

Seeking Alpha: Excess Risk Taking and Competition for Managerial Talent

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4 April 2015

Abstract

We present a model where firms compete for scarce managerial talent (“alpha”) and managers are risk-averse. When managers cannot move across firms after being hired, employers learn about their talent, allocate them efficiently to projects and provide insurance to low-quality managers. When instead managers can move across firms, firm-level coinsurance is no longer feasible, but managers may self-insure by switching employer to delay the revelation of their true quality. However this results in inefficient project assignment, with low-quality managers handling too risky projects. The model has several empirical predictions and policy implications.

JEL classification: D62, G32, G38, J33.

Keywords: short-termism, long-term risk, managerial turnover, mobility, competition, executive compensation.

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Acknowledgments: We are grateful to the editor (Bruno Biais) and three anonymous referees for very helpful suggestions. Ulf Axelson, Marco Battaglini, Philip Bond, Mike Burkart, Adolfo de Motta, David Dicks, Michael Fishman, Hendrik Hakesen, Hugo Hoppenhayn, Giancarlo Spagnolo and participants in the 2010 AEA Meetings, 2012 AFA Meetings, the Third Conference on Financial Integration and Stability in Mannheim, 2010 EFA Meetings, 2010 Mitsui Conference at University of Michigan, the 2011 WFA Meetings, the 2011 ESSET in Gerzensee, the 2012 CSEF-IGIER Symposium on Economics and Institutions, the 2013 Econometric Society Meetings in San Diego, and in seminars at Arizona State University, Bocconi University, Boston College, INSEAD, New York University provided useful comments and discussions. We acknowledge financial support from the Fondation Banque de France, ERC (FINLAB project no. 295709), Europlace Institute of Finance, Inquire Europe, and BNP Paribas Hedge Fund Center (HEC Paris).

“The dirty secret of bank bonuses is that these practices have arisen not merely due to a culture of arrogance; the more pernicious problem is a sense of insecurity. Banks operate in a world where their star talent is apt to jump between different groups, whenever a bigger pay-package appears, with scant regard for corporate loyalty or employment contracts. The result is that the compensation committees of many banks feel utterly trapped. ... Against that background, what the members of some compensation committees are quietly starting to conclude is that the only real solution is to start clamping down on the whole “transfer” game. “If Fifa can stop clubs poaching other players and ripping up contracts, then why can’t the banks do the same?” asks one... It is time, in other words, for bankers and regulators to take a leaf out of football’s book and start debating not just the issue of pay, but also the poaching culture that is at the root of those huge bonus figures.” – Tett (2009)

“Should any investor be prepared to bet on [Mexico’s] next 100 years - or that of any country?... Cynics suggest no one buys a century bond thinking further away than their next job move since it won’t be their problem when it does come due.” – Hughes (2010)

1 Introduction

After the financial crisis, many have blamed banks and securities companies for generously rewarding managers (and other risk-takers such as traders and salesmen) who undercook investments with high short-term returns but large long-term risks.¹ As governments rescued failing financial institutions, media and politicians have stressed the need to rein in managerial incentives to take risks, making compensation more dependent on long-term performance.² It is natural to ask whether this is the right policy response to the problem. It is crucial to ask what is the root of the problem – that is, precisely what market failure produced excessive rewards for short-term

¹See, for example, Rajan (2005, 2008) and Richardson and Walter (2009), although there is less than perfect agreement on the effect of managerial compensation on risk-taking (see Section 2).

²For instance, the 2008 German bailout plan required banks accepting state aid to cap annual salaries of their executives at €500,000, and to forgo bonuses and dividend payments. Similarly, in early 2009 the U.S. government capped the pay of top executives at companies receiving significant federal assistance at \$500,000. The British, Swedish, and Swiss governments also set limits on financiers’ compensation in their efforts to rescue their banking systems.

performance at the expense of a build-up of long-term risks.

This paper argues that the root of the problem is the difficulty of rewarding managerial talent when projects can have long-term risk and the market allows executives to move from firm to firm before that risk materializes. For instance, a trader in a financial firm may set up a “carry trade” and then leave the firm before it can be determined whether the carry was an actual arbitrage opportunity or simply the reward for risk (so that the trade may eventually “blow up”). In this situation managers who take long-term risks while moving rapidly between firms raise their short-term performance and pay, while reducing their accountability for failures. When such job churning is possible, competition for managerial talent induces a negative externality, every firm offering an “escape route” to the others’ employees. If instead the market for managerial talent is not very competitive, managers are more likely to be stuck with their initial employer and so be held responsible for project failures. The contrast between these two managerial labor market regimes recalls that between the current high-mobility scene and that prevailing around the middle of last century. As Frydman (2007) shows for a balanced panel of U.S. firms from 1936 to 2003, top executives who worked for the same company throughout their careers accounted for 30 percent of the total in 1990-2003, down from 70 percent in 1940-67.

