SELLING COMPANY SHARES TO RELUCTANT EMPLOYEES: FRANCE TÉLÉCOM'S EXPERIENCE

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In 1997, France Télécom, the state-owned French telephone company, went through a partial privatization. The government offered current and prior France Télécom employees the opportunity to buy portfolios of shares with various combinations of discounts, required holding periods, leverage, tax treatment, and levels of downside protection. We adapt a neoclassical model of investment decision-making that takes into account firm-specific human capital and holding period restrictions to predict how employees might respond to the share offers. Using a database that tracks over 200,000 eligible participants, we analyze the employees' characteristics and their decisions whether to participate; how much to invest; and what form of stock alternatives they selected. The results are broadly consistent with the neoclassical model. However, we report four anomalous findings: (1) The firm specificity of human capital has a negligible effect on employees' investment decisions; (2) the amount of funds invested in the stock plans seems driven by a different set of forces than the decision to participate, which we suspect reflects a "threshold effect" that we attempt to measure; (3) employees "left on the table" benefits equal to one to two month's salary by failing to participate; and (4) most potential participants underweighted the most valuable asset, a decision hard to reconcile with rational portfolio choice.

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Many of the proposed solutions to the misalignment of managers', workers', and shareholders' interests recommend that managers and workers hold shares in the firms in which they work.[1] By giving employees the financial incentives of shareholders, they will act to increase shareholder value. This prescription is embodied in a number of institutional practices: the payment of stock (and stock options) to executives and workers as a portion of their compensation, the establishment of Employee Stock Ownership Plans (ESOPs), the sale of discounted stock to employees, and government mandates that workers of privatized firms buy shares in the firms for which they work.

Yet selling stock to their employees often proves a substantial challenge for companies. Workers whose undiversified human capital fluctuates with the fate of their employer may prefer to invest their financial assets *outside* the firm.[2] Furthermore, in many countries, there is still little tradition of individuals investing in the stock market. Finally, in privatizations, unions may oppose private ownership and members may voice their opposition by refusing to buy shares. Thus the sale of company stock to employees represents a large-scale marketing challenge, especially in privatizations.

In this paper, we study one of the larger privatizations in Europe, which faced this problem: France Télécom's 1997 *Ouverture du Capital* or "opening of shareholding". The state-owned French telecommunications giant was planning to sell a portion of the firm's shares to private investors, and under French law, was required to set aside 10% of the offering for employees.[3] The firm created four distinct investment vehicles for employees. The schemes were all based upon the firm's common stock, but differed along five dimensions: the level of discounts and free shares granted to employees; the access to subsidized financing and additional leverage; the period that employees were required to hold the stock; the tax treatment; and finally, the degree of downside

1. See for instance Blinder [1990] and the articles therein, Jones and Kato [1995], and Scholes and Wolfson [1990]. The case for employee ownership is advanced by the National Center for Employee Ownership (http://www.nceo.org).
2. Brennan and Torous [1999] show that the welfare costs of under-diversification can be large.
3. The shares could not simply given away to employees: For example, French law capped the permissible employee discount on the share offering price at 20%.

protection offered to the employee in the event that the stock price declined below the initial offering price.

Our paper analyzes the employees' response to the firm's stock offering proposal. Our database consists of information on more than 200,000 past and present France Télécom workers eligible to participate. For each eligible participant, we have personnel data including their age, tenure, rank, gender, and employment status (civil servant, non-civil servant, retiree, or former employee). We also have information on the number and type of shares requested and obtained for each employee.

We have two related goals in writing this paper. The first is to *describe* the employee response to the investment offers, addressing three related questions: Which employees chose to participate in the employee stock offering plan? How much did they invest in the plan? And how did the employees choose from among the four different alternatives?

Our second goal is to extend existing theory to produce *testable implications* about the investment choices of the worker-investors of France Télécom. Drawing primarily upon neoclassical models of optimal investment and consumption, we build a stylized model of the investment choices facing a risk-averse worker-investor whose human capital is partially firm-specific, i.e., his labor income is correlated to the firm's fortunes. (The model is detailed in **Appendix A**, available from the authors). We then examine how the size of human vs. financial capital, the degree of firm-specificity in human capital, the investors' horizon, and the degree of relative risk aversion should influence the investment choice of the worker-investor. We relate these unobserved parameters to observed employee characteristics to draw implications about different investment choices. For example, our sample includes current workers (both civil servants and employees-at-will), retirees, and prior workers still in the workforce. We appeal to these differences to capture levels and firm specificity of human capital.

The effects predicted by the neoclassical model for financial wealth and salary are broadly borne out by the data: Workers with higher financial wealth and salary participate and invest more, and, consistent with the notion that as retirement horizon decreases, risk aversion increases, we find

that older workers tend to invest less. We also find some evidence of a human capital effect on investing decisions, but the magnitudes are quite small.

While a neoclassical model helps explain broad patterns in employee investment behavior, there are still anomalies that it cannot explain. We document unexpected and economically significant seemingly sub-optimal investment choices by France Télécom employees. We are at a loss to explain why. Many purchased insufficient amounts of (or completely shunned) the most attractive investment vehicle offered to them –a downside-protected stock-based asset.

Finally, we find that employees' decisions *whether* to participate in the offering and *how much* to contribute are driven by different factors. Several groups of employees –especially former employees and retirees– participated less frequently, but conditional on participating, invested more. It appears that a threshold level of desired investment must be attained for participation to occur, and we measure this threshold in a latent variable framework. We find that employees may forgo benefits equal to one or two months' salary by failing to participate. We conjecture that this threshold arises due to the cost of analyzing the France Télécom offering, and our findings hint at the importance of marketing efforts in the employee stock offering.

The remainder of the paper is organized as follows: Section 1 discusses the challenge of selling company stock to France Télécom employees. Section 2 describes the alternatives the government and France Télécom made available to eligible participants in the employee stock plan. These choices allowed employees to trade-off larger discounts in return for either longer holding periods or some downside protection. Section 3 reviews the existing theory of investment decision-making and discusses the predictions of this theory as applied to our problem. The formal model we use is detailed in **Appendix A** (available from the authors). Section 4 describes the data and the variables we use. Section 5 provides the core of the empirical analysis, in which we report on the three aspects of employee response: The decision to participate, the quantity of funds invested, and the portfolios. We examine the cross-sectional dispersion of employee choices as a function of observable characteristics. Section 6 presents a brief conclusion.

I. The challenge of selling company stock to France Télécom employees

Selling stock to France Télécom employees was a challenge for three reasons: First, the fraction of French individuals with prior experience in stock investing was quite low. Second, the privatization of France Télécom had met with political opposition from a large number of employees. Third, at least some employees might appreciate the appeal of diversification and be reluctant to invest in the stock of their employer.

The first challenge for France Télécom and the government was to overcome the absence of a tradition of stock market investing by individuals in France. According to the *Commission des Opérations de Bourse* (the French stock market regulatory body) about 5 million French individuals held stock in 1997, out of a population of 60 million.[4] This reluctance to invest in stocks was even more pronounced for blue-collar workers or civil servants that made up the bulk of France Télécom's employees.[5] Research showed that less well-to-do French households were less inclined to hold shares.[6] The choice of many France Télécom employees to be civil servants might also indicate a low tolerance for bearing risk or a minimal interest in the private sector. Although no data are available on employees' portfolios of financial assets, anecdotes suggest only a minority was familiar with the basics of stocks as investments.[7]

The second hurdle for marketing the stock to employees was political. Initially, France Télécom's unions opposed its privatization. France Télécom's civil servant employees enjoyed job security and a generous pension scheme that privatization could jeopardize. On October 12, 1993, 75% of France Télécom employees went on strike against privatization. In 1996, the company

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4. See *Commission des Opérations de Bourse* [1998]. This figure does not include households holding stock indirectly through mutual funds. The equivalent figure for direct stock ownership in the US (from the *Survey of Consumer Finances*) is 10.4% of the population.

5. 78% of France Télécom employees were civil servants.

6. See Arrondel and Masson [1990] and Szpiro [1995].

7. We have been told that many employees did not understand why the stock price simulations in the offering documents included cases in which the stock price fell. After the offering, whenever the stock price went down, France Télécom received telephone calls from some employees asking for an explanation.

negotiated an agreement with unions that defused employees' fears.[8] However, a lingering hostility to privatization remained among at least a minority of employees. Moreover, the platform of the Socialist government elected in the spring of 1997 explicitly opposed the privatization of France Télécom. Under the combined pressure of fiscal realism and the upcoming deregulation of the European telecommunications market, the Socialist government performed a quick about-face, and in September 1997 officially announced a slightly scaled-back privatization of France Télécom.[9] The result of this uncertain path to privatization was that among France Télécom employees, most of those favoring the privatization were recent converts, while those opposing it may have felt betrayed and embittered by the Socialist government's reversal.

The third obstacle to selling company stock to France Télécom employees was the desire of employees to diversify their risk. Workers whose undiversified human capital fluctuates with the fate of their employer may prefer to invest their financial assets *outside* the firm. Many France Télécom workers feared the inevitable efficiency gains that privatization and deregulation would bring –British Telecom had cut its work force by half in the previous ten years. The fears among employees are well summed up in a comment made by a France Télécom employee demonstrating against privatization in October 1997: "Our next demonstration will be against the first layoff announcement."[10] Even if an employee's status makes it hard to fire him, his firm-specific human capital suffers whenever the firm performs poorly: Salary raises and promotions are more scarce, or employees may be subject to forced job relocations. Also, note that since the privatization of France Télécom looked unlikely as recently as two years before it happened, at the time of

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8. Under the deal, the State would keep a stake of at least 51% in France Télécom; current employees would keep their civil servant status even after privatization, while new employees would acquire private sector status; and France Télécom would make a one-time payment to the State to fund its employees' pensions.

9. The French State sold 23% of its stake, of which one-tenth (or 2.3% of France Télécom's shares) were earmarked for the employee offering. The offering took place on September 23, 1997. The offer price for individual investors was set at FF 182, while the price for institutional investors was FF 187. The individual investor tranche was oversubscribed by 2.91 times, while the institutional investor tranche was oversubscribed 20 times. The first day closing price was FF 206.50, for a one-day return of 13.5% from the individual investor offer price. The exchange rate around this time was approximately 6 FF/1$US.

10. Nadia Lemaire, Michel Samson and Catherine Simon, « Contre la privatisation de France Télécom, les rangs étaient clairsemés. Inquiétude commune aux manifestants: Après la privatisation, les licenciements?", Le Monde, October 2, 1997.

privatization the average France Télécom employee was likely to have acquired more firm-specific human capital risk than employees of otherwise similar firms. Hence, the human capital of France Télécom employees was still to be at risk after the privatization, and they may have hesitated to add a financial risk closely correlated to their existing human capital risk.[11]

While the firm expended substantial marketing resources to make the offering a success, the financial incentives the government could offer to employees were constrained by law and politics. The France Télécom offer to employees was reported to be "the best ever agreed to by the State to employees of companies that list their shares in the Stock Exchange."[12] It was not politically feasible to merely give the shares to employees, so to induce workers to buy shares (albeit at a discount) the security designers needed to create an attractive set of investments.

II. The privatization of France Télécom: The offering schemes

The challenge of designing employee stock offerings that simultaneously addressed the low level of liquid financial wealth of most employees, their risk aversion, their poorly diversified human capital and their hesitation with holding shares had been an issue in all of the prior French privatizations. France Télécom adapted the program initially used by the French *Trésor* (Treasury) and Rhône-Poulenc in 1993.[13] In literature describing the program to employees, the company outlined the principles that dictated the design of the offerings:

> "To make the purchase of France Télécom shares accessible to everyone, the offer reserved for employees follows five principles:
>
> - Concentrates a majority of benefits on the first few thousand Francs in investment.
> - Helps each of you to finance your investment by offering payment terms and by offering a

11. Might investing in the firm's stock provide employees with a *hedge* against firm-specific human capital risk? Such would be the case if, for example, the stock went up at layoff announcements. In fact, Hallock [1998] documents that (contrary to conventional wisdom) layoff announcements are associated with *negative* stock price reactions.
12. Quote taken from the informational brochures given to employees during the privatization.
13. See Collat and Tufano [1994].

plan with a bank loan.

- Offers a number of choices, and the possibility of investing in more than one plan at the same time.
- Gives incentives for long-term shareholding to foster the creation of a stable shareholder base.
- Respects the freedom of choice of each agent and guarantee the confidentiality of the operation."

The literature provided to employees was quite detailed and informative, and attempted to explain in simple terms the specifics of the offering. It was, however, substantial, and included a fair amount of legal language.

The desire to offer employees choices was manifested in the fact that France Télécom offered its employees four different share ownership programs: *Abondix, Multiplix, Simplix,* and *Disponix*. In general terms, the employee could get bigger discounts, more attractive financing, tax-free treatment or protection from losses by committing to hold the France Télécom shares for a longer period of time. **Table I** presents details of each program. The most important characteristics of the plans are as follows:

- Effective discount (including price discount from the offering price, matching bonus given by France Télécom, and free shares): *Abondix* was the most advantageous, followed by *Simplix* and *Disponix*.[14]
- Required holding period: *Abondix* and *Multiplix* required the stock to be held for 5 years, compared to 2 years for *Simplix*, and no requirement for *Disponix*.
- Downside protection: Of the four plans, only *Multiplix* offered downside protection.

