
Austria	16	64.0%	7	28.0%	2	8.0%	-	-	25	100.0%
Denmark	9	81.8%	-	-	-	-	2	18.2%	11	100.0%
Ireland	6	31.6%	13	68.4%	-	-	-	-	19	100.0%
Norway	4	50.0%	4	50.0%	-	-	-	-	8	100.0%
Finland	9	47.4%	8	42.1%	1	5.3%	1	5.3%	19	100.0%
Poland	17	73.9%	3	13.0%	3	13.0%	-	-	23	100.0%
Czech Rep.	7	50.0%	3	21.4%	4	28.6%	-	-	14	100.0%
Hungary	6	66.7%	1	11.1%	1	11.1%	1	11.1%	9	100.0%
Total	215	57.5%	124	33.2%	24	6.4%	11	2.9%	374	100.0%

Table 3 . Providers and Issuance, Summary Statistics

This tables reports the distribution of product types issued since inception by providers and level of capital protection. Providers are sorted by market share.

Provider	**Capital Protection**					
	<100%		**100%**		**Total**	
	No.	Col %	No.	Col %	No.	Col %
Raiffeisen	1,926	44.6%	2,397	55.4%	4,323	100.0%
German Landesbank	1,312	42.0%	1,811	58.0%	3,123	100.0%
UBS	1,197	44.8%	1,473	55.2%	2,670	100.0%
Vontobel	2,269	93.7%	153	6.3%	2,422	100.0%
KBC	390	17.5%	1,834	82.5%	2,224	100.0%
EFG Bank	1,944	93.9%	126	6.1%	2,070	100.0%
Deutsche Bank	1,071	54.6%	890	45.4%	1,961	100.0%
Societe Generale	987	62.2%	600	37.8%	1,587	100.0%
Clariden Leu	1,443	92.2%	122	7.8%	1,565	100.0%
ING	742	42.6%	999	57.4%	1,741	100.0%
RBS	446	30.9%	997	69.1%	1,443	100.0%
JP Morgan	883	64.1%	494	35.9%	1,377	100.0%
Caja de Ahorros	33	2.5%	1,288	97.5%	1,321	100.0%
Nordea	613	50.1%	610	49.9%	1,223	100.0%
Unicredit	638	56.2%	498	43.8%	1,136	100.0%
Credit Suisse	779	67.7%	372	32.3%	1,151	100.0%
Barclays	383	32.1%	809	67.9%	1,192	100.0%
BNP Paribas	681	59.4%	465	40.6%	1,146	100.0%
Volksbank	414	38.2%	670	61.8%	1,084	100.0%
Commerzbank	813	76.0%	257	24.0%	1,070	100.0%
Other	12,087	35.3%	22,109	64.7%	34,196	100.0%
Total	31,051	44.3%	38,974	55.7%	70,025	100.0%

Table 4 . Payoff Structure, Summary Statistics

This tables reports the distribution of payoff features in the payoff structure algorithm describe in section 4 over years.

	2002	2006	2010	Total
	%	%	%	%
Underlying Asset Class				
Equity (Single Stock)	51.3%	51.5%	34.0%	40.4%
Equity (Index)	30.6%	26.2%	34.8%	31.9%
Interest Rate	3.2%	4.9%	12.9%	9.9%
Commodity	0.2%	2.2%	4.3%	3.4%
Other	14.7%	15.3%	14.1%	14.5%
Product Type				
Coupon	15.2%	37.2%	72.6%	58.5%
Participation	84.8%	62.8%	27.4%	41.5%
Primary Structure				
Call	63.5%	44.5%	21.2%	30.7%
Pure Income	4.8%	11.0%	37.2%	27.3%
Digital	6.0%	17.0%	20.4%	18.6%
Floater	1.9%	7.2%	14.7%	11.6%
Other	23.9%	20.4%	6.6%	11.9%
Diversification				
Basket	57.7%	45.3%	42.9%	44.4%
Deposit	4.8%	2.4%	1.6%	2.0%
None	37.5%	52.2%	55.5%	53.5%
Exotic Condition				
Range	0.4%	1.2%	1.0%	1.0%
American Option	0.3%	0.3%	0.3%	0.3%
Other	0.6%	2.0%	0.1%	0.8%
None	98.7%	96.5%	98.5%	97.9%
Underlying Selection				
Worst	5.2%	5.2%	24.8%	17.7%
Best	10.2%	8.9%	2.9%	5.1%
Other	5.4%	0.6%	0.2%	0.6%
None	79.1%	85.3%	72.1%	76.6%
Exposure Modulation: Increased Downside				
Reverse Convertible	1.9%	21.2%	47.2%	36.7%
None	98.1%	78.8%	52.8%	63.3%
Exposure Modulation: Limited Upside				
Cap	18.5%	14.0%	21.3%	18.9%
Fixed Upside	0.2%	0.7%	1.1%	1.0%
None	81.3%	85.3%	77.6%	80.2%
Early Maturity				
Knockout	0.6%	14.1%	18.5%	16.2%
Callable	2.0%	2.8%	4.1%	3.6%
Other	1.2%	0.7%	0.7%	0.7%
None	96.2%	82.5%	76.7%	79.5%
Path Dependance				
Averaging	28.9%	23.0%	8.3%	14.0%
Asian Option	2.1%	2.6%	0.7%	1.3%
Other	0.9%	0.5%	2.8%	2.0%
None	68.1%	73.9%	88.3%	82.7%

Table 5 . Number of Payoff Features, Summary Statistics

This tables reports summary statistics on the number of payoff features over product category and years. Section 2 describes the method implemented to break down any payoff formula in basic features.