More specifically, we consider a setting in which managers are risk-averse while risk-neutral firms compete for scarce managerial talent. We model managerial talent as “alpha”, the ability to generate high returns without incurring high risks: lacking such talent, managers can generate high returns only by taking correspondingly high risks. But risk only materializes in the long run, so managerial talent can be identified with certainty only if the managers who have chosen risky projects stay with their

employer for a long enough time. If they leave earlier, their contribution to the long-term performance of their projects is learnt only with some probability.

In this setting, if managers were bound to their employer, then over time firms could determine which managers are talented, and so could also insure managers against the risk of being found to be untalented. There would therefore be two efficiency gains. First, better choice of investment projects: when managers' skills are known they can be assigned to the project they are best suited to manage. Second, better risk-sharing: managers who prove to be low-skill can be cross-subsidized at the expense of the more talented.

However, competition for managers can prevent both of these gains. If firms compete aggressively ("seeking alpha"), then managers can leave before the long-term risks that they have incurred materialize. This means that the managers who are discovered to be high-alpha types will extract all rents from their firms by generating competitive offers that reward their talent, and so prevent firms from subsidizing low-alpha managers. Thus if the labor market is competitive, managers face skewed performance rewards once their types are revealed: high-alpha types extract all rents and low-alpha types get no subsidy. Now, if firms assign managers of unknown quality to risky projects (which they will do if the risky projects outperform safe ones by a large enough margin), then managers have the incentive to move to another firm before the risk materializes. There, they will replicate the same behavior. In the aggregate, many managers will churn from one firm to the next, choosing risky projects regardless of their ability to avoid the implied risks. Talented executives will be identified only in the long run: as managers proceed in their careers, their true quality gradually emerges anyway, so that their incentive to churn decreases. The

end result is inefficiency relative to the case of no competition for managers: since types are not revealed quickly enough, efficient allocation of managers to projects does not take place in time and too many projects fail; along the way, managers' pay is not commensurate with their actual performance.

The model generates several further results. First, since the benefit of churning is to delay the revelation of a manager's true quality, a key parameter in the model is the sensitivity of project performance to the manager's individual input: the lower such sensitivity, the better the manager can cover his tracks, and thus the greater the insurance benefit from churning. But by the same token, the greater the implied sacrifice of productive efficiency, which requires early learning of the workers' quality. Second, the more risk-averse managers are, the stronger will be their incentive to churn across employers to benefit from the implied insurance, and thus the more likely that untalented managers are assigned to risky projects: ironically, greater risk aversion by managers entails greater risk for society as a whole. Third, even though managers' mobility would be lower if firms made their compensation conditional on the actual payoff of the project or on the manager's decision to leave the firm, firms have no incentive to condition managerial compensation on these outcomes if the labor market is competitive. Fourth, frictions in the market for managers (e.g. search costs) and asymmetric information about the manager's quality can actually mitigate inefficiency by reducing managerial churning.

Finally, when the model is extended to three periods or to the infinite horizon case, it produces several, potentially testable, predictions regarding the correlation between managerial reputation and mobility. First, mobility is positively autocorrelated, and decreases over the manager's career: as information about the manager's ability

become sharper over time, there is less scope for mobility. Second, high-performance managers are more likely to move than low-performance ones. Thirdly, the longer the manager's residual career and therefore his horizon, the greater the benefit of mobility, and therefore the longer the period in which he will churn across firms.

To summarize, competition in the market for managers generates an inefficiency due to the contractual externality among firms. The financial sector appears to fit our model particularly well since trading and sales skills are highly fungible, prompting firms to compete keenly for “alpha”. And many financial sector products, from AAA-rated mortgage-backed securities to credit default swaps or longevity insurance, have the feature of earning a carry (interest or insurance premium) in the short run but with potential long-run risks (default or longevity). While there are other explanations for excess risk-taking, e.g., government guarantees for the financial sector without proper risk controls, our model may help explain why it occurred even in parts of the financial sector, such as investment banks and insurance, that were not apparently entitled to government guarantees, explicit or implicit.

The paper is organized as follows. Section 2 discusses the literature. Section 3 describes the overall setting. In Section 4 we analyze the two-period version of the model, solve for the equilibrium in the non-competitive and in the competitive labor market regime, and compare their efficiency properties. In Section 5 we relax several of our assumptions by extending the two-period model to the cases of conditional pay, switching costs and asymmetric information. Section 6 briefly explains how the results change when the model is extended to three periods, and Section 7 analyzes its infinite-horizon version. Section 8 concludes with a brief description of the model's policy implications. The proofs are in the Appendix.

2 Literature

Our model of the labor market is close to that by Harris and Holmstrom (1982). Workers are long-lived and their productivity is uncertain. Because workers are risk-averse and firms are risk-neutral, the first-best is for firms to fully insure workers and pay a constant wage; but, as noted by Harris and Holmstrom, full insurance is not feasible if there is labor market competition and worker mobility. The reason is that under full insurance, workers who turn out to be very productive will be paid less than their marginal product. So competing firms will want to hire them, leaving the original firm with only low-productivity workers.