Functionally, the *Multiplix* scheme is quite different from the other three plans. Where the other plans offer linear payoffs, *Multiplix* offers a non-linear, option-style payoff. The payoff can be represented as the sum of two components: (a) a risk-free zero-coupon bond paying 1.25 times the employee's personal contribution plus bonus, and (b) 10 call options struck at the offer price for each share that the employee bought directly. Legally, this payoff was delivered through a peculiar guaranteed "loan" which allowed the employees to buy nine additional shares for each one

14. *Multiplix* cannot be compared with the other plans on this dimension.

purchased through personal contributions and bonus.[15] The *Multiplix* option dominates investments in *Abondix* for a wide range of final stock prices; it is downside protected and offers much larger upside. See **Figure I** for a graphical description of the payoffs.

Each plan's distinctive feature was well captured in the pamphlet given to employees:

- *Disponix*: "Be able to sell the shares at any time."
- *Simplix*: "Achieve a balance between offering plan benefits and holding period."
- *Abondix*: "Acquire numerous benefits and invest for the long term."
- *Multiplix*: "Multiply, with full security, your savings capacity."

All 174,091 current French employees of France Télécom (or of more than 50%-owned subsidiaries) were eligible to participate. In addition, 30,985 former employees who left the firm between 1991 and 1997 were eligible to participate, but could purchase only two of the four plans (*Simplix* and *Disponix*). The group of former employees includes 22,357 retirees as well as 8,628 former employees who left prior to retirement.

Overall, the share alternatives were quite attractive to the employees. To give a sense, were an employee to invest FF 9000, he could buy about FF 12,000 of stock under the *Disponix* plan, FF 16,312 under *Simplix* and FF 25,610 under *Abondix*. (These ignore the subsidized financing, avoidance of transaction costs, and tax-free status under *Abondix*). Were he able to invest FF 9,000 in *Multiplix*, he would receive a package worth between FF 27,500 and FF 39,000, depending on the volatility of France Télécom stock.[16] These are substantial benefits, large enough to attract employee attention. **Figure II** illustrates the number of shares of France Télécom employees were able to buy through the three linear programs *Abondix*, *Simplix* and *Disponix* for personal investments from FF 1,000 to FF 9,000. *Multiplix* is not comparable on this dimension

15. What makes this loan peculiar is that the repayment is effected through the withholding of the dividends and tax credits (over the five-year life of the plan) and a variable repayment schedule at maturity that is a function of the ultimate France Télécom stock price. In effect, the loan repayment amount is equal to the positive difference between the value of ten shares less the payoff to the employee described in the text. The loan does *not* entail downside-risk since the employee is *never* required to repay more than the value of her shares after five years.

16. The value of the *Multiplix* package is calculated using the Black-Scholes formula and assumes that the dividend plus the tax credit yield on France Télécom is 3.6%.

because of the embedded call options. Under the principle of allowing employees freedom of choice, the program allowed employees to participate in more than one plan, subject to numerous limitations, such as:

- Total contributions to the *Abondix* and *Multiplix* programs combined in each year could not exceed 1/4 of the employees' gross France Télécom income. The loan implicit in *Multiplix* would count towards this limit. This limitation often turned out to be binding.
- The total personal investment into *Multiplix* could not exceed FF 9,000.
- The maximum request for shares could not exceed FF 823,200. The bonus and the bank loan implicit in *Multiplix* counted towards this total, while free shares were excluded. [17]
- Were the employee offering to be oversubscribed, rationing rules would be determined and announced by France Télécom and the government at that time. Formal allocation rules were not announced in advance.

With combinations of the four alternatives, employees could create highly customized shareholding packages. Within the limitations above, they could vary the degree to which investments were taxable, the average holding period, the payment options, the average total discount (taking into account discounts, bonuses, and free shares) and the average number of shares with downside protection.

If we were to ignore taxes, risk aversion, needs for liquidity, and heterogeneity among workers, we can solve the linear programming problem suggested by the constraints above to calculate the "naïve optimal" (value-maximizing) investment package. A risk-neutral investor chooses assets to maximize expected returns, and evaluates the call options implicit in *Multiplix*

17. The most severe constraint on investor behavior is presented by the rule that no more than 1/4 of annual salary can be invested into the long-lived assets. We find 169 individuals in the data for whom the FF 9,000 constraint on the *Multiplix* investment binds, but estimate the 1/4 annual salary constraint to be binding for 8,375 individuals. Only 265 individuals requested the maximum amount of shares of FF 823,200.

using Black-Scholes.[18] Given the extreme discounts offered, investors would certainly participate in the offering. Our calculations show that *Abondix* and *Multiplix*, which offer the highest discounts, dominate the optimal naïve portfolios. But this "naïve optimal" solution obviously ignores the actual situation facing security designers who are encouraging these employees to buy shares:

- Employees are risk-averse.
- Employees have a mix of human and financial capital.
- Human capital can be risky and also firm-specific, i.e., its value can be related to the value of France Télécom.
- Employees may be unable to borrow against their illiquid positions and thus the holding period of an investment may be important.
- The pool of workers is heterogeneous with respect to these characteristics.

To understand the optimal portfolio under these circumstances, we model the joint consumption, investment and portfolio choices of investors.

III. Applying investment decision-making theory at France Télécom

In this section we first present the standard neoclassical approach to the rational portfolio selection problem. We then use a simple neoclassical model to obtain predictions on the employees' decision about participation, level of investment, and choice of investment vehicle in the context of the France Télécom employee offering.

Standard portfolio selection models, as developed in Samuelson [1969] and Merton [1969,1971], derive optimal consumption-portfolio decisions from utility maximization by rational consumers. A number of extensions of these models consider portfolio allocation decisions when investors have non-diversified human capital or when they face uncertain labor income. Bertaut and Halliasos [1997] solve a life-cycle model in which investors choose portfolios in order to buffer

18. We ignore the possibility that employees of France Télécom may have had real or imaginary private information about the future stock price performance. If for example employees were convinced that the France Télécom stock was going to

against long-run career uncertainty. An implication of their model is that employees with more risky human capital would be less likely to participate in the France Télécom offering, and on the margin more likely to prefer a scheme with downside protection like *Multiplix*. Viceira [2001] solves an infinite horizon consumption and portfolio selection problem where labor income is subject to permanent and transitory shocks, and employees face an exogenously given probability of retirement per period. He shows that the demand for the risky asset declines as workers approach retirement, implying that younger workers would be more likely to participate in the risky France Télécom share offering. If labor income shocks were positively correlated with the risky asset (as would be expected in the case of employees purchasing France Télécom stock), Viceira demonstrates a negative hedging demand for the risky asset.

Bodie, Merton, and Samuelson [1992] choose a somewhat different strategy to model labor income uncertainty. They allow human capital to be partly random and partly under the control of the investor. Their main result is that flexibility in labor supply induces higher risk taking. Negative portfolio returns are smoothed out by increased labor supply, especially for young workers, who can assume relatively more risk in their financial portfolio. This implies greater participation by younger France Télécom workers. Little empirical work addresses how well these models perform in predicting investing behavior.[19]

While the neoclassical models of investment behavior are rich, no one model is designed to capture the essence of the problem faced by the France Télécom employees. In particular, employees have risky human capital tied to the value of the France Télécom stock, have a choice of liquidity (holding period), and can buy assets with downside protection.[20]

We develop a stylized, three-period model to obtain predictions with respect to the employees' decisions about participation, level of investment, and choice of investment vehicle in

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under-perform, then the call options implicit in *Multiplix* become less attractive than buying shares through *Abondix*.

19. An exception is Guiso, Jappelli, and Terlizzese [1996].

20. In addition, there are constraints on the amounts investors can put into the long-lived assets, and investors have to trade off between the two long-lived assets whenever one of the constraints is binding. Finally, the bonuses and free shares are concentrated in the first few thousand French Franc invested, making the expected return on any asset a decreasing function

this particular setting. The model explicitly analyzes how utility-maximizing employees would choose among a set of investments that are realistic representations of the choices facing the France Télécom workers. In addition to the France Télécom offerings, the investor is given the choice of a riskless asset and an additional risky asset unrelated to France Télécom. **Appendix A** (available from the authors) details the setup of the model and relates it to the existing literature. Starting from a realistic baseline calibration, we analyze the consumption, savings and optimal investment by the worker-investor as a function of his relative risk aversion, his initial financial wealth, the level of labor income/human capital, the firm specificity of his human capital, and the idiosyncratic riskiness of labor income.[21] Selected predictions are discussed in the following paragraphs.

Participation rate and investment intensity. The model predicts that all employees will participate in at least one of the employer's stock choices.[22] At face value, as more than a third of eligible participants choose not to participate, the model obviously fails to capture some critical aspect of their decision-making.

However, the model does predict that the intensity of participation will vary across the population. Bearing out simple intuition and echoing earlier models, it predicts that employees who are more willing and able to bear financial risk hold more risky securities:

- As relative risk aversion increases, employees shift away from the risky France Télécom assets towards cash until they hold only moderate amounts of the downside protected *Multiplix*. With

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of the invested amounts.

21. The standard calibration of the three period model uses the following parameter values: Initial wealth equals FF 200,000 and initial labor income equals FF 180,000 p.a. The relative risk aversion (RRA) parameter is set to 5 and is varied between 2 and 20. This range relates to extant empirical work. Friend and Blume [1975] find an aggregate relative risk aversion coefficient of 2. More recent findings attempt to calculate RRA coefficients for subsets of investors. Brav and Géczy [1996] find that RRA parameters for US households in 1980-1991 range from 3 to upwards of 20. Mankiw and Zeldes [1991] find RRA parameters of 36 to 100. The individual time preference rate is equal to the risk-free interest rate at 5 percent and the equity premium is set to 6%. The risk parameters in the baseline calibration are a 30 percent annual volatility for the France Télécom stock return, a 25 percent volatility for the orthogonal 'market' asset and a 5 percent volatility for the independent labor income shock. ρ, the parameter controlling the covariation between stock returns and labor income, is set to 0.1.

22. This prediction of non-zero investment in a risky asset with positive expected excess return is a common feature of all constant-relative-risk-aversion portfolio selection models. The intuition behind this is that an infinitesimally small investment in the risky asset increases the mean portfolio return without an equivalent increase in the volatility of the portfolio.

the baseline calibration, the predicted personal contribution falls from FF 75,600 for log-utility (relative risk aversion of 1) to FF 3,800 for relative risk aversion of 20.

- As labor income becomes more correlated to the firm, workers invest less in the risky financial assets offered by France Télécom. Again with the baseline calibration, the predicted personal contribution is at FF 44,700 for no correlation and falls to FF 9,400 for strongly positive covariation between labor income and stock returns (ρ greater than 0.3).
- When labor income (human capital) increases for a given financial wealth then the intensity of participation increases, but less than proportional to the increase in labor income. Higher labor income creates a positive wealth effect on the intensity of participation, while the increased exposure of wealth to France Télécom has a negative effect. The net effect is positive, and predicted personal contribution rises from FF 9,800 for labor income of FF 20,000 to FF 107,000 for an annual labor income of FF 700,000.[23]
- The effect of adding idiosyncratic risk to the labor income process has an ambiguous effect on the intensity of participation. The unavoidable risk in human capital discourages risk taking in the financial portfolio, but at the same time increases the savings rate for precautionary reasons. For relative risk aversion of five we find the net effect on personal contribution to be positive, while for relative risk aversion of twelve it is negative.

Figure III, Panel A illustrates the personal contributions in French Franc as a function of relative risk aversion, firm-specificity of labor income, and labor income.

Mix of investments among participants. The decision of how to allocate the personal savings among the France Télécom assets and the outside alternatives is severely restricted by the rules of the offering. Because the *Multiplix* plan delivers downside protection and appreciation on ten shares, it is a nearly dominant security and without additional constraints would be part of all

23. The less than proportional increase corresponds to the hedging motive in Viceira's [1997] model. Increasing labor income with constant financial wealth implies that the investor has more total wealth, but also more exposure to France Télécom. The net effect is weak and not monotone, and depends on the ratio of labor income to financial wealth. The non-monotonicity is due to the constraint that not more than ¼ of annual salary can be invested into the two long-lived assets combined. Whenever we increase annual salary for constant initial wealth, this constraint is gradually relaxed, essentially

participating employees' choices. (More generally, Leland [1980] suggests that downside protected investments should be more attractive to investors who are more risk averse, and we see a similar pattern in our model.) However, due to the constraint on the total amount investable in *Multiplix* and *Abondix* combined, the investor has to trade-off each unit of *Multiplix* against ten units of *Abondix* whenever the constraint is binding. We focus on the predictions for the relative allocations to the France Télécom assets, since any holdings of outside risky or riskless assets are not observable to us. To further simplify, the model abstracts from the distinction between *Disponix* and *Simplix* and analyzes the choice between the long-lived assets *Abondix* and *Multiplix* and a short-lived asset based on France Télécom stock.

- As relative risk aversion increases, the model predicts that the investor's portfolio of France Télécom assets shifts from 32% in the short-lived asset and 68% in *Abondix* with log utility to 91% in *Abondix* and 9% in *Multiplix* with relative risk aversion of 5 and finally to 100% in *Multiplix* with relative risk aversion of sixteen and higher. At high levels of risk aversion, the desire for downside protection makes *Multiplix* the dominant asset.
- As the firm-specificity of human capital (ρ) increases, the model's predictions are very similar to increasing relative risk aversion: With $\rho = -0.2$, the portfolio of France Télécom assets is 67% in *Abondix* and 33% in the short-lived asset, shifts to 91% in *Abondix* with ρ equal to 0.1 and finally to 100% in *Multiplix* with ρ equal to 0.75 and larger.
- When labor income increases for a given financial wealth, the investor shifts from the short-lived France Télécom asset to *Abondix* and finally to *Multiplix*. With labor income of FF 20,000, the employee invests 43% in *Abondix* and 57% in the short-lived France Télécom asset; the worker shifts to 100% in *Abondix* with annual labor income of FF 50,000 and then gradually increases the *Multiplix* share up to labor income of FF 500,000. This pattern is caused by both the income-based constraint on the total investment in long-lived assets and by the negative effect of increased human capital on the desire to take on additional exposure to France

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enlarging the investment opportunity set.