Year	**Mean**	**Min**	**Median**	**Max**
Product Type				
Capital not Guaranteed	3.1	1	3	7
Capital Guaranteed	2.4	1	2	8
Year				
2002	2.5	1	2	6
2006	2.6	1	2	8
2010	2.9	1	3	7
Provider Type				
Comm./Savings	2.6	1	3	8
Private Banking	2.9	1	3	7
Total	2.7	1	3	8

Table 6. Fitted Bias, Description

Bias	Bias definition	Reference	Translation in SRP	Identifier	% Products
Beliefs					
Familiarity bias	Estimating the probability of an event is influenced by how causes and effects look similar to another event's	Kahneman and Tversky (1974)	Product structure is close to a familiar riskless one. For example pure income with a reverse convertible feature are assimilated to fixed coupon investment	Fixed Guaranteed Rate, Pure Income, Vanilla	34%
Availibiity bias	Predicting the frequency of an event based on how easily it can be brought to mind	Kahneman and Tversky (1974)	Structuring a product on an underlying that has recently overperformed	Overperforming underlying	-
Anchoring	When forming estimates, starting with an initial value in mind and then adjusting from it.This leads to underestimating the probability of future levels to differ significantly from present ones (anchor point)	Kahneman and Tversky (1974)	Concave Pay-offs	American Option, Basket, Bunch, Cap, Range, Reverse Convertible, Worst of Option	77%
Conjunction fallacy	Assuming that specific conditions are more likely than general ones (c.f. Linda problem)	Kahneman and Tversky (1982)	Favorable scenario is subject to several conditions. Investors would over-estimate the probability of the favorable outcome.	American Option, Basket, Cliquet, Range, Spread, Worst of Option	46%
Quantification fallacy	Using quantifiers for the premises that differ from the quantifier of the conclusion	-	Inconsistency between the product term and the period when the performance is measured. Discarding compounding effect when calculating performance over a several year period; averaging performance over different time periods	Bunch, Leveler, Smoothing	16%
Money illusion	Confusing real and nominal values, neglecting time value of money.	Fisher (1928), Shafir et al. (1997)	Delayed payments	Cliquet, Delay, Digital	19%
Probability Neglect	Disregarding real probabilities when making decisions	-	Limited number of possible outcomes that investors typically treat as having the same likelihood, thus over-estimating the probability of favorable outcomes	Altiplano, Digital Enhanced Tracker Podium	20%
Preferences					
Regret aversion	People fear to regret. Standard investments expose the investor to a high risk of regret, especially when the asset declines after a sharp increase. Regret aversion is a possible explanation for the dividend puzzle, as dividends bring *ex post* comfort in this scenario.	Kahneman and Tversky (1974) - Shefrin and Statman (1984)	Payment of an income when underlying is performing well	Accrual, Altiplano, Cliquet, Fixed Guaranteed Rate, Knock Out	26%
Naïve / false diversification	Splitting investments between available choices even if similar / unappropriate	Simonson (1990)	Offering 2 products packaged in one. Pay-offs based on basket that increase downside risk	Bunch, Deposit, Worst of Option	15%
Multiple outcome aversion	The less possible outcomes, the easier to grasp the problem met	-	Paying a limited number of fixed returns or a unique fixed payoff with a high probability	Altiplano, Digital, Pure Income, Reverse Convertible	49%
Disposition effect	Investors are enclined to sell stocks that have risen in value and keep the ones with latent losses	Shefrin and Statman (1985)	Early termination of a well performing product, therefore renouncement to additional upside	Callable, Knock Out	17.50%

Table 7 . Number of Bias, Summary Statistics

This tables reports summary statistics on the number of bias over product category and years. Section 2 describes the method implemented to match product to behavioral biases.

Year	**Mean**	**Min**	**Median**	**Max**
Product Type				
Capital not Guaranteed	3.9	0	4	9
Capital Guaranteed	2.4	0	2	8
Year				
2002	2.6	0	3	7
2006	2.9	0	3	9
2010	3.6	0	3	9
Provider Type				
Comm./Savings	3.1	0	3	9
Private Banking	3.5	0	3	9
Total	3.2	0	3	9

Table 8. Strategic Structuring

This table shows probit regressions. The dependant variables indicate 1 if the payoff structure includes a reverse convertible feature in columns (1) and (2) and a cap feature in columns (3) and (4). Implicit Volatility is the Implicit Volatility Index (VIX). The three columns introduce country fixed effects. Column (2) and (4) show t-stat clustered by providers.