With respect to this framework, our paper introduces two novel elements: a project choice by firms, and a decision to move by managers. The choice of projects allows the firm to control whether types can become observable: if managers are assigned to the safe project, their type stays hidden, while if they are assigned to a risky project it becomes known, unless the employee moves to another firm. The option of the safe project eliminates the Harris-Holmstrom problem, since if productivity shocks are hidden, then full insurance becomes possible. But this insurance comes at a cost, since knowing a worker's productivity is useful in selecting the most suitable project for him. Hence, our model features a trade-off between the two information effects discussed in Hirshleifer (1971): information revelation has a cost (destroying insurance possibilities) but also a benefit (enhancing production efficiency). However, in our model the firm considers only the efficiency benefit in assigning workers to projects: if a worker stays on for more than one period, the employer learns his type and thereafter assigns him to risky, high-yield projects if he is good or to safe,

low-yield projects otherwise. Thus if a worker wants to delay the revelation of his type, he will try to churn across firms. Such mobility provides insurance, but also produces inefficiency in worker-project matching.

Our results represent a countervailing force to the benefits arising from competitive labor markets through efficient matching. Gabaix and Landier (2008) present matching models à la Rosen (1981) in which the rise in CEO pay is attributed to the scarcity of their talent and the fact that it is efficiently matched with larger firms. In our setting, instead, competition for talent results in less efficient matching of managers to projects within each firm.

The fact that competition for scarce talent in our model introduces an externality in wage setting is reminiscent of the corporate governance externalities formalized by Acharya and Volpin (2009) and Dicks (2012). In these models, competition prompts firms to incentivate managers via higher salaries rather than better governance, a result supported empirically by Acharya, Gabarro and Volpin (2012). In the same spirit, Thanassoulis (2012) shows that competition for bank executives generates a negative externality, driving up remuneration and hence increasing rival banks' default risk: optimal financial regulation should limit the proportion of resources going to bonuses. In contrast to these works on governance externalities, our paper posits a dynamic setting in which it takes time for firms to learn about their employees and assign them to the right tasks, but this is impeded by managers' ability to generate offers from other firms before their type is revealed.

Labor market competition may also lead companies to rely too heavily on high-powered incentives, shifting effort away from the less easily contractible tasks, such as risk management, towards the contractible ones. This point is captured by Bénabou

and Tirole (2015), in a multitasking model where workers differ in productivity in a rewardable task and in willingness to perform an unrewarded one (work ethic). When firms compete for workers, they will use incentive pay also to attract or retain the most productive workers, and by doing so they reduce work ethic below the social optimum. Our model is complementary to theirs: we focus on employees’ firm-level insurance and on how labor-market competition, by eroding such insurance, leads to churning as an alternative way of synthesizing insurance; in contrast, Bénabou and Tirole focus on multi-tasking and on how competition reduces effort in non-contractible tasks.

Finally, competition for talent may hinder firms’ ability to discipline managers, generating inefficient executive compensation in settings with moral hazard. Axelson and Bond (2014) show that smart workers may be “too hard to manage”, because their high outside options make them insensitive to the threat of dismissal. De Marzo, Livdan and Tchistyi (2013) show that in a dynamic moral hazard model limited liability may make it too costly for the firm to restrain managers’ risk-taking. Similarly, Makarov and Plantin (2012) develop a model of active portfolio management in which fund managers may secretly gamble in order to raise their reputation and attract investment, with trading strategies that expose investors to severe losses. Our analysis differs from these models insofar as excess risk-taking arises not from moral hazard but from inefficiently slow learning of employees’ skills.

Our paper is motivated by the anecdotal evidence of trader churning in the financial sector (see Tett, 2009, cited in the introductory quote) and the financial firms’ competitive “search for yield” (which we interpret as “seeking alpha”). Rajan (2005) was one of the first to warn of excessive risk-taking in financial institutions driven by

short-termist pay packages, which he later called “fake alpha” (Rajan, 2008). In another thought-provoking piece, Smith (2009) refers to the role of managerial mobility in entrenching the culture of bonus without performance on Wall Street.³ Indeed, the argument could apply beyond the financial sector, considering that the mobility of U.S. top managers has increased in all industries since the 1970s (Frydman, 2007), while the idiosyncratic volatility of listed U.S. firms has risen considerably, be it gauged by real or financial variables (Campbell, Lettau, Malkiel and Xu, 2001, Comin and Mulani, 2006, Comin and Philippon, 2006, among others).

Admittedly, complete consensus on the role of pay packages in firms’ risk-taking has not been reached. Fahlenbrach and Stulz (2011) present evidence that bank CEOs lost a significant portion of their stock-based pay and conclude that pay excesses were not the likely cause of risk-taking at financial firms. Bebchuk, Cohen and Spamann (2010) contest this thesis, showing that prior to the crisis bank CEOs had given themselves payoffs greatly in excess of the amounts that they lost eventually, and benefited from short-term compensation not tied to long-run performance. Cheng, Hong and Scheinkman (2015) also present evidence linking compensation and risk-taking at financial firms in 1992-2008 that is consistent with payouts to top management being tied to incentives for short-term risk. None of these papers, however, explicitly examines the role of employee turnover.