Télécom. With no labor income, the employee is not allowed to invest into either *Multiplix* or *Abondix*. As labor income increases, this constraint is gradually relaxed and the investment into *Abondix* rises. Finally, with labor income high relative to financial wealth, the exposure of total wealth to France Télécom is large and the investor seeks the downside protection offered by *Multiplix*.[24]

Figure III, Panel B illustrates the portfolio allocations among the available France Télécom assets as a function of relative risk aversion, firm-specificity of labor income, and labor income.

In our model, as the willingness or ability to take additional exposure to France Télécom decreases, the average holding period of the portfolio of France Télécom assets *increases*. This result is due to the investors' ability to substitute away from the France Télécom assets in favor of outside assets. For very low risk aversion, no firm-specificity of human capital or little human capital relative to financial capital, the slightly discounted short-lived France Télécom asset is part of the optimal portfolio. Increasing either risk aversion or the exposure to France Télécom causes the investor to replace the short-lived asset by assets unrelated to France Télécom, leaving only the long-lived France Télécom assets in the observable portfolio. **Figure III, Panel C** illustrates the average holding period in years and the fraction of the portfolio that is downside protected through *Multiplix* as a function of relative risk aversion, firm-specificity of labor income, and labor income.

The model delivers a set of predictions about the factors that should drive participation, extent of contribution, and the mix of stock plans utilized. These predictions are framed with respect to a handful of theoretical parameters: The amount of labor income, the firm specificity of labor income, the idiosyncratic risk of labor income, and the employee's risk aversion. The empirical challenge is to find the best-possible proxies for these parameters, which we discuss in the following section.

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24 Beyond labor income of FF 500,000, the investor hits the FF 9,000 constraint on the personal investment in *Multiplix*. Without this constraint, the *Multiplix* portfolio share rises to 100% at labor income of FF 1,000,000.

IV. Data description

Our data set consists of a unique database of 205,076 current and former employees of France Télécom. The data were kindly provided to us by France Télécom's Internal Shareholders Department. For each individual we have data on age; gender; job tenure; job category; salary grade; whether the employee is currently employed, formerly employed or retired; and the location of the employee's business unit. We also have information on the number of shares demanded and obtained by each employee. Finally, we have the town and the postal code of the employee's home, which we have matched to demographic data from INSEE, the French government statistical agency. **Table II** provides summary statistics for some of the observed variables.

Amount of human capital. The present value of labor income (human capital) is a function of the current level of monthly salary, its growth rate, and the time horizon over which salary will be received. *Current salary* captures the first component and *age* captures the third aspect of human capital, with younger workers generally having more human capital (future value of labor income) than older workers. We can observe an employee's salary grade, from which we can estimate his or her salary.[25] In addition, we can identify *retirees*, whose human capital (future labor earnings) is presumably small.[26]

Firm specificity of human capital. We have a number of proxies for the firm-specificity of human capital. First, we can identify *former (non-retired) workers* versus *current workers*. The former would have no France Télécom firm-specific capital, as they were no longer in the firm's employ. For current workers, we use *job tenure* as a proxy for firm-specificity of human capital.

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25. France Télécom would not reveal individual employee's salary nor divulge the entire mapping between salary grades and salary ranges. They did provide detailed information about this mapping for broad subsets of salary grades (11 to 23, 31 to 33 and 41 to 46), broken down by gender. Based on these six data points, we fit a piecewise linear function to obtain estimates of the intermediate salary levels. All regressions in Section 6 have been estimated with salary dummies and the fitted salary estimates. Since there is no information available on salary levels at France Télécom subsidiaries, we retain dummy variables for salary grades.

26. We do not have current salary levels for former, non-retired employees who left between 1992 and 1997 and use their last salary at France Télécom instead. This stale salary data is likely to underestimate the true current salary level if employees leave for better paying jobs.

Prior theoretical and empirical research suggests that tenure is a good measure of this variable.[27] In the empirical analysis, we distinguish the tenure effect between civil servants and non-civil servants. While the firm-specificity of human capital increases in tenure for both groups, we would anticipate that the job security implicit in the civil servant status makes this effect less relevant for civil servants.

Idiosyncratic shock to human capital. The possibility of a sudden shock to human capital should affect the worker's investment decision. Here we exploit the differences between the *civil servant employees* of France Télécom and the non-civil servants. The former have much more job security than the latter and thus, we argue have lower levels of idiosyncratic labor shocks.

Financial wealth. We do not directly observe the financial wealth of the workers, but we construct a proxy based on the worker's choice of residence. We match the towns of the worker's residence to the INSEE (French National Statistical Service) database, and use the average income of the households in the same town as a rough measure of wealth. Our logic is that choice of residence is a function of wealth (and income) and given the large disparities between towns and neighborhoods, it captures some of the unmeasured variation in household wealth.

Other control variables. To test Viceira's [2001] predictions that time to retirement can affect employee's retirement motives to invest in risky assets, we also control for employees' *age* and *age-squared*. Age is a variable that could have many interpretations in this analysis. Not only does it capture years to retirement, but also it affects human capital, financial capital and the ratio of the two.[28] Younger people have large future labor income but smaller financial assets, whereas older people have smaller remaining future labor income and larger financial assets. At some point, financial assets begin to dwindle as people use them to pay for children's education, support of

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27. There are two rationales for why higher tenure should be associated with higher salaries and higher firm-specific human capital. Following Becker [1964], an employee's firm-specific skills build up over time. They increase the employee's marginal productivity on the current job, but are useless when the current employment relationship is terminated. Another line of reasoning argues that the quality of the match reveals itself gradually over time (see Jovanovic [1984]). Good matches are more likely to survive than bad matches and result in a higher marginal product and wage payment to the worker. See Topel [1991] and Williams [1991] for empirical evidence.

28. See the discussion in Bodie, Merton, and Samuelson [1992].

aging parents or retirement, and to capture this non-linearity, it is appropriate to include not only an "age" variable, but a squared age term as well.[29]

Prior research, such as Barber and Odean [1999], suggests that men and women make different investment decisions. They attribute this to differences in self-confidence, but more generally gender differences could reflect other factors as well, such as risk aversion. To account for these differences, we include *gender* as a control variable.

Omitted variable bias and risk aversion. In spite of the uniqueness and breadth of our database, we acknowledge that some potentially very helpful data have not been made available. For example, we have no information on employees' marital status, number of children, whether their spouse is an employee of France Télécom, and whether the employee is a homeowner. Clearly, such variables have bearing on France Télécom employees' participation in the share offering. Nor do we have information on employees' promotion history, union affiliation, training, or other portfolio holdings, which may have influenced employees' attitudes toward the offering.

While some of these variables might be made available at some time, the one key variable that will always be unavailable is risk aversion. However, other observable variables could be related to risk aversion. Absolute risk aversion should decrease with total wealth and income. Wealthier workers may be more willing to buy risky assets than less wealthy workers. The decision to become a civil servant may reflect higher risk aversion; if so, civil servants might be less likely to participate in the offering. Risk aversion may change over a person's lifetime, so older people may become more risk averse. Risk aversion could differ between men and women. It is prudent to remember that there is no independent measure of risk aversion, virtually all observable variables may be correlated with it, and thus it may be difficult to interpret the empirical results.

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29. To improve the fit of the second order polynomial, we subtract the mean from age and age-squared when using it as an explanatory variable.

V. Empirical results

We first present our results on participation and investment intensity, focusing on the discrepancies between the two, which we interpret as evidence of a threshold effect. We then turn to how employees allocated their investment among the various plans.

A. Participation and investment intensity

The theoretical model we developed predicted that all eligible current and former employees would participate, and that the "average worker" (as determined by our baseline calibration but with no human capital at risk) should invest about FF 26,000 in the offer. **Table III**, **Panel A** shows that the participation rate was 62.8% overall (68% among current employees). Thus, the neoclassical model fails to predict that a significant fraction of eligible worker-investors chose to pass up entirely the sizeable benefits attached to the various offering plans. **Panel B** shows that the actual investment among workers –conditional on participating– was FF 26,554 suggesting that our model calibration is reasonable for participants. Additionally, **Figure IV** shows histograms of personal contribution versus participation rates (conditional on participating) for current and former/retired employees respectively.

To test our predictions regarding participation and investment intensity we run a Probit regression of the probability of participation on individual characteristics, and a truncated regression of personal contribution on the same set of characteristics. Unlike the Tobit model, the truncated regression framework allows the determinants of the participation decision to differ from the amount of investment decision without merely throwing away zero-investment observations and biasing the results. It can accommodate reasonable deviations from the standard choice setting: for example, even when the optimal contribution level is non-zero, participation may still not occur due to search, information and transaction costs. Similarly, the potential investor may first decide whether the offering is worth analyzing, and only if the answer is in the affirmative, go on to decide the desired

contribution level.[30] We report our results for the Probit regression in **Table IV, Panel A,** and the results for the truncated regression in **Panel B**.[31]

We predicted a negative effect of tenure (a proxy for the firm-specificity of an employee's human capital) on participation and personal contribution. These predictions are partially supported by the data. Tenure has a negative effect on participation only for non-civil servant current employees, who may have felt that their jobs would be most at risk in case France Télécom did poorly. Longer tenure is also weakly associated with a smaller personal contribution, especially for current non-civil servants who decrease their personal contribution by FF 460 for each additional year of job tenure.

According to the neoclassical model, labor income and financial wealth should be associated with higher levels of participation and personal contribution. We find strong support for this prediction. Inspecting the relationship between salary grades and coefficients in the first column of **Table IV**, **Panel A,** there is nearly a monotonically-increasing relationship between salary levels and the propensity to participate, even after controlling for age, tenure, civil servant status and job category. Moving from the lowest salary grade for "ordinary employees" to the lowest salary grade for "middle managers," the probability of participating increases 58 percentage points. In column two of **Panel A,** we include the estimated salary level; the coefficient on this variable is the most significant determinant of participation.

Our proxy for wealth also has a positive impact on participation. We incorporate both a wealth term and a square of wealth to allow for nonlinearities in the wealth-participation relationship. The coefficient on wealth is positive, suggesting that as wealth increases participation is more likely, and the squared term is negative, which suggests that this relationship flattens off or could even turn around at high levels of wealth. Over the range of data in our sample, the first-order term dominates

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30. The truncated regression specification uses a MLE framework, correcting for the bias that would occur if one merely ignored the non-participation data (See Hausman and Wise [1975] or Greene [1993]).

31. Individuals with missing observations on some of the explanatory variables have been eliminated in the regressions in **Table IV**. This reduces the sample size from 205,076 in **Table III** to 167,064 in **Table IV, Panel A,** and to 111,912 in **Panel B**.

the squared term for 95-99% of all the employees, producing a positive relationship between wealth and participation for virtually all of the participants in our sample. These findings are consistent with the notion that employees with greater total wealth have lower absolute risk aversion and are therefore more willing to invest in risky assets.

Higher-paid workers not only are more likely to participate, but also to invest more in the stock-offering plan, as shown in **Table IV, Panel B**. Moving from salary grade 11 to salary grade 31 (31 to 41) results in a FF 10,000 (14,000) increase in personal contribution. The impact of wealth on amount invested is consistent with this finding.[32] The squared INSEE wealth measure dominates the first-order term, suggesting that increases in our wealth proxy are correlated with higher contribution amounts.[33] These results are also consistent with the comparative statics from our model.[34]

We predicted that adding idiosyncratic risk to labor income has an ambiguous effect on the willingness to participate in the offering. For low relative risk aversion we predicted the net effect on investment intensity to be positive, while for higher relative risk aversion the effect would be negative. Based on the Probit marginals evaluated at the means, civil servants are about 7 percentage points less likely to participate than non-civil servants (calculated from the first specification in **Table IV**, **Panel A**). This observation is compatible with civil servants having less labor income uncertainty than non-civil servants, and with low levels of risk aversion. An alternative explanation is that civil servants are more risk averse, evidenced by their revealed preference of taking a civil servant position. If civil servants have both higher job security and higher risk aversion than non-civil servants, then the predicted negative effect of risk aversion may overwhelm the predicted positive effect of higher job security. Finally, some residual opposition against the

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32. We estimated the same regression using the ratio of personal contribution to annual salary as independent variable. The results are qualitatively similar to those presented, and are omitted for brevity.

33. The negative coefficient on the linear term in the INSEE wealth measure is dominated by the positive second order term. This is true for the top 99% of the wealth distribution in both truncated regression specifications in **Table IV**, **Panel B**.

34. While the model predicts a less than proportional increase of personal contribution as a function of labor income, this prediction is derived holding wealth constant. Clearly the INSEE measure is an imperfect proxy for wealth, and the labor income coefficients are likely to pick up much of the residual variance in wealth.

privatization may have existed, especially by employees who joined France Télécom fully expecting a lifelong public sector career, and who felt betrayed when France Télécom became a privately-owned entity.

We find that older employees are less likely to participate in any of the stock purchase plans, with workers one standard deviation older about 4% less likely to participate. However, age is associated with a larger personal contribution (conditional on participating) over almost the entire age range of employees.[35] According to Viceira's [2001] model, investors closer to retirement will be more risk-averse, since they expect their propensity to consume out of wealth to go up soon. Hence our finding on participation is consistent with the idea that this negative effect of age on the demand for risky assets overwhelms the positive effect of diminished firm-specific human capital on the hedging demand for the risky asset.[36] This result is also consistent with age proxying for unaccounted variation in personal wealth. In the extreme, we see that retirees are much less likely to participate in the stock plan than are current workers, also consistent with Viceira's hypothesis. Retirees were 30% less likely to participate, evaluating the Probit coefficients at their mean values.