	(1) Reverse Convertible	(2) Reverse Convertible	(3) Cap	(4) Cap
Implicit Volatility	0.00486***	0.00477**	0.00797***	0.00820**
	(0.000566)	(0.00198)	(0.000537)	(0.00358)
Swap Rate, 5 years	-0.131***	-0.134**	-0.0471***	-0.0405
	(0.00658)	(0.0621)	(0.00638)	(0.0341)
Country Fixed Effects	Yes	Yes	Yes	Yes
Cluster	No	Provider	No	Provider
Observations	82528	80132	82528	80132
Pseudo R^2	0.280	0.283	0.031	0.031

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 9. Competition and Complexity

This table shows regressions in which complexity proxies are regressed on the number of competing providers per country (Compet./Country) . The complexity proxy is the number of payoff features in columns (1) to (3), and the number of fitted bias in column (4) to (6).

	(1) N. Payoffs	(2) N. Payoffs	(3) N. Payoffs	(4) N. Fitted Bias	(5) N. Fitted Bias	(6) N. Fitted Bias
Compet./Country	0.00852***	0.00498***	0.00498	0.0138***	0.0211***	0.0211***
	(0.000742)	(0.00115)	(0.00374)	(0.00125)	(0.00193)	(0.00681)
Term	0.0596***	0.0628***	0.0628***	0.0801***	0.0819***	0.0819***
	(0.00238)	(0.00240)	(0.0115)	(0.00357)	(0.00361)	(0.0205)
Capital Protion	-0.548***	-0.544***	-0.544***	-1.616***	-1.611***	-1.611***
	(0.0101)	(0.0102)	(0.0705)	(0.0176)	(0.0175)	(0.167)
Country F. E.	Yes	Yes	Yes	Yes	Yes	Yes
Provider F. E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F. E.	No	Yes	Yes	No	Yes	Yes
Cluster	No	No	Provider	No	No	Provider
Observations	73540	73540	73540	73540	73540	73540
R^2	0.150	0.155	0.155	0.270	0.275	0.275

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 10. Financial Literacy

This table shows regressions in which complexity proxies are regressed on a private banking dummy, product term in years and the interaction between the private banking dummy and term. The complexity proxy is the number of payoff features in columns (1) to (3), and the number of fitted bias in column (4) to (6).

	(1) N. Payoffs	(2) N. Payoffs	(3) N. Payoffs	(4) countbias	(5) countbias	(6) countbias
Private Banking	-0.0206	0.249***	0.249	0.328***	0.954***	0.954***
	(0.0338)	(0.0416)	(0.203)	(0.0629)	(0.0766)	(0.344)
Term	0.0261***	0.0407***	0.0407***	-0.0390***	-0.00506	-0.00506
	(0.00251)	(0.00289)	(0.0142)	(0.00407)	(0.00457)	(0.0317)
Private Banking*Term		-0.0567***	-0.0567		-0.132***	-0.132*
		(0.00542)	(0.0378)		(0.00914)	(0.0695)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Provider Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Robust Sd	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	No	No	Provider	No	No	Provider
Observations	72381	72381	72381	72381	72381	72381
R^2	0.120	0.122	0.122	0.175	0.177	0.177

Table 11. Financial Literacy and Wrapper Type

This table shows regressions in which complexity proxies are regressed on a private banking dummy, wrapper type dummies (deposit, fund, life insurance, security), and the interaction between the private banking and wrapper type dummies. Deposit is omitted. Year and country fixed effects are included.

	(1) Description Length	(2) Condition Number	(3) N. Payoffs	(4) countbias
Private banking	-27.56***	-0.222***	-0.119***	-0.808***
	(6.136)	(0.0468)	(0.0294)	(0.0617)
Fund*Private Banking	69.83***	0.686***	0.183***	1.351***
	(13.08)	(0.101)	(0.0648)	(0.130)
Life Insurance*Private Banking	18.04**	0.228***	0.232***	1.018***
	(8.348)	(0.0606)	(0.0473)	(0.0925)
Security*Private Banking	39.41***	0.358***	0.219***	1.069***
	(6.794)	(0.0528)	(0.0336)	(0.0693)
Observations	33258	33258	33298	33298
R^2	0.149	0.242	0.118	0.211

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table 12. Financial Literacy and Wrapper Type, Providers Fixed Effects

This table shows regressions in which complexity proxies are regressed on a private banking dummy, wrapper type dummies (deposit, fund, life insurance, security), and the interaction between the private banking and wrapper type dummies. Deposit is omitted. Year, country and provider fixed effects are included.

	(1) Description Length	(2) Condition Number	(3) N. Payoffs	(4) countbias
Private banking	5.321	0.277**	0.182**	-0.0911
	(14.78)	(0.114)	(0.0781)	(0.141)
Fund*Private banking	71.91***	0.424**	-0.0128	0.768***
	(20.90)	(0.166)	(0.104)	(0.203)
Life Insurance*Private banking	-4.390	-0.288**	-0.0715	0.218
	(20.15)	(0.140)	(0.126)	(0.229)
Security*Private banking	16.39	0.230**	-0.158**	0.656***
	(14.15)	(0.110)	(0.0747)	(0.135)
Observations	31897	31897	31937	31937
R^2	0.233	0.317	0.185	0.286

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01