³Smith (2009) writes as follows: “*In time there was significant erosion of the simple principles of the partnership days. [...] Competition for talent made recruitment and retention more difficult and thus tilted negotiating power further in favor of stars. Henry Paulson, when he was CEO of Goldman Sachs, once remarked that Wall Street was like other businesses, where 80% of the profits were provided by 20% of the people, but the 20% changed a lot from year to year and market to market. You had to pay everyone well because you never knew what next year would bring, and because there was always someone trying to poach your best trained people, whom you didn’t want to lose even if they were not superstars. Consequently, bonuses in general became more automatic and less tied to superior performance.*”

3 Setting

There are K profit-maximizing firms (indexed by $k = 1, \dots, K$), owned by risk-neutral shareholders, and I risk-averse managers (indexed by $i = 1, \dots, I$). Firms and managers have the same time horizon. Firms are competitive and maximize their expected profits. Manager i maximizes the discounted expected utility of their stream of wages, conditional on current information:

$$V_{it} = E \left[\sum_{s=0}^{T-1} \rho^s u(w_{it+s}) | \Omega_t \right], \quad (1)$$

where $u(w_{it+s})$ is the utility of the wage w_{it+s} received in period $t + s$, ρ is the discount factor, Ω_t is the information available to them in period t , and T is the time horizon. In the simplest and most intuitive case, analyzed in Section 4, managers and firms have a two-period horizon ($T = 2$); Section 5 contains some extensions of the 2-period model; Section 8 extends the analysis to the three-period case ($T = 3$), and Section 7 to the infinite-horizon case. In all three variants, $u(\cdot)$ is increasing and concave: managers are risk-averse regarding their compensation. Moreover, they are born with no wealth and are impatient (their discount factor ρ being smaller than the market interest rate factor $1/(1+r)$), so that their consumption equals their wage at each date. hence, managers do not insure themselves by saving against shocks to the value of their human capital resulting from changes in their reputation. As we shall see, this allows us to focus on the firm and on mobility across firms as the only sources of insurance against these shocks.⁴

Each firm can make its compensation conditional on the projects assigned to

⁴The impact of these shocks on consumption cannot be softened by borrowing either, since the shocks that we analyze are not transitory ones, since they refer to the value of managers' human capital.

the manager and on past information about the manager. The results would not be affected if the firm could make managerial pay conditional also (i) on the actual payoff of the project assigned to the manager or (ii) on the manager's decision to resign and leave the firm. In both cases, in equilibrium firms will not make pay conditional on these additional outcomes, as shown in Section 5.

3.1 Projects and managers

There is a continuum of managers, each of whom can run a new project per period. Each project produces its payoff at the end of the corresponding period. Managers are not equally good at managing risk: a fraction $p \in (0, 1)$ are high-quality managers, and a fraction $1 - p$ of them are low-quality. Moreover, high-quality managers are relatively scarce: $p \leq 1/2$. Initially, the manager i does not know his own quality $q_i = \{H, L\}$. Manager i starts working at any firm k and can move to another firm j before the project initiated in that period pays off.

Projects are of two types. Safe projects (S) generate a certain but low payoff y_S , irrespective of the quality of the manager initiating it. The payoff of risky projects (R), instead, depends on the manager's quality: in the hands of high-quality managers, these projects produce a large payoff $\bar{y}$, but in the hands of low-quality ones, they produce a lower, possibly negative, payoff $\bar{y} - c$, as shown in the upper panel of Figure 1. Making the risky project's yield depend on the manager's type constitutes recognition of personal ability in managing it. Good managers add value by decreasing risk (for simplicity, to zero, the same as the safe project), without reducing expected revenue. In this sense, the good manager generates "alpha", that is, improves the risk-return trade-off of his employer. Conversely, bad managers generate

the same return $\bar{y}$ but only at the cost c .⁵

[Insert Figure 1: Payoffs of the risky project]

A key assumption is that if a manager initiates a project of type R , his ability becomes perfectly known only if he remains in charge of it until the project pays off, that is, *until the end* of the corresponding period. If the manager leaves *before* the end of the period, the outcome of the project will reflect not only the manager's quality but also some noise, due to the fact that the project is no longer monitored by its initiator after his departure, as illustrated in the lower panel of Figure 1: if the manager does not complete the project, with probability β the project's payoff will reflect his type ($\bar{y}$ if the manager is good, and $\bar{y} - c$ if he is bad), and with probability $1 - \beta$ a noise factor that will make the project succeed (i.e. produce $\bar{y}$) with probability p , the same as if the initiator were randomly drawn from the managers' population. Hence, when noise intervenes the project's outcome is uninformative about the quality of its initiator. Making the performance of risky projects less than fully informative about the quality of departing managers captures the idea that it takes time to determine a person's ability to manage a risky project: one must observe the manager at work for the whole project's duration to perfectly learn his ability. Notice that, however, the noise factor does not *per se* change the expected payoff of the project: as can be seen in Figure 1, even when it is not completed by its initiator, the risky project succeeds with probability p and fails with probability $1 - p$.