Finally, while we have no clear hypothesis for why gender should affect the decision to participate in the stock plans, it does have an effect. Women were about 5% more likely to participate than men. This might result from differences in family status: French households are more likely to have two incomes if the woman works than if the man works. It could also reflect differences in risk aversion[37], or a more careful reading of the plan documents. We

35. For the first specification in **Table IV**, **Panel A**, the positive first order term in age dominates until age 55, and for the second specification in **Table IV, Panel A** the positive first order term dominates until age 77.

36. The hedging demand is negative due to the positive correlation between human capital and stock returns. For a given level of wealth and firm-specificity of human capital, diminishing human capital makes the negative hedging demand smaller in absolute value.

37. Sundén and Surrette [1998] document that women invest their retirement savings more conservatively than do men, even after controlling for marital status, age, and risk return/preferences.

merely report the result as consistent with the notion that gender has some impact on this investment decision.

B. Discrepancies between the participation and personal contribution: A threshold effect

Our most surprising finding is that several employee characteristics have opposite effects on participation and personal contribution. For example, while women are more likely to participate than men, they contribute less. The same is true of retirees and former employees, and is most vividly seen in **Panel A** and **Panel B** of **Table III**: Former employees were much less likely to participate than current employees (22% vs. 68%). However, conditional on participating, the personal contribution of former employees is much higher (in absolute terms and as a percentage of monthly salary).[38] This is strong evidence that the decisions of whether and how much to invest may be driven by different factors, rather than as a result from a single optimizing decision by employees.

One explanation is that a threshold level of desired investments (latent demand) must be attained for participation to occur.[39] When this threshold is higher, participation rates are low, but contributions (if made) are high. What might account for such a threshold? Our suspicion, reinforced by our discussions with management, is that our findings could be explained by the substantial "cost" (in time and effort) for employees to evaluate the France Télécom offer. The offering documents sent to employees, although clear and informative, were substantial, and included a fair bit of legal paperwork, and as Section 3 attests, analyzing the nuances of the four different plans can be taxing, especially for investors unfamiliar with investing (and even for finance academics!) As in models with search costs, self-selection becomes critical: Employees for whom this "analysis" cost is higher are less likely to participate, but conditional on participating will invest more.

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38. These findings hold in a multivariate setting. Based on the Probit regression results, former employees were 61 percentage points less likely to participate than current workers. The truncated regression estimates show that former workers invested 21% more than current employees, other things equal.

39. The possibility of threshold levels and fixed (information) costs of stock market participation has been discussed by Bertaut and Halliassos [1995], Bertaut [1998], and Vissing-Jorgensen [1999].

Testing this explanation is difficult because it is not obvious why "analysis costs" would vary across groups. Various groups could differ in their innate levels of diligence (for example, male employees may have spent less time analyzing the offering in detail than female employees), but we have we no way of measuring these differences. France Télécom assured us that the marketing effort devoted to the offering was spread evenly across employees, so there is no reason to think that some employees got better access to information than others.

But France Télécom management also conceded to us that having former employees and retirees invest in the offering was not a top management priority, and the marketing effort toward them was much lower than toward current employees. The offering was aggressively marketed or "pushed" toward current employees, while it was merely made available to former employees or retirees. Current employees could hear presentations on the offer and compare notes with one another, while former employees had to make the decision on their own. We hypothesize that this difference could explain the difference in participation and personal contribution. If "search costs" were lower for current employees, we would expect the determinants of participation and personal contribution to diverge less for current employees than former employees or retirees.[40] Comparing columns between the equivalent specifications in **Panels A** and **B** in **Table IV**, we find that such is the case, lending support to our threshold explanation.

While we cannot be sure that our threshold explanation is correct, we can measure the apparent size of the thresholds for various subgroups of employees, letting the data tell us the level of latent demand below which certain potential participants have chosen to forgo participating. With non-zero thresholds of participation, the truncated regression model presented for personal investment levels (**Table IV, Panel B**) is misspecified. When estimating a Tobit-type model using Heckman's [1976] two-step estimator, we do not impose equality of the coefficients from the first-step (participation Probit) and second-step (contribution amount) regressions. Combining the

40. Rather than facing different costs, different potential participants could perceive different levels of benefits, either on the basis of systematically different levels of risk aversion or due to different expectations of the future success of a privatized firm.

estimates from the first-step Probit regressions and the second-step contribution amount regression, we can back out the implied threshold levels for different groups of individuals.[41] The procedure for estimating group-specific threshold levels is detailed in **Appendix B**, available from the authors.

The first column of **Table V** shows the average threshold level estimates for different subsets of individuals. A value of FF 18,749 for the reference group of currently employed male non-civil servants implies that, on average, individuals of this group do not participate if their desired (latent) investment is smaller than this threshold. The incremental thresholds for women, civil servants, former employees and retirees are to be added to this baseline threshold. The estimated threshold of latent demand to induce participation for retirees is 43% higher than for current male workers, and 70% higher for former (non-retired) France Télécom employees than for current male workers.

The remaining columns of **Table V** use these thresholds to calculate the monetary value in bonuses, discounts and free shares foregone by non-participants.[42] In essence, this calculation estimates how much money investors at the threshold limits were willing to "leave on the table" by not participating. Retirees and former employees have substantially higher demand thresholds, but because they were not eligible to participate in the most financially-attractive investments, they actually left less money on the table than current workers, about the equivalent of one-month's salary (for a mid-level manager.) Current workers threshold levels were lower, but they passed up benefits equal to 1.7 month's salary, because they could have enjoyed more generous terms than former employees.

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41. This procedure makes two simplifying assumptions: First, we assume that the threshold levels are not functions of the other independent variables, and are the same for all individuals in a dummy-indexed subset of individuals. Second, the threshold levels are assumed to be additive across groups. For example, when the baseline threshold is estimated for male currently employed non-civil servants, then the threshold estimate for female currently employed civil servants is the sum of the baseline threshold and the incremental thresholds estimated for women and for civil servants.

42. The calculations make the illustrative assumption that the investor would have chosen a value-maximizing portfolio. Given the structure of the assets offered, this allows us to calculate the benefits the government had to offer to induce individuals to participate. For current employees, the salary-based constraint on the investment into the two long-lived assets has to be taken into account when calculating value-maximizing portfolios. The free benefits for retirees and former employees are calculated from the two short-lived assets only, and no salary-based constraints apply. The fact that the long-lived assets were not available to former and retired employees explains why their high threshold levels translate into

While we believe the threshold story is plausible, we are open to alternative explanations. One possibility is that the differences in participation and investment amounts could be attributed to certain groups of employees attempting to "game" the system by requesting more shares than they actually wanted, in order to end up with a post-rationing amount they desired. But as we note earlier, the rationing rules were not announced in advance, so it may have been difficult to place orders strategically. Further, we were told that employees were surprised that any rationing took place, suggesting that their requested investments were their desired investments. Nevertheless, suppose employees were completely prescient, and could predict how many shares they would be allocated conditional on their requests. It would then be appropriate to analyze the *post-rationing allocations* of shares rather than the original orders. When we repeated the truncated regressions in **Table IV, Panel B** using the *ex post* measure of wealth invested, the results were virtually identical to those we report in the table. This suggests that while gaming may have been a problem, it cannot explain the inconsistency between the determinants of participation and investment amount.

C. Type of offer

How did participating employees allocate their funds among the four plans? Recall that the main characteristics of the plans were as follows:

- *Disponix*: No holding period, small discounts.
- *Simplix*: 2-year holding period, moderate discounts.
- *Abondix*: 5-year holding period, large discounts.
- *Multiplix*: 5-year holding period, downside protection.

Table III, Panel C reports the actual frequencies with which the different assets are chosen. For current employees, the two long-horizon plans with large discounts were favored: *Abondix* is the most preferred package, followed by *Multiplix*.[43] We also analyze the frequencies of particular asset *combinations* by different groups of individuals. For current employees, pure

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comparatively low levels of lost free benefits.

43. The numbers in **Table III, Panel C** do not add to one because portfolios may contain multiple assets.

Abondix is by far the most preferred choice, followed by the *Abondix-Multiplix* combination. Employees heavily weighted their portfolios to long-horizon/high discount offerings with all but 2.2% of eligible participating employees buying *Abondix, Multiplix* or both. The average participant selects a plan with required holding period of 4.6 years, thus heavily tilting his portfolio to the long-horizon plans. In general, the average employee portfolio is very much like the utility-maximizing portfolios we derive from our model.

Our model not only suggests the overall composition of the "optimal portfolios," but also how portfolio characteristics should vary among participants. We stress two functional characteristics of the portfolios: The average chosen holding period and the fraction of the portfolio protected by puts (invested in *Multiplix*). This analysis is conducted only for employees who chose to contribute and is limited to current employees (as former employees and retirees did not have access to the longest horizon or downside protected plans.)

With respect to holding period, we have several testable hypotheses: Holding period should increase with the firm-specificity of human capital, relative risk aversion and labor income. We see the first two effects in the first column of **Table VI**. The dependent variable is the contribution-weighted holding period of the investors' portfolios, and the presented results are from a double-censored Tobit regression.[44] As the neoclassical model predicts, the chosen holding period rises with tenure, our measure of firm-specific human capital, and is higher for civil servants, who are likely to be more risk averse. Holding period should decrease with initial financial wealth, which is confirmed by the negative coefficient on the INSEE wealth measure. The finding that holding period decreases in labor income is inconsistent with our predictions, and again most likely caused by insufficient control for wealth. (Salary and wealth effects should go in opposite directions, and the more precise salary variable is probably picking up wealth effects.) In addition, we find that women choose longer holding periods than men.

A serious concern is that the regression results could reflect the institutional constraints on

44. Running the same regression using OLS yields qualitatively the same results.

personal contribution rather than individual preferences. Column two of **Table VI** presents the results when the dependent variable in the regression is changed to the ratio of chosen holding period to maximum feasible holding period. The maximum feasible holding period is calculated for each investor individually, using her chosen level of personal contribution and an estimate of her salary level based constraint. We discard employees at subsidiaries of France Télécom for this analysis, since the salary level information necessary to calculate the maximum feasible holding period is not available for them.[45] The results are qualitatively similar to the ones in column one.[46]

The third column in **Table VI** analyzes the fraction of the portfolio invested in *Multiplix*, the plan with downside protection. The dependent variable is the downside-protected proportion of the investors' personal contributions, and the presented results are from a double-censored Tobit regression.[47] Our model predicts the desired downside protection to be increasing in relative risk aversion, firm specificity of human capital, labor income and weakly in idiosyncratic labor income risk. Consistent with the predictions, we find that the downside-protected share is increasing in tenure and that civil servants, whom we expect to be more risk averse, purchase more *Multiplix*. The tenure effect is barely significant. Higher labor income tends to increase the downside-protected share, again conform to the model predictions. Given the limitations on the amount that employees could invest into *Multiplix*, our model predicts a strong negative coefficient on wealth. This prediction is confirmed by the negative coefficient on the INSEE wealth measure.

Again we are concerned that the regression results could reflect the institutional constraints on personal contribution rather than individual preferences. Column four of **Table VI** presents the results when the dependent variable is changed to the ratio of chosen downside protection to maximum feasible downside protection. The maximum feasible downside protection is calculated

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45. The results are the same when we use OLS instead of double-censored Tobit in the regression. For comparison, we also run the regression in the first column of **Table VI** using only investors at the parent company. The results are qualitatively similar to the ones presented in column one.

46. We also run the regressions in column one and two of **Table VI** using only employees who we estimate to be unconstrained. The results do not change in any significant way. The same applies when we ignore *Abondix* investments made through the transfer scheme from the company pension plan (see **Table I)**.

47. Running the same regression using OLS yields qualitatively the same results.

for each investor individually, using her chosen level of personal contribution and an estimate of her salary level based constraint. Again we have to discard employees at subsidiaries of France Télécom for this analysis due to lack of salary data.[48]

The results in column four diverge for two explanatory variables from the results in column three: First, the negative effect of wealth on downside protection is no longer significant. This finding is consistent with the model prediction that wealthy investors are likely to be constrained and have to reduce their investment into *Multiplix*. Using the ratio of chosen to maximum feasible downside protection as dependent variable then weakens the negative effect of wealth. Secondly, the positive effect of non-civil servant tenure becomes small and insignificant. This loss of significance is due to the elimination of investors at France Télécom subsidiaries, and also occurs when we exclude these investors from the regression in column three. It appears that the firm-specific human capital effect captured through tenure is stronger for employees at subsidiaries than for employees at the parent company. This difference could be attributed to the fact that adverse effects on employees of the privatization are more likely at subsidiaries of France Télécom than at the mother company. Employees at subsidiaries may have been concerned about France Télécom divesting subsidiaries after the privatization, and may enjoy less trade union protection than their counterparts at the parent company.[49]

Overall, a few salient facts emerge from the analysis of portfolio allocations. Investors seem undeterred by long holding periods. Over 90 percent of currently employed participants choose some assets with the five-year holding periods, and over 90 percent of former employees choose

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48. The results are the same when we use OLS instead of double-censored Tobit in the regression. We again test the sensitivity of the results in column three and four of **Table VI** against using only employees who we estimate to be unconstrained, and against the exclusion of *Abondix* investments made through the transfer scheme from the company pension plan (see **Table I**). The results from these alternative regressions are qualitatively the same as the ones reported in **Table VI**.