⁵Project R can be interpreted as a carry trade. To generate a profit $\bar{y}$ the trade needs to be closed in time. So the skilled trader chooses the right time to close and incurs no cost; the unskilled trader (who has no clue when to close) incurs a cost c .

To summarize, the payoff of project R depends both on managerial type and on whether the manager stays or leaves: defining the managerial quality indicator $I_i = \mathbf{1}_{[q_i=H]}$ (equal to 1 if $q_i = H$ and 0 if $q_i = L$), the payoff of a risky project completed by manager i is

$$y_R = \begin{cases} \bar{y} & \text{if } I_i = 1, \\ \bar{y} - c & \text{if } I_i = 0, \end{cases} \quad (2)$$

and that of a risky project left unfinished by manager i is

$$y_R = \begin{cases} \bar{y} & \text{with probability } p_i, \\ \bar{y} - c & \text{with probability } 1 - p_i, \end{cases} \quad (3)$$

where the probability of success p_i is

$$p_i = \beta I_i + (1 - \beta)p = \begin{cases} \beta + (1 - \beta)p & \text{if } I_i = 1, \\ (1 - \beta)p & \text{if } I_i = 0. \end{cases} \quad (4)$$

If the manager leaves the firm prematurely, the probability of success p_i reflects his true quality (captured by the indicator function I_i) with probability β and the noise factor with probability $1 - \beta$. Hence, β is the sensitivity of the project to its initiator's quality, or equivalently the informativeness of its outcome about the departed manager's quality. In the limiting case where $\beta = 1$, the project always succeeds if initiated by a good manager and fails otherwise, so that its outcome is perfectly informative. In the polar opposite case where $\beta = 0$, the project succeeds with the unconditional probability ($p_i = p$), irrespective of its initiator's quality.

The relative profitability of the two projects is assumed to satisfy the following condition:

$$\bar{y} - (1 - p)c > y_S > \bar{y} - c. \quad (5)$$

The left-hand side inequality indicates that, if the manager is of unknown quality, the expected revenue of project R exceeds that of project S : this captures the idea that

greater risk corresponds to higher expected return. The right-hand side inequality states that, if the manager is bad, project S yields a greater expected return than project R . Assumption (5) implies that it is optimal to assign bad managers only to safe projects, and good ones only to risky projects: assigning bad managers to risky projects would imply excessive risk-taking. To characterize the difference between the two projects, it is convenient to define the variable $\eta \equiv (\bar{y} - y_S)/c$, that is, the excess return of the risky project divided by its downside risk: $\bar{y} - y_S$ is the excess return that a good manager can generate if assigned to a risky project rather than a safe one, while $c = \bar{y} - (\bar{y} - c)$ is the range of payoffs that the risky project produces in the hands of a good and a bad manager. Hence, we will refer to η as a measure of the risk-adjusted efficiency gain of the risky project. Assumption (5) can thus be rewritten as:

$$1 - p < \eta < 1, \tag{6}$$

where $\eta < 1$ rules out that the risky project is so efficient that it should be assigned to all managers, thus making project assignment trivial, and $\eta > 1 - p$ guarantees that the risky project is efficient enough as to be viable if assigned to a manager of unknown quality.

3.2 Market for managerial talent

We posit that in each period the pool of projects available to a firm includes at least one safe and one risky project per manager. Therefore, managers – not projects – are the scarce factor of production, since only managers can start a new project.

Let i denote a generic manager, k a generic firm and t a generic period. At the beginning of period t , the firm decides whether to make an offer to the manager,

who can accept or reject it. The offer consists of a sequence of wages $\{w_{ik\tau}\}_{\tau=t}^{\tau=T}$, where T is the maximum number of periods of employment. Being paid in advance, at the beginning of the relevant period, each wage $w_{ik\tau}$ reflects manager i 's expected productivity in period τ , and therefore is contingent on the project $P_{ik\tau}$ to which he will be assigned in period τ and on his perceived quality $\theta_{i\tau-1} \in [0, 1]$ conditional on information learnt up to period $\tau - 1$:

$$w_{ik\tau} = w(P_{ik\tau}, \theta_{i\tau-1}), \quad (7)$$

where $P_{ik\tau} \in \{R, S\}$ indicates whether manager i is assigned to a risky project or a safe project in period τ . Since the belief $\theta_{i\tau-1}$ about the manager's quality evolves on the basis of his performance, the contract is effectively contingent on the realized payoffs of the past projects run by the manager at firm k and at other former employers. In the baseline version of the model, the period- τ wage cannot be contingent on the manager's decision to stay or leave the firm before the end of period τ : the maximum penalty for resignation is receiving no further wage payments from one's former employer. As already mentioned, this assumption is with no loss of generality, as shown in Section 5.