49. When we eliminate employees at France Télécom subsidiaries from the participation and personal contribution regressions in **Table IV**, the effect of non-civil servant tenure stays negative and significant, but the effect on personal contribution becomes smaller in magnitude. This observation is consistent with the interpretation that employees at subsidiaries are more concerned with the effect of the privatization on their firm-specific human capital.

some assets with a two-year holding period.[50] The portfolio compositions are roughly consistent with our predictions regarding wealth and firm-specific human capital, suggesting that the neoclassical model is not at odds with the data.

D. Deviations from "optimal" portfolios.

While our results are generally consistent with a neoclassical model, we also find that employees sometimes deviated from optimal portfolio choice. To understand these deviations, we examine the choice of *Abondix* vs. *Multiplix*. Both plans had a holding period of five years. Ignoring the constraint that no more than one quarter of annual gross salary can be invested into *Abondix* and *Multiplix* combined, *Multiplix* dominates *Abondix: Multiplix* offers more value per Franc invested and is downside protected.[51] Hence no (weakly) risk-averse investor should choose *Abondix* over *Multiplix* as long as the salary-based constraint is not binding.[52] This strong prediction will hold for any concave, non-decreasing utility function and is testable.

We examine those investors who selected a portfolio that includes some long-term assets (*Abondix* and/or *Multiplix*[53]) and whom the salary constraints would have allowed to substitute a share of *Multiplix* for *Abondix*. By making this substitution, the investor could have increased the value of his portfolio at no additional cost while simultaneously making her investment safer.[54]

The results from this exercise are striking: There are 74,023 participants for which the relevant salary constraint is not binding, and of these 71,253, or 96%, purchase too many units of *Abondix* relative to *Multiplix*.[55] Even more striking, there are 47,136 investors in the sample for

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50. The assets with five-year holding periods were not available to former employees.

51. This is true unless we assume an implausibly low value for the volatility of the France Télécom stock.

52. The situation is in fact slightly more complicated. Since the 50% matching bonus on *Multiplix* is capped at FF 1,000, while the 100% *Abondix* bonus runs up to FF 3,000, there exists a small intermediate range in which it is marginally beneficial to add *Abondix* rather than *Multiplix* to the portfolio. The subsequent analysis takes this complication into account and identifies only those investors who could have increased the value of their portfolio by substituting *Multiplix* for *Abondix*.

53. Whether the individual portfolio also includes *Simplix* or *Disponix* is irrelevant for this analysis.

54. The individual limits on the total investment into *Abondix* and *Multiplix* can be calculated from our estimates of the salary levels, as described earlier in the paper (see note 25).

55. In order to test whether this strong violation of investor rationality is due to our misestimation of salary levels, we repeat

whom the salary-based constraint is not binding and who invest in *Abondix*, but do not invest in *Multiplix* at all. Conditional on their willingness to hold an asset with a five-year holding period, this choice is hard to reconcile with utility maximization.

These suboptimal decisions are economically significant: Ordering investors by the amount of money left on the table, the mean inefficient investor could have increased the value of his portfolio by FF 7,682 (37.2%) without changing the holding period of his portfolio or bearing any conceivable costs.[56] Since we can perform our test only on investors who invest small amounts relative to their salary income, one can argue that the sub-optimal behavior may be restricted to small and probably less sophisticated investors. It is also possible that the violations of expected utility theory are restricted to the non-linear asset *Multiplix*. The payoff and benefits of *Multiplix* may not have been well understood by many France Télécom employees. However, a violation of investor rationality of this order of magnitude casts considerable doubt on the notion that the portfolios are chosen optimally.

E. A measure of the value of liquidity for a subset of investors

The institutional structure of the France Télécom employee offering enables us to estimate the value that employees put on the liquidity or their ability to sell their France Télécom stock holdings at will. For the purpose of this analysis, it is convenient to focus on former employees and retirees, who were restricted to the *Simplix* and *Disponix* plans. *Disponix* could be sold immediately after the offering, and gave a small amount of free shares and discounts. *Simplix* gave more free shares and discounts but had to be held for two years. In order to receive the free shares, investors had to hold *Simplix* for three years and *Disponix* for one year. Hence retirees and former employees were given the choice of trading off more free shares and discounts for less

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the analysis requiring that an investor be further away from the salary-based constraint than necessary to purchase one unit of *Multiplix*. Since for 75% of the inefficient investors the estimated slack under the constraint is more than FF 10,079, the results are essentially the same.

56. The median inefficient investor could have increased the value of his portfolio by FF 8,573 (34%), and the 25% and 75% quartile improvements are FF 3,378 (9%) and FF 11,029 (67%) respectively. For 10% of the inefficient investors, the

liquidity.

Of the 8,672 participating retirees and former employees, 82% chose a pure *Simplix* portfolio offering high discounts but a two-year holding. Only 6% chose pure *Disponix*, and 13% combined *Simplix* and *Disponix*. While investors who chose only one asset can be seen as at a corner solution of their individual optimization problem, the investors who chose interior combinations reveal their marginal trade-off between portfolio value and liquidity. We calculate the change in portfolio value for the interior investors when (i) the total investment into *Disponix* is replaced by *Simplix* and (ii) the *Disponix* holding is reduced by one share, and the *Simplix* holding is increased by one share.[57]

The average interior investor could have increased the value of his portfolio by 9.9% by replacing his entire holdings of *Disponix* through *Simplix*. Simultaneously, the required holding period of his portfolio would have increased from 2.08 years to 3 years.[58] At the margin, the average interior investor would have increased the value of his portfolio by FF 45 when replacing one unit of *Disponix* by a unit of *Simplix* and FF 36.40 in cash. The marginal trade-off between portfolio value and holding period can be identified by dividing the marginal change in value through the marginal change in holding period, and averaging across investors. This calculation yields a value of FF 9,460 or 12.2% of portfolio value, indicating that the average interior investor trades off a 12.2% increase in portfolio value for a one-year increase in holding period at his individual optimum. We cannot judge this behavior as suboptimal, but it gives a sense of how strongly one subgroup of investors values the ability to rebalance their portfolio at will.

F. Behavioral explanations

Might behavioral explanations account for some of our surprising findings? Prospect theory

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costless value increase would have been larger than FF 12,834 (77%), with a maximum of FF 30,055 (121%).

57. Since a unit of *Disponix* costs FF 182 and a unit of *Simplix* only FF 145.60, the difference of FF 36.40 is added to the new portfolio as cash holding.

58. We use the holding periods required to receive the free shares for this analysis. Investors were allowed to sell *Disponix* immediately and *Simplix* after two years, but had to hold the assets for one and three years respectively to receive the free shares.

(Kahneman and Tversky [1979]) predicts that investors exhibit loss aversion: They perceive losses relative to the status quo as worse than equivalent foregone gains. Based on loss aversion, we would expect *Multiplix* to prove even more attractive than our neoclassical model predicts, as if offered complete downside protection, as well as a sizeable share of the upside on the France Télécom stock. In fact, as we note above, more than half of participants invested nothing in *Multiplix* (**Table III, Panel C**) and the fraction of contribution in protected shares was not substantially larger than we anticipated. Further, on the margin, employees not at their salary limit constraints could have improved their wealth (and utility) by substituting *Multiplix* for *Abondix* (see section D above). Perhaps employees not used to the hazards of stock market investing underestimated the volatility of the France Télécom stock, especially over a five-year period. Or perhaps loss aversion conflicted with a "self-control" rule against borrowing: employees may have shunned the fictional loan embedded in *Multiplix*, not recognizing it as fictional.[59]

The small size of the human capital effects may be due to many factors,[60] but could be consistent with the mental accounting hypothesis. Mental accounting as described in Thaler [1985, 1990 and 1998], Shefrin and Statman [1993 and 1994] and Shefrin and Thaler [1988] refers to the tendency of investors to subdivide their total wealth into disjoint accounts and apply different decision rules to different accounts in isolation without pursuing overall utility maximization. If employees assigned their France Télécom human capital to a different account than their France Télécom financial capital, they will not have perceived the increased risk exposure due to the correlation of the two. Given the mental accounting effects documented in the behavioral literature when just money is at stake, the mental separation of human and financial capital is plausible.

Equally plausible, employees with longer tenure may feel optimistic about the prospects of France Télécom, and be confident about their knowledge of the prospects of France Télécom.

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59. The theory of self-control (Thaler and Shefrin [1981], Schelling [1984], Shefrin and Statman [1984]) posits that the desire to restrain one's short-term behavior leads investors to adopt rules and self-imposed constraints on behavior, such as automatic savings plans or "no-debt" rules.

60. If tenure is an imperfect measurement of the firm-specificity of human capital, the coefficient on tenure in our regressions will be attenuated.

When people are given more information on which to base a forecast or assessment, accuracy of their forecasts tends to improve much more slowly than their confidence in the forecasts. Thus, additional information can lead to an illusion of knowledge and foster overconfidence.[61]

Loyalty effects may have been at work in the offering. Employees in the high-salary range may be better performers and therefore feel greater loyalty to France Télécom, and express it through more participation and more personal contribution.

We find these *post-hoc* behavioral explanations of our findings unsatisfying, in part reflecting of what Laibson and Zeckhauser [1998] label the "promiscuous prediction problem": Behavioral theories may yield opposite predictions, and allow too many degrees of freedom. However, as Laibson and Zeckhauser note, "the promiscuous prediction problem also plagues mainstream economics. Both behavioral models and standard economics models are often so flexible that almost any outcome can be explained by them."

61. In a widely cited study, Oskamp [1965] documents that pyschologists' confidence in their clinical decisions increased with more information, but accuracy did not. Long tenure is likely to be correlated with a positive opinion about the prospects of France Télécom, which is then reinforced through the illusion of knowledge.

VI. Conclusions

The partial privatization of France Télécom offers an interesting setting for analyzing the investment decisions of individuals with human and financial capital at risk. We develop a neoclassical model that attempts to capture the essential features of the decision facing employees, and compare the predictions of our model to the observed participation of France Télécom employees.

The data are consistent with many predictions from the simple neoclassical model. In general terms, we expect that employees who are better able and willing to bear risk will participate in the stock offerings. We find evidence to this effect. Wealthier workers and those who are better paid are more likely to buy shares in France Télécom, consistent with the predictions of the model, and invest more in the firm. They also invest more in short-horizon assets and less in *Multiplix*, given the plan limitations on their investments in long-horizon assets.

Our most surprising finding is that the decisions whether to participate and how much to invest are driven by different factors. It seems that a threshold level of desired investments must be attained for participation to occur, perhaps because of the cost to employees of analyzing the offering. We attempt to measure the size of these thresholds, and find that employees may forgo benefits equal to one to two months of salary by failing to participate. We interpret this finding as manifesting to the importance of marketing efforts in the employee stock offering, but recognize that alternative explanations might be at work.

Our empirical analysis reveal a related puzzle: human capital considerations suggest that former employees should have been the most eager participants, followed by currently employed civil servants, and finally by non-civil servants. We find the opposite pattern. Among current employees, we do find some evidence of human capital effects, but they are small: one standard deviation of tenure above the mean is associated with 0.6% less likelihood of participation, and with 11%-14% less personal contribution, conditional on investing. Employees may have fallen prey to a

"mental accounting" illusion, treating their human capital separately from their financial capital, and neglecting the risk due to the correlation between the two.

We also document a clear-cut and economically significant asset allocation anomaly by France Télécom employees: many purchased insufficient (or zero) amounts of the most attractive investment vehicle offered to them –a downside-protected stock-based asset. Merely creating and offering a superior investment vehicle does not guarantee that investors will buy it.

For a subset of participants, we can measure the apparent value that investors place on an additional year of holding period. This crude measure gives us a window into how individual investors value liquidity and the apparent value is substantial. We also find that men and women invest differently with respect to their likelihood of participating, the levels of their investments and their chosen portfolios.

While this empirical study uses imperfect data to test highly stylized models, we believe that work of this sort can be very valuable in revealing how investors make decisions. Our theories can be challenged and enhanced by detailed examination of actual investment behavior.

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Table I
Description of the France Télécom Privatization Offerings to Employees

This table summarizes the characteristics of the four share programs offered to France Télécom employees during its privatization.[a]

Program	Discount	Matching Bonus	Free Shares [b]	Tax Treatment	Required Holding Period	Payment Options	Guarantees	Limits
Abondix	20% off of offer price	‣ 100% for first FF 3000 ‣ 50% for next FF 6000 ‣ 25% for next FF 66000	‣ One for each share purchased up to FF 3000 ‣ One for each four shares purchased for the next FF 3860	Tax free [c]	5 years	‣ In cash ‣ In three payments over two years [d] ‣ In 36 monthly payments [e] ‣ Through transfer from company pension plan [f]	None	PEG limits [g]
Multiplix [h]	20% off of offer price	‣ 50% for first FF 2000 ‣ Plus 9 x (personal contribution and bonus) as a guaranteed bank loan. ‣ The investor forgoes dividends and tax credit	None	Tax free [c]	5 years	‣ In cash ‣ In three payments over two years [d] ‣ In 36 monthly payments [e] [1]	‣ 25 % return over five years on personal contribution ‣ guaranteed repayment of the bank loan	‣ PEG limits [g] ‣ Personal contribution less than FF 9000
Simplix	20% off of offer price	None	‣ One for each bought share up to FF 3000 ‣ One for each four shares purchased for the next FF 3860	Taxable [i]	2 years/ 3 years for free shares	‣ In cash ‣ In three payments over two years ‣ In 36 monthly payments [e]	None	5 times the annual Social Security limit (FF 823,200 in 1997)
Disponix	none	None	‣ One for each three shares bought up to FF 6860	Taxable [i]	none/ 1 year for free shares	In cash only	None	5 times the annual Social Security limit)

Notes:

a. Eligibility: Eligible for all programs are (i) the personnel of France Télécom or of French subsidiaries of which France Télécom owns more than 50% of capital. To be eligible for access to the group savings plan PEG (*Multiplix+Abondix*) requires furthermore at least three-month seniority at the time of subscription. Only current employees can purchase *Multiplix* and *Abondix*. Employees with bad credit history are not eligible for participation in *Multiplix*.
b. The free shares have a global limit of FF 6,860 for all share programs combined. Free share payments will be made to *Disponix* first, then *Simplix*, and last, *Abondix*. The maximum request for shares cannot exceed 5 times the Social Security limit, or FF 823,200 for 1997.
c. Since the shares are held by the group savings plan (PEG), the bonus, capital gains and paid dividends are tax-free. Social security contributions (CSG/CRDS) are applicable.
d. The three payments of 30% at delivery, 30% after one year and 40% after two years are interest free.
e. The 36 monthly payments are interest free.
f. Payments made through transfers from the pension plan carry no bonus.
g. The total annual investment in the group savings plan (PEG) cannot be larger than one quarter of the annual salary of the employee. Furthermore, the total bonus paid into PEG cannot exceed FF 22,500, whereby the *Abondix* bonus is allocated before the *Multiplix* bonus.
h. In order to participate in *Multiplix*, the employee must have bought at least one share in one of the other programs.
i. Under the French tax regime, the first FF 8,000 of dividends for individuals, and the first FF 16,000 for couples are tax free. Above this, dividends are taxed at regular income rates, which would range from 28% to 37%for the bulk of France Télécom employees. Capital gains are taxed at a 20.9% rate.