A firm's strategy is a profit-maximizing choice of wage offers and project assignments. More precisely, the firm chooses its offer $\{w_{ik\tau}\}_{\tau=t}^{\tau=T}$ to each manager i and, upon hiring him, assigns him to project $P_{ikt} \in \{R, S\}$, so as to maximize its expected revenue, conditional on the belief θ_{it-1} :

$$\pi(P_{ikt}|\theta_{it-1}) = \begin{cases} \bar{y} - (1 - \theta_{it-1})c & \text{if } P_{ikt} = R, \\ y_S & \text{if } P_{ikt} = S. \end{cases} \quad (8)$$

Firms commit to pay the sequence of wages that they have offered, but not to a specific project assignment: once the contract is agreed upon, the firm assigns the

manager to whatever projects P_{ikt} maximizes its expected profits. The manager's strategy consists in a period-by-period choice of employer: manager i employed by firm k in period t will choose whether to keep working at firm k or switch to a new employer in period $t + 1$ as a function of the belief θ_{it-1} about his quality, so as to maximize the expected utility (1) from his compensation.

We assume that in offering wage contracts, firms bid competitively for managers, anticipating their future performance: hence, managers extract all of the expected profit that they generate with an employer. But, while *ex ante* there is perfect competition for managerial talent, switching costs may prevent it *ex post*: over time, managers may make location- or firm-specific investments or develop location- or firm-specific tastes, impeding poaching by other firms. To bring out the implications of *ex-post* competition for managerial talent, we focus initially on the two polar cases of totally absent or prohibitively high switching costs – the “competitive” and the “non-competitive” regime, respectively. In both regimes, managerial performance is taken to be publicly observable: if a manager's ability becomes known to the current employer, it is also known to other firms.⁶ In an extension, we consider the intermediate case of a managerial labor market with some frictions in the form of switching costs.

In the competitive regime, at the start of each period a manager chooses whether or not to leave his current employer. In the non-competitive regime, once he has

⁶This assumption is not essential in our context, however. To see why, suppose a manager's performance is visible only to his current employer. Then, in the competitive regime a manager who turned out to be good could be hired by an outside employer. If assigned to a risky project, the manager would have the incentive to stay with the employer for a whole period, to allow him to verify that he is good. So even if the manager's performance were not publicly observed, outside offers would be effectively conditioned on his true type, if this has become known to the manager.

accepted the initial offer, he can no longer leave. When indifferent between staying and leaving, a manager is assumed to stay. This tie-breaking assumption can be thought as reflecting the presence of an arbitrarily small switching cost even in the competitive regime.

The difference between the two regimes may capture, for instance, the changing relationship between managers and their employers documented by Frydman (2007), with their mobility between companies rising sharply over the last half-century as their skills grew less and less firm-specific. This has certainly been the case in banking, which once entailed a great deal of local knowledge, so that over their careers bank managers developed employer- and location-specific skills; today banking is much less local, due to technological change and financial innovation. And corporate “loyalty” has lost appeal in the world of finance, as Tett (2009) highlights in our epigraph.

3.3 Time line

Assuming without loss of generality that the representative manager i is employed in all periods, the sequence of his actions in a typical period t is as follows:

(i) At the start of period t , manager i accepts an offer from firm k (or renegotiates his previous contract with firm k), which assigns him to project $P_{ikt} \in \{R, S\}$.

(ii) Before completion of the project, the manager chooses whether to stay with employer k also in period $t + 1$ or leave.

(iii) At the end of period t , project P_{ikt} is completed and produces its payoff y_{ikt} . If $P_{ikt} = S$, the payoff is y_S . If $P_{ikt} = R$ and manager i stays, the payoff y_{ikt} perfectly reflects his quality, by (2); if instead he leaves, the project proceeds unsupervised, so

that its payoff y_{ikt} is a noisy signal of the manager's quality, by (3).

(iv) In any subsequent period, the sequence of moves is the same as in (i), (ii) and (iii), with appropriate changes in the firm and time indices.

3.4 Evolution of beliefs about managerial quality

In any period t the employment history of manager i can be summed up in the belief θ_{it} that his quality is high ($q_i = H$). Since in our setting information about the manager's quality is symmetrical, this belief is shared by all players. At the beginning of his career, the manager's quality is unknown: he is good with probability p and bad with probability $1 - p$. Hence, $\theta_{i0} = p$. In each subsequent period t , the belief θ_{it} may be updated on the basis of the manager's previous performance, depending on whether the manager is assigned to a safe or a risky project, and on whether he has ever chosen to stay with his employer for an entire period or not.