Table II
Descriptive Statistics of Characteristics of Individuals Eligible to Participate in France Télécom Employee Share Offerings

The table below shows information about the 205,076 employees eligible to participate in the France Télécom share offering scheme in 1997. **Panel A** reports age and job tenure (date of employment through time of offer.) **Panel B** shows the breakdown by type of participant, job category, and gender. **Panel C** presents the sample by salary grade. Salary grade code 11 is the lowest and 46 is the highest salary level. Salary grades 11 to 23 indicate ordinary employees and technicians. In this group the average monthly salary in 1997 was FF 12,562 for men and FF 11,928 for women. 31 to 33 are middle managers, with an average salary of FF 17,104 for men and FF 16,059 for women. Finally, 41 to 47 are managers, with an average monthly salary of FF 25,445 for men and FF 22,548 for women. CD stands for cadre dirigeant (executive) while OE, AM and CA refer to employees at subsidiaries and stand for clerical/technical employee, foremen and manager respectively. IN stands for indeterminate and refers to employees at both France Télécom and subsidiaries.

Panel A

	Age (years)	Job tenure (years)
Mean	44. 5	19.9
Standard Deviation	10.4	10.5
Number of observations	200,216	200,606

Panel B

Type of employee	Number	Job category	Number	Sex	Number
Current employee	174,091	Civil servant	14,3781	Male	124,444
Former employee, not retired	8,628	Non civil servant	38,010	Female	80,146
Retiree	22,357				
Total	205,076	Total	181,791	Total	204,590

Panel C

Salary Level	Number	Salary Level	Number
11	1,102	42	6,981
12	3,066	43	3,200
13	17,313	44	1,378
21	41,514	45	650
22	52,000	46	161
23	24,212	CD	130
31	4,128	OE	9,207
32	6,559	AM	2,664
33	12,167	CA	7,189
41	4,651	IN	2,650
		Total	**200,925**

Table III
Offering Participation Statistics

Panel A shows participation ratios and total number of eligible employees by class of employee: Current, former, retired, civil servant and non-civil servant. **Panel B** shows average personal contributions in Francs of each employee class, and the personal contribution as a fraction of monthly salary. This table considers only employees who chose to participate in the offering, thus represents contributions conditional on some contribution. The salary levels are estimated as described in the text. The ratios for retirees and not-retired former employees are calculated on the basis of their last salary at France Télécom. **Panel C** shows participation percentages for each of the four assets broken down by employee type. Retirees and former employees were not allowed to purchase *Abondix* or *Multiplix*. The percentages do not add up to one as employees could participate in multiple share schemes.

Panel A

	All potential investors	**Current employees**	**Currently employed civil servants**	**Currently employed non-civil servants**	**Retirees**	**Former employees (not retired)**
Participation ratio	62.8%	68.0%	66.5%	73.5%	37.8%	21.6%
Eligible number of individuals	205,076	174,091	135,891	38,200	22,357	8,628

Panel B

	All investors	**Current employees**	**Currently employed civil servants**	**Currently employed non-civil servants**	**Retirees**	**Former employees (not retired)**
Average personal contribution	26,554	26,337	22,597	40,404	25,116	44,253
Average personal contribution / monthly salary	145%	144%	139%	182%	150%	242%
	Current ordinary employees and technicians (Grades 11-23)		**Current middle managers (Grades 31-33)**		**Current managers (Grades 41-47)**	
Average personal contribution / monthly salary	118%		157%		265%	

Panel C

	All investors	**Current employees**	**Currently employed civil servants**	**Currently employed non-civil servants**	**Retirees**	**Former employees (not retired)**
	Assets demanded					
Abondix	90.4%	97.2%	98.2%	93.6%	n/a	n/a
Multiplix	40.9%	44.4%	45.6%	40.1%	n/a	n/a
Simplix	21.8%	16.4%	15.3%	20.5%	92.8%	94.5%
Disponix	11.5%	11.0%	10.9%	11.1%	16.7%	22.5%
	Most popular asset combinations					
Abondix only	41.2%	45.2%	45.2%	45.4%	n/a	n/a
Simplix only	9.4%	1.5%	0.8%	4.2%	66.9%	77.6%
Disponix only	0.8%	0.4%	0.4%	0.6%	4.5%	5.6%
Abondix-Multiplix	28.7%	32.3%	33.3%	28.4%	n/a	n/a
Abondix-Simplix	3.9%	4.0%	3.8%	4.8%	n/a	n/a
Simplix-Disponix	1.4%	0.3%	0.2%	0.8%	9.3%	16.8%
Abondix-Multiplix-Simplix	5.2%	5.9%	5.9%	6.0%	n/a	n/a

Table IV
Analysis of participation in France
Télécom employee share offering program

Panel A shows the Probit analysis, while **Panel B** shows the truncated regression results. In **Panel A,** the dependent variable is a dummy variable that equals one if the employee requested any shares under any of the programs, and in **Panel B** the dependent variable is total employee contribution. The independent variables are tenure, age, age squared, claimant category, salary grade, estimated salary level and job category (not reported). The claimant category dummies are to be interpreted relative to current employees and the salary grade dummies relative to salary level 11, the lowest. Salary levels can only be estimated for salary grades 11 to 46, and salary grade dummies are included for employees at France Telecom subsidiaries. Estimated salary levels and the wealth measure have been divided by 10,000.

PANEL A

		Probit Regression		**Probit Regression**	
		Coefficient	**t-stat**	**Coefficient**	**t-stat**
Constant		-0.9184	-14.68	-1.9554	-38.69
Tenure					
	current civil servants	0.0043	5.50	0.0110	14.84
	current non-civil servants	-0.0026	-2.14	-0.0002	-0.21
	former employees	0.0163	9.34	0.0227	13.06
Age		-0.0104	-14.22	-0.0164	-23.47
Age squared		-0.0001	-2.27	-0.0000	-0.81
Civil servant dummy		-0.2201	-10.75	-0.1482	-7.53
Female dummy		0.1484	20.36	0.2551	35.35
Retiree dummy		-0.8422	-14.03	-0.8636	-14.40
Former employee dummy		-1.7318	-47.79	-1.7955	-49.43
INSEE wealth measure		0.0317	6.69	0.0353	7.47
INSEE wealth measure squared		-0.0007	-6.08	-0.0008	-6.92
Salary levels (estimated)				0.1126	92.28
Salary grades (FT)					
	11 (lowest)				
	12	0.6182	11.32		
	13	0.6285	12.59		
	21	0.9463	19.33		
	22	1.1008	22.34		
	23	1.4327	28.63		
	31	1.6064	29.72		
	32	1.7504	33.29		
	33	1.6859	33.10		
	41	2.1134	37.79		
	42	1.8977	36.66		
	43	2.0452	35.71		
	44	2.4434	32.03		
	45	2.1619	25.01		
	46 (highest)	2.7471	13.82		
…at subsidiaries*	Clerical/Technical	0.7598	15.40	1.6469	51.93
	Foreman	1.3774	24.70	2.2997	54.54
	Manager	1.7225	33.35	2.6663	72.53
	Indeterminate	2.0927	27.30	2.9338	45.13
	N	**167,064**		**167,064**	
	Pseudo-R^2	0.0995		0.0914	

PANEL B

		Truncated regression		Truncated regression	
		Coefficient	**t-stat**	**Coefficient**	**t-stat**
Constant		22324	4.57	-34240	-11.83
Tenure					
current civil servants		-267	-5.75	-435	-9.63
current non-civil servants		-460	-6.93	-402	-6.06
former employees		-411	-2.84	-439	-3.04
Age		198	4.37	372	8.43
Age squared		-9	-3.51	-8	-3.18
Civil servant dummy		-1586	-1.49	-1066	-1.01
Female dummy		-5490	-13.02	-976	-2.28
Retiree dummy		5970	1.14	2144	0.41
Former employee dummy		7722	2.31	9139	2.73
INSEE wealth measure		-1172	-4.25	-1326	-4.79
INSEE wealth measure squared		61	8.69	68	9.57
Salary levels (estimates)				3993	72.16
Salary grades (FT)					
	11 (lowest)				
	12	1662	0.35		
	13	2262	0.52		
	21	5152	1.20		
	22	9009	2.10		
	23	10996	2.54		
	31	11808	2.66		
	32	14681	3.35		
	33	21473	4.95		
	41	25980	5.91		
	42	44893	10.36		
	43	64107	14.47		
	44	90171	19.37		
	45	119537	23.09		
	46 (highest)	165104	22.97		
…at subsidiaries*	Clerical/Technical	7985	1.83	64196	36.55
	Foreman	16446	3.62	72963	33.19
	Manager	61855	14.20	117945	64.84
	Indeterminate	28679	6.00	85252	33.73
	N	**111,912**		**111,912**	
	Adjusted R^2	0.0918		0.0836	

* The lettered salary grade codes are for employees at majority owned subsidiaries of France Télécom. Indeterminate refers to employees at both France Télécom and subsidiaries.

Table V
Threshold Levels of Investment and Foregone Benefits

The first column shows the threshold level estimates for different subsets of individuals. A value of FF 18,749 for the reference group of currently employed male non-civil servants implies that individuals of this group have not participated if their desired (latent) investment is smaller than this threshold. The incremental thresholds for women, civil servants, former employees and retirees are to be added to this baseline threshold. **Appendix B** (available from the authors) describes the methodology used to calculate these thresholds. The remaining columns use the thresholds to calculate the monetary value (in bonuses, discounts and free shares) an investor whose latent demand is just below the threshold has foregone. For current employees, the salary-based constraint on the investment into the two long-lived assets has to be taken into account. The threshold levels are calculated for three different gross salary levels, corresponding to the averages for ordinary employees/technicians, middle managers and managers. The free benefits for retirees and former employees are calculated from the two short-lived assets only, and no salary-based constraints apply.

Employee characteristic	**Incremental threshold**	**Total threshold**	**Corresponding free benefits foregone by representative employees (annual salary)**		
			Average Ordinary Employee and Technician (147,000 FF)	Average Middle Manager (198,000 FF)	Average Manager (288,000 FF)
Currently employed male non-civil servant	18,749 FF (reference)	18,749 FF	26,213 FF	29,401 FF	34,921 FF
Currently employed female non-civil servant	-6,117 FF	12,632 FF	24,551 FF	27,657 FF	32,055 FF
Currently employed male civil servant	-549 FF	18,201 FF	26,215 FF	29,403 FF	34,923 FF
Retiree and male non-civil servant	+8,110 FF	26,859 FF	15,182 FF		
Former employee and male non-civil servant	+13,060 FF	31,809 FF	16,421 FF		

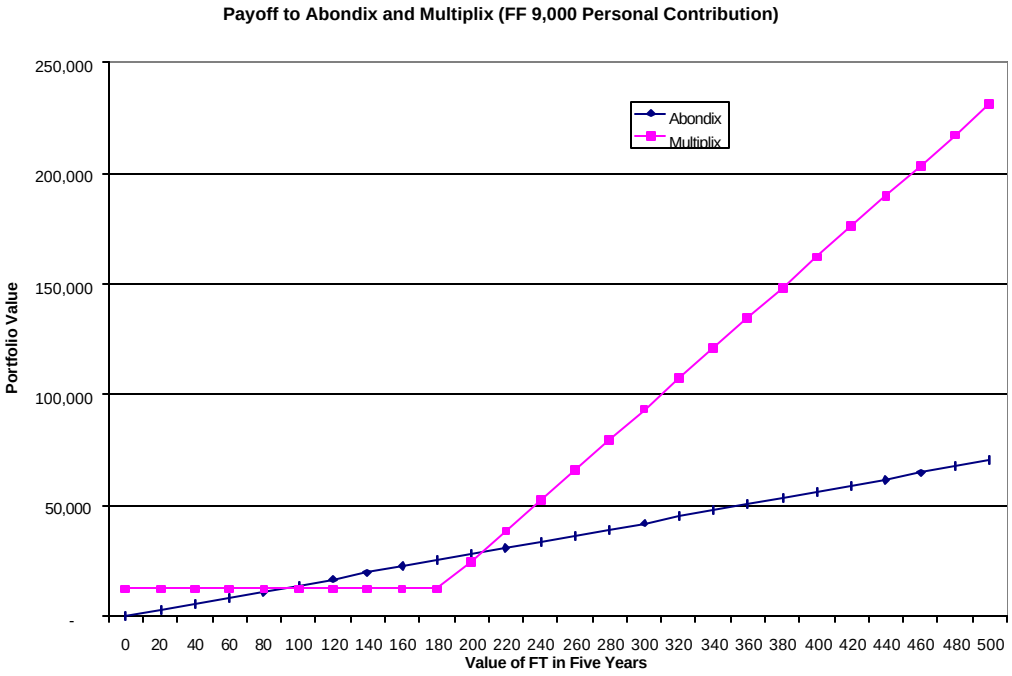
Table VI
Holding Period and Downside Protection Measures as a Function of Employee Characteristics

Two-sided censored Tobit regressions for holding period and downside protection as a function of employee characteristics. The dependent variable in the first column is the average contribution-weighted *ex ante* holding period, and the ratio of chosen to maximum feasible holding period in column two. The dependent variable in the third column is the fraction of the employee's personal contribution invested in *Multiplix* (protected by puts), and the ratio of chosen to maximum feasible downside protection in column four. This analysis is conducted only for employees who chose to contribute and is limited to current employees (former employees and retirees were not eligible for long-term plans, including *Multiplix*). The independent variables are tenure, age, age squared, claimant category, the INSEE wealth measure, salary grade, and job category (not reported). The claimant category dummies are to be interpreted relative to current employees and the salary grade dummies relative to salary level 11, the lowest. The INSEE wealth measure has been divided by 10,000.

	Holding Period				**Downside Protection**			
	Chosen holding period		Ratio of chosen to max. feasible holding period		Chosen downside protection		Ratio of chosen to max. feasible downside protection	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Constant	6.4627	33.88	1.3520	28.61	-0.1075	-4.9	-0.2464	-4.98
Tenure								
current civil servants	0.0024	1.26	0.0003	0.58	0.0004	1.79	0.0018	3.64
current non-civil servants	0.02	7.47	0.0054	5.74	0.001	3.33	0.0006	0.61
Age	0.0037	1.93	0.0012	2.35	-0.0019	-9.05	-0.0036	-7.12
Age squared	-0.0001	-0.71	-0.0000	-0.58	-0.0002	-14.96	-0.0004	-14.36
Civil servant dummy	0.1483	3.48	0.0400	3.52	0.0239	5.01	0.0496	4.30
Femal dummy	0.3688	20.95	0.0859	19.03	-0.023	-12.25	-0.0678	-15.63
INSEE wealth measure	-0.0156	-5.75	-0.0023	-3.15	-0.0012	-4.05	-0.0007	-0.98
Salary grades (FT)								
11 (lowest)								
12	0.587	2.8	0.1661	3.20	0.0244	1.03	0.0607	1.15
13	0.3042	1.58	0.0877	1.85	0.0151	0.68	0.0540	1.09
21	0.2137	1.13	0.0658	1.41	0.0401	1.84	0.1006	2.06
22	-0.1678	-0.89	-0.0237	-0.51	0.0773	3.55	0.1962	4.02
23	-0.3072	-1.61	-0.0560	-1.20	0.1023	4.68	0.2626	5.35
31	-0.3792	-1.95	-0.0732	-1.53	0.1078	4.84	0.2606	5.22
32	-0.583	-3.04	-0.1268	-2.68	0.1268	5.75	0.3087	6.24
33	-0.8007	-4.2	-0.1737	-3.70	0.1248	5.69	0.3154	6.41
41	-0.9521	-4.96	-0.2084	-4.40	0.1355	6.13	0.3412	6.88
42	-1.1036	-5.81	-0.2302	-4.92	0.135	6.17	0.3716	7.58
43	-1.3364	-6.94	-0.2705	-5.71	0.1425	6.42	0.4145	8.34
44	-1.5382	-7.73	-0.3175	-6.48	0.1546	6.72	0.4852	9.44
45	-1.8023	-8.37	-0.3763	-7.10	0.1485	5.91	0.5437	9.69
46 (highest)	-2.1007	-7.38	-0.4133	-5.90	0.1167	3.4	0.5606	7.36
Clerical/Technical	0.3663	1.9			0.0695	3.14		
Foreman	0.0667	0.33			0.1195	5.26		
Manager	-0.7257	-3.8			0.1281	5.82		
Indeterminate	-1.1357	-5.48			0.0543	2.22		
N	**108,298**		**99,044**		**108,298**		**99,044**	

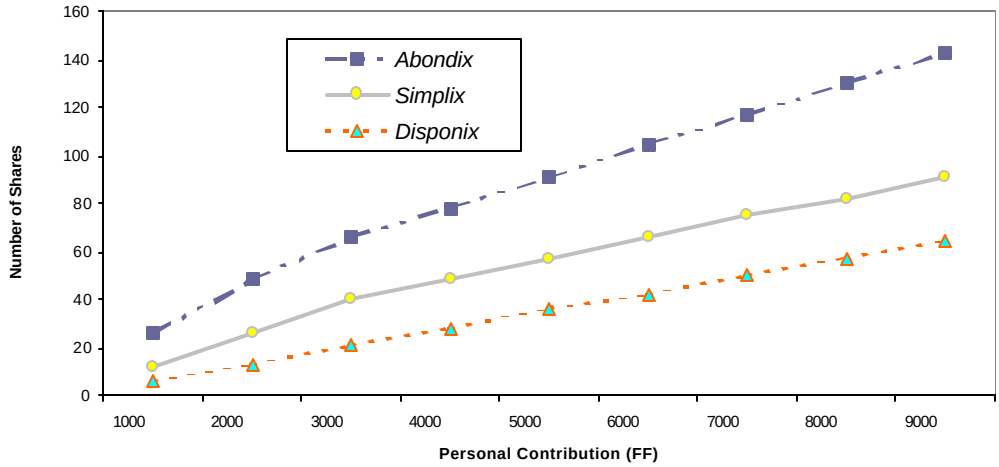
* The lettered salary grade codes are for employees at majority owned subsidiaries of France Télécom. Indeterminate refers to employees at both France Télécom and subsidiaries.

Figure I



Payoff of *Multiplix* vs. *Abondix* for the maximum allowed *Multiplix* investment amount
Final portfolio value after five years of an initial FF 9,000 investment in either *Abondix* or *Multiplix*, including all bonuses and free shares, assuming that the dividend plus tax credit yield on France Télécom is 3.6%.

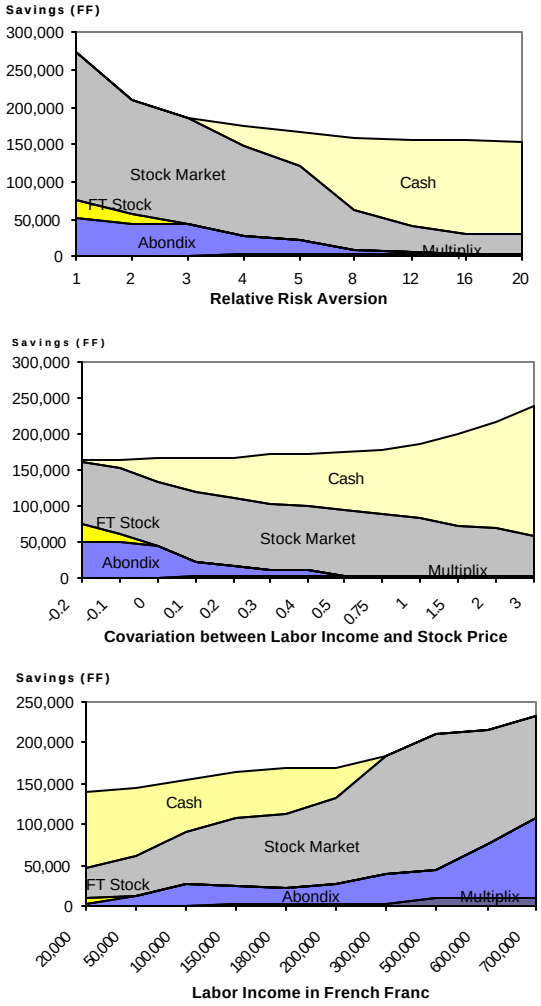
Figure II



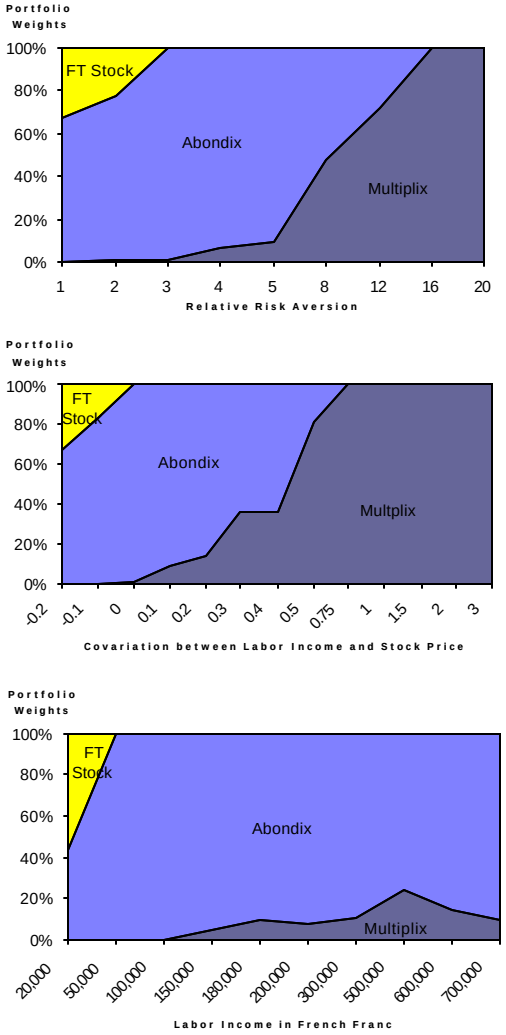
Number of shares delivered by the programs for different levels of personal contribution
The number of France Télécom shares available for a given level of personal investment through the three linear investment schemes. The calculations assume that none of the constraints on personal contribution is triggered at the amounts shown. The offer price for individual investors was set at FF 182, while the price for institutional investors was FF 187. The first day closing price was FF 206.50, for a one-day return of 13.5% from the individual investor offer price.

Figure III

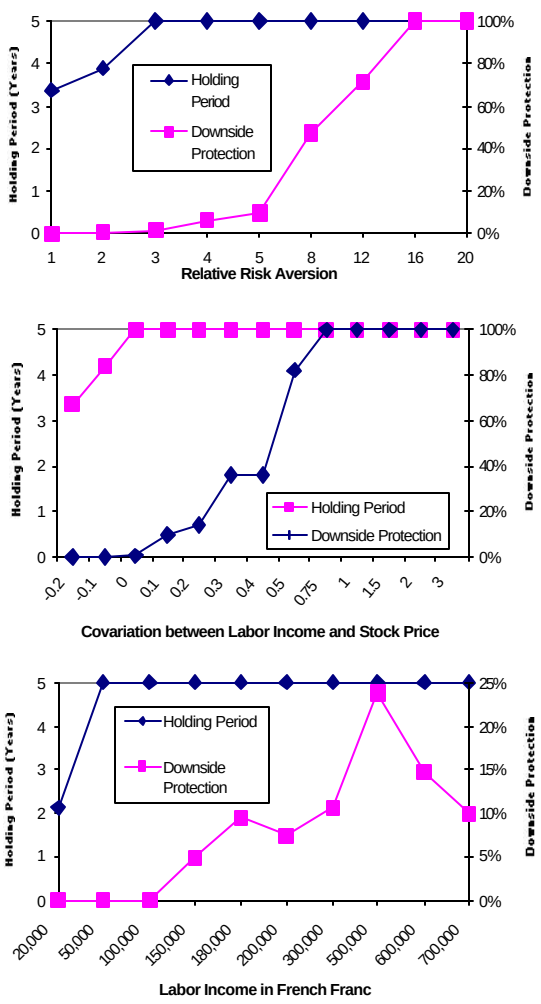
Panel A



Panel B



Panel C

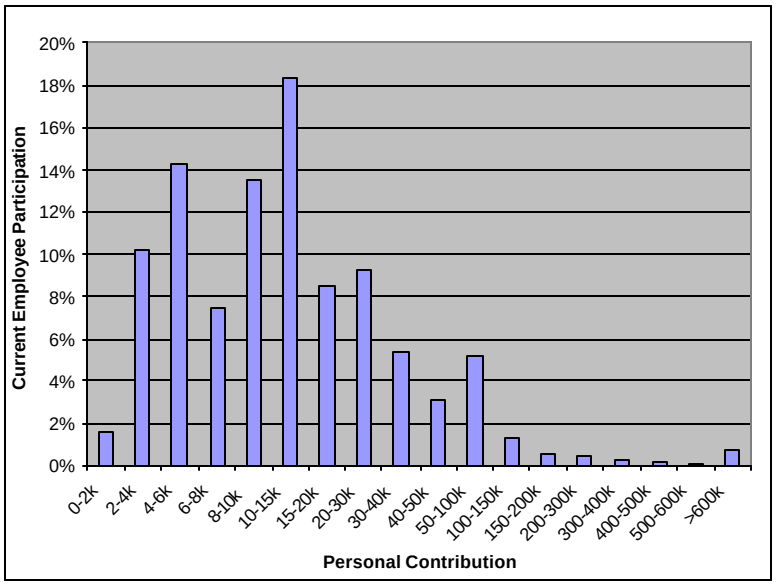


Model-Predicted Portfolio Allocations

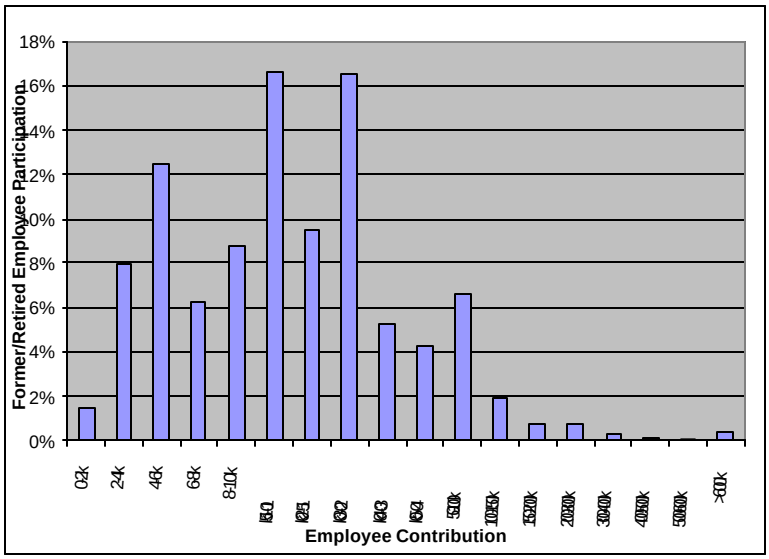
Illustration of the model predictions for savings and portfolio selection decisions as a function of relative risk aversion, firm-specificity of labor income (represented by the covariation parameter ρ), and labor income in French Franc. **Panel A** shows the savings (given by financial wealth plus labor income minus consumption), **Panel B** shows the portfolio allocations for participants in the France Télécom offering, and **Panel C** shows the average holding period (in years) of the chosen portfolio, and the fraction of the portfolio that is downside protected through *Multiplix*. All the model variables are set to their baseline calibration, except for the variable being examined.