Consider first the updating of beliefs in period 1. If manager i is assigned to a safe project ($P_{ik1} = S$), there is no updating, as the project's payoff is independent of i 's quality: $\theta_{i1} = \theta_{i0} = p$. If instead the manager is assigned to a risky project ($P_{ik1} = R$) and stays until completion of the project, its payoff y_{ik1} reveals his quality, and beliefs are updated accordingly: if $y_{ik1} = \bar{y}$, manager i is revealed to be good, so that $\theta_{i1} = 1$; if $y_{ik1} = \bar{y} - c$, he is revealed to be bad, so that $\theta_{i1} = 0$. Finally, if the manager is assigned to a risky project but leaves before the completion of the

period-1 project, beliefs are updated using Bayes' rule:⁷

$$\theta_{i1} = \begin{cases} \theta_H = \beta + (1 - \beta)p > p = \theta_{i0} & \text{if } y_{ik1} = \bar{y}, \\ \theta_L = (1 - \beta)p < p = \theta_{i0} & \text{if } y_{ik1} = \bar{y} - c. \end{cases} \quad (9)$$

Since $\theta_H > p$, after a high payoff ($\bar{y}$), the belief that the manager is good is revised upwards ($\theta_{i1} > \theta_{i0}$), the revision being larger the greater is the sensitivity of the project's payoff to managerial quality (β). Symmetrically, since $\theta_L < p$, after a low payoff ($\bar{y} - c$) the belief that the manager is good is revised downwards ($\theta_{i1} < \theta_{i0}$).

If manager i , upon moving to a new firm h in period 2, is assigned again to a risky project ($P_{ih2} = R$) and moves again before the end of period 2, beliefs are updated again based on the second project's payoffs, using Bayes' rule:

$$\theta_{i2} = \begin{cases} \theta_{HH} \equiv \frac{p[\beta + (1 - \beta)p]^2}{p[\beta + (1 - \beta)p]^2 + (1 - p)(1 - \beta)^2 p^2} & \text{if } (y_{ik1}, y_{ih2}) = (\bar{y}, \bar{y}), \\ \theta_{HL} = \theta_{LH} \equiv \frac{\beta + (1 - \beta)p}{1 + \beta} & \text{if } (y_{ik1}, y_{ih2}) = (\bar{y}, \bar{y} - c) \text{ or } (\bar{y} - c, \bar{y}), \\ \theta_{LL} \equiv \frac{p(1 - \beta)^2 (1 - p)^2}{p(1 - \beta)^2 (1 - p)^2 + (1 - p)[\beta + (1 - \beta)(1 - p)]^2} & \text{if } (y_{ik1}, y_{ih2}) = (\bar{y} - c, \bar{y} - c). \end{cases} \quad (10)$$

Clearly, $1 > \theta_{HH} > \theta_H > \theta_{HL} = \theta_{LH} > \theta_L > \theta_{LL} > 0$: the reputation of a manager whose first project did well improves if his second project does well too, and deteriorates otherwise; symmetrically, the reputation of a manager whose first project did badly improves if his second project does well, and deteriorates otherwise.

By induction, the odds ratio $\theta_t / (1 - \theta_t)$ of the manager's type, as long as he moves across firms, can be shown to evolve according to the following law of motion

⁷Looking at Figure 1, one can easily compute the probabilities of the manager's type being good conditional on the two observed outcomes of the risky project:

$$\theta_H \equiv \Pr(q_i = G | y_{ik1} = \bar{y}) = \frac{p\beta + p^2(1 - \beta)}{p\beta + p^2(1 - \beta) + p(1 - p)(1 - \beta)} = \beta + (1 - \beta)p,$$

and

$$\theta_L \equiv \Pr(q_i = B | y_{ik1} = \bar{y} - c) = \frac{p(1 - p)(1 - \beta)}{(1 - p)\beta + (1 - p)^2(1 - \beta) + p(1 - p)(1 - \beta)} = (1 - \beta)p.$$

(dropping the manager's and firm's subscripts to simplify notation):

$$\frac{\theta_t}{1 - \theta_t} = \frac{\theta_{t-1}}{1 - \theta_{t-1}} \times \begin{cases} 1 + \frac{\beta}{(1-\beta)p} \equiv 1 + \delta^+ > 1 & \text{if } y_t = \bar{y}, \\ 1 & \text{if } y_t = y_S, \\ 1 - \frac{\beta}{1-(1-\beta)p} \equiv 1 - \delta^- < 1 & \text{if } y_t = \bar{y} - c. \end{cases} \quad (11)$$

where δ^+ indicates the size of upward revisions of the ratio upon “good news” and δ^- the size of downward revisions of the ratio upon “bad news”. The size of upward revisions δ^+ is increasing in β and decreasing in p : when the manager leaves the firm, good news have a large positive impact on his reputation if the project's outcome is very sensitive to the manager's quality (large β), and if the chance of a lucky outcome is low (small p). The size of downward revisions δ^- is also increasing in β but is increasing in p : bad news have a large negative impact on the manager's reputation if the project's outcome is very sensitive to his quality, and if the chance of a lucky outcome is high.