Figure IV

PANEL A



PANEL B



Histograms of employee contribution vs. participation rates

Panel A shows the histogram for current employees, conditioned on participating, while **Panel B** shows the results for former and retired employees, conditioned on participating.

NOTE: These Appendices will be made available from the authors, and would not necessarily be included in the publication version of the paper.

Appendix A
Setup of a simple model of portfolio selection

Our stylized three-period model provides intuition and testable predictions of the determinants of portfolio choice in a setting with risky labor income, incomplete markets and a binding choice of holding period. Markets are incomplete along three dimensions: Firstly, there is no borrowing at either the risky or riskless rate. This extends the liquidity constraints that have gained prominence in the literature on precautionary savings (Deaton [1991], Browning and Lusardi [1996]). Second, idiosyncratic labor income risk is not insurable (Bodie, Merton and Samuelson [1992], Bertaut and Haliassos [1997], Viceira [2001]). Since labor income is exogenous in our model, the associated risk is related to the concept of unavoidable background risk (Gollier and Pratt [1996]). Finally, there are no markets in the long-lived assets between the date of purchase and the maturity date.

There are two distinguishing characteristics of our model. First are the state-dependent period two budget constraints: An investor cannot sell any of the long-lived assets purchased in period one to finance consumption or new investments in period two. Thus the period two consumption and investment decision depends on three factors: The amount of consumable financial wealth, realized period-two labor income, and the value of and composition of the non-consumable portion of financial wealth. Second are the numerous discounts, matching bonuses and free shares as well as the constraints on the amounts that can be invested. It is not clear whether the general predictions from the portfolio selection literature continue to hold with this unusual investment opportunity set, which we therefore model explicitly.

Worker-investors choose their investment and consumption in three periods, subject to shocks to both risky financial assets and risky labor income. The investment choice set –modeled to closely reflect the choices facing the France Télécom workers– includes the assets from the France Télécom offering and the standard risk-free asset and a risky asset unrelated to France Télécom (e.g. an investment in equities unrelated to France Télécom).

In the first two periods, the investor decides about his current consumption and about the composition of his financial portfolio. In period one, the investor has the choice between five different assets. The first asset is the standard risk-free bond. The second asset is a slightly discounted share in France Télécom. The share can be traded in period 2, and is meant to represent a simplified version of

the *Disponix* and *Simplix* products, which have short holding periods in exchange for reduced purchase discounts.[1] To capture the discounts, the investors receive free shares as a function of the number of shares purchased based on the actual terms of the *Disponix* offering.

Additionally, there are two illiquid, long-lived assets based on the France Télécom stock. These assets cannot be sold in the intermediate period, such that any investment has to be held until period three. The first illiquid asset, *Abondix*, is nothing more than the standard France Télécom stock, sold at a 20% reduced price. *Abondix* also comes with a matching bonus and delivers a number of free shares as a function of the number of units purchased. The second long-lived asset, *Multiplix*, is downside protected: Investors have to pay the same price as for *Abondix* and are guaranteed a return of 25% on their personal investment in period three. On top of the guaranteed repayment, investors receive a matching bonus in period one and ten times the positive difference between the period three share price and the period one share price as final payoff. *Multiplix* thus delivers the upside on ten shares for each share purchased, and the guaranteed personal investment is augmented by an additional matching bonus.[2]

The model takes into account the rules applied to the granting of bonuses and free shares in the offering, and incorporates the constraints put on the amounts that can be invested into the long-lived assets.[3]

Finally, the period one investment opportunity set contains a risky asset unrelated to France Télécom. This captures the possibility to invest into the stock market or other risky assets independently from the France Télécom offering. Realistically, one would have to take into account that the French stock market, and probably most risky assets available to French retail investors, are correlated with the return on the France Télécom stock. Instead we make the simplifying assumption that the return on the unrelated risky asset is orthogonal to the return on the France Télécom stock.

In period two, the investor has to hold onto any illiquid assets *Abondix* and *Multiplix* bought in

---

1. In reality, *Disponix* and *Simplix* have different number of free shares, purchase discounts, and holding period tradeoffs, that we do not adequately capture in our simple model. We make this simplification in order to concentrate on the longer-lived assets and to make the model more tractable.

2. For simplicity, we ignore tax considerations and subsidized financing.

3. The rules under which the discounts, bonuses and free shares are granted as well as the relevant constraints are described in detail in the body of the paper.

period one. He then faces the standard consumption-savings decision, and has to allocate any additional savings between the two short-term risky and the riskless asset. The only assets available for investment at in period 2 are risk-free bonds, standard France Télécom shares and the independent risky asset. We assume that the investor receives no utility from bequests and consumes all his wealth in period three. The uncertainty in our model unfolds as follows. The one-period return on the France Télécom share is given by:

$$R_{FT,t} = R_f + premium + \varepsilon_{FT,t} \text{ for } t = 1,2 \quad \text{(A1)}$$

where R_f is the gross risk-free rate, premium is the equity premium and $\varepsilon_{FT,t}$ is a mean-zero shock to the stock return between period t and period $t+1$. Similarly, the return on the unrelated risky asset is given by:

$$R_t = R_f + premium + \varepsilon_t \text{ for } t = 1,2 \quad \text{(A2)}$$

The investor in our model receives labor income in each period. Period one labor income L_1 is known with certainty, but second and third period labor income is risky. It is subject to two random shocks, one of which corresponds to the shock to the France Télécom stock. This formalizes the notion that human capital is a risky asset, and related to the performance of the employing firm. The second shock represents idiosyncratic labor income risk, such as illness, layoffs, or unexpected income windfalls. Shocks to labor income are persistent, such that a shock at t=2 affects income at t=3. Formally, period-two labor income is given by:

$$L_2 = L_1(1 + \rho \cdot \varepsilon_{FT,1}) \cdot (1 + \varepsilon_{L,1}) \quad \text{(A3)}$$

where $\varepsilon_{FT,1}$ is the shock to the France Télécom stock return and $\varepsilon_{L,1}$ is a mean-zero idiosyncratic labor income shock. The covariation between labor income and stock returns is strictly increasing in the parameter ρ. Labor income in period 3 continues to be subject to shocks to the France Télécom stock:

$$L_3 = L_2(1 + \rho \cdot \varepsilon_{FT,2}) \quad \text{(A4)}$$

For simplicity, we set the idiosyncratic labor income shock in period three to zero. To prevent our investor from simply hedging the positions in the illiquid assets at t=2, we assume that short sales of both risky and riskless assets are prohibited.[4] All three sources of risk – $\varepsilon_{FT,t}$, ε_t and $\varepsilon_{L,t}$ – are mutually

4. Were employees able to sell stock short, they would have immediately purchased infinite amounts of the discounted asset,

independent.

The preferences of our investor are described by a constant-relative-risk-aversion utility function, a formulation that is common in the neoclassical portfolio selection literature, and we assume the standard Von Neumann-Morgenstern time-separability conditions. Thus the investor's objective function is to maximize utility of consumption over the three periods, which is given by[5]

$$U(c_1, c_2, c_3) = u(c_1) + \delta u(c_2) + \delta^2 u(c_3)$$

(A5) and

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$$

where δ represents the time discount factor, and γ is the coefficient of relative risk aversion.

In order to solve the model, we assume that each of the three sources of risk –the France Télécom shock, the shock to the unrelated asset and the labor income shock –can take on only one of two values in each period. We represent the underlying uncertainty in the form of a binomial tree and solve the model numerically by backward induction. Assuming binomial shocks and three sources of uncertainty results in nine decision nodes in the intermediate period. We apply a grid search to the investor's decision problem at each of the intermediate nodes, and to his decision problem in the first period. The standard calibration of the model uses the following parameter values: Initial wealth equals FF 200,000 and initial labor income equals FF 180,000 p.a. before taxes. The relative risk aversion (RRA) parameter is set to 5 and varied between 2 and 20. This range is arbitrary, but relates to previous empirical work.[6] The individual time preference rate is equal to the risk-free interest rate at 5%, while the equity premium equals 6%. The risk parameters in the baseline calibration are a 30% annual volatility for the France Télécom stock return, a 25% volatility for the unrelated risky asset and a 5% volatility for the independent labor income shock. The outside risky asset has a more attractive Sharpe ratio than the France Télécom stock, capturing the idea that holding (for example) an indexed fund offers in general a more favorable risk-return tradeoff than holding a single stock. The parameter controlling the covariation between stock returns and labor income, ρ, is set to 0.1

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shorted them and earned arbitrage profits by "monetizing" the discount.

5. Because we are trying to model the tradeoff between liquidity and return, we cannot assume that the investor is maximizing over final wealth, since in that case the portfolio weight on the liquid, low return asset would be zero.

Appendix B

Estimating the threshold levels

This section describes the methodology for estimating the threshold levels below which latent individual investments would not be observable. The double-hurdle specification is closely related to the censored regression model first proposed by Tobin [1958] and the sample-selection models described by Heckman [1976]. It follows the model of Cragg [1971], in which the first hurdle is a Probit model for participation, and the second hurdle is a censored regression for the contribution level similar to Tobin's model.[7]

We illustrate the methodology for the simple case when there is only one threshold applicable to all individuals. The underlying latent variable model is given by:

$$
\begin{aligned}
& y_i^* = \alpha + x_i'\beta + \varepsilon_i \qquad\qquad \varepsilon_i \sim N(0, \sigma^2) \\
\text{(B1)} \qquad & y_i = y_i^* \ \textit{iff}\ y_i^* \geq K \\
& y_i = 0 \ \textit{otherwise}.
\end{aligned}
$$

where y_i^* is the latent personal investment, which will be observed if and only if y_i^* is larger than some threshold level K. The likelihood function of the standard Tobit model augmented by the threshold effect K is given by:

$$
\begin{aligned}
L(\alpha, \beta, K, \sigma) &= \prod_{y_i^* \geq K} \Pr(y_i^* \geq K) * f(y_i \mid y_i^* \geq K) \ * \prod_{y_i^* < K} \Pr(y_i^* < K) \\
\text{(B2)} \qquad &= \prod_{y_i^* \geq K} \frac{1}{\sigma} f\left(\frac{y_i - \alpha - x_i'\beta}{\sigma}\right) \ * \prod_{y_i^* < K} 1 - \Phi\left(\frac{(\alpha - K) + x_i'\beta}{\sigma}\right)
\end{aligned}
$$

Here $f(\cdot)$ and $\Phi(\cdot)$ correspond to the standard normal pdf and cdf respectively. The two parts in (B2) correspond to a classical regression model for the non-censored observations and to a Probit-type probability term for the censored observations. The only non-standard feature of this formulation is the appearance of the threshold level as part of the constant term for the censored observations. Note that estimating the model in (B1) as a standard Tobit model amounts to forcing the constants in the

---

6. See note 21 in the body of the text for a discussion of the relevant literature.

7. For an in-depth treatment of limited dependent variable models with selectivity, see Lee [1983]. A recent application of the

censored and the non-censored part to be equal, whereas the correct specification (B2) allows the constant term in the Probit part to be reduced by the threshold level.

Heckman [1976] estimates the standard Tobit model in two steps, using the well known result that the expected value of a non-censored observation can be written as:

$$\text{(B3)} \qquad E(y_i \mid y_i^* \geq K) = \alpha + x_i'\beta + \sigma\lambda\left(\frac{K - \alpha - x_i'\beta}{\sigma}\right)$$

Here $\lambda(\cdot)$ stands for the inverse Mills ratio. An estimate of $\lambda(\cdot)$ can be obtained by defining a dummy variable which takes the value one for participants and zero for non-participants, and running a Probit regression for the participation decision. This provides us with consistent estimates of $(K - \alpha - x_i'\beta)/\sigma$ and hence consistent estimates of $\lambda(\cdot)$. Substituting these into (B3), we can estimate the contribution regression by OLS. This in turn gives us consistent estimates of α and σ. Finally, combining the consistent estimates of α and σ from the contribution regression with the consistent estimate of $(K - \alpha)/\sigma$ from the participation regression, we get a consistent estimate of the threshold level K.

techniques employed in this section can be found in Maki and Nishiyama [1996].