By iterating expression (11), the odds ratio at any future date $t + T$ is seen to be increasing in the odds ratio in period t : denoting the number of upward and downward revisions by U and D (where $U + D = T$), respectively, we can write it as

$$\frac{\theta_{t+T}}{1 - \theta_{t+T}} = \frac{\theta_{t-1}}{1 - \theta_{t-1}} \times (1 + \delta^+)^U \times (1 - \delta^-)^D, \quad (12)$$

so that manager's future reputation θ_{T+t} is increasing in his current reputation θ_{t-1} . Expression (11) can also be used to compute the law of motion of the manager's reputation itself:

$$\theta_t = \begin{cases} \theta_t^U \equiv \theta_{t-1} \times \frac{1+\delta^+}{1+\theta_{t-1}\delta^+} > \theta_{t-1} & \text{if } y_t = \bar{y}, \\ \theta_{t-1} & \text{if } y_t = y_S, \\ \theta_t^D \equiv \theta_{t-1} \times \frac{1-\delta^-}{1-\theta_{t-1}\delta^-} < \theta_{t-1} & \text{if } y_t = \bar{y} - c. \end{cases} \quad (13)$$

Hence, the manager's reputation conditional on good news at t , θ_{it}^U , is increasing and concave in his past reputation θ_{it-1} : good news are less informative for already

reputable managers. Conditional upon receiving bad news at t , the manager's reputation, θ_{it}^D , is increasing and convex in his past reputation θ_{it-1} : bad news are more informative if they concern reputable managers.

4 Two-period model

Some of the key results of the model can be obtained in a simple two-period model. In this case, manager i 's expected utility (1) reduces to $V_{i1} = u(c_{i1}) + \rho u(c_{i2})$. As mentioned in the Section 3.2, we compare two regimes: a competitive labor market where managers can freely move ex post between firms at the end of period 1, and a non-competitive one where they cannot, and therefore effectively commit to work in the same firm in both periods.

4.1 Competitive labor market

The regime where managers are free to move between firms at the end of period 1 is illustrated by the time line in Figure 2.

[Insert Figure 2: Time line of the 2-period model]

In period 1, the manager's type is unknown: when he is assigned to the period-1 project the belief about his quality is the unconditional probability $\theta_{i0} = p$. His decision to stay with firm k or move to another firm j before the completion of the period-1 project does not affect the expected payoff of the project, but does affect how much is learnt about his type: if manager i assigned to project R stays with the initial employer k until the project pays off, his type q_i is perfectly learnt; if i leaves before the end of period 1, the updating is described by (9).

We solve the model by backward induction starting from the firm's choice of project in period 2. Since in that period the manager may be employed by firm k or by firm j (depending on the manager's choice to stay or leave), for notational simplicity we drop the firm's subscript from the project assigned to manager i and from the wage paid to him.

4.1.1 Firm's project choice in period 2

The firm that employs manager i in period 2 will assign him to the project that maximizes its profit $\pi(P_{i2}|\theta_{i1})$ defined by (8), and therefore depends on manager i 's reputation θ_{i1} :

$$P_{i2} = \begin{cases} R & \text{if } \eta \geq 1 - \theta_{i1}, \\ S & \text{if } \eta < 1 - \theta_{i1}. \end{cases}$$

The manager will be assigned to the risky project only if his reputation is sufficiently good, so that the risk-adjusted efficiency gain of the risky project, η , exceeds the conditional probability of the manager being bad, $1 - \theta_{i1}$. Recalling that there is perfect competition for managers, the wage paid to manager i in period 2 equals his expected productivity:

$$w_{i2} = \begin{cases} \bar{y} - (1 - \theta_{i1})c & \text{if } P_{i2} = R \\ y_S & \text{if } P_{i2} = S \end{cases} \quad (14)$$

Notice that in period 1 the manager i , being of unknown quality, must have been assigned to the risky project ($P_{i1} = R$), by assumption (5). Depending on its realized payoff, his reputation θ_{i1} will take one of four possible values:

(i) $\theta = 1$ if the manager i stayed in period 1 and the payoff of the risky project P_{i1} was $\bar{y}$;

(ii) $\theta = \theta_H$ if manager i moved in period 1 and the payoff of the risky project P_{i1}

was $\bar{y}$;

(iii) $\theta = \theta_L$ if manager i moved in period 1 and the payoff of risky project P_{i1} was $\bar{y} - c$; and,

(iv) $\theta = 0$ if the manager i stayed in period 1 and the payoff of the risky project P_{i1} was $\bar{y} - c$.

The choice of projects in period 2 is as follows:

Lemma 1 *There are two cases to consider:*

1. if $\eta \geq 1 - \theta_L$, then $P_{i2} = \begin{cases} R & \text{if } \theta \in \{1, \theta_H, \theta_L\}, \\ S & \text{otherwise.} \end{cases}$
2. if $\eta < 1 - \theta_L$, then $P_{i2} = \begin{cases} R & \text{if } \theta \in \{1, \theta_H\}, \\ S & \text{otherwise.} \end{cases}$

4.1.2 Manager's decision to move or stay

We proceed backwards to the manager's period-1 decision whether to stay with the current employer (firm k) or to move to firm j . If the manager stays, his period-2 wage w_{i2} will equal $\bar{y}$ if he is found to be a good type ($q_{i1} = G$), which happens with probability p ; or, y_S if he is found to be a bad type ($q_{i1} = B$), which occurs with probability $1 - p$. Hence, his expected continuation utility is

$$pu(\bar{y}) + (1 - p)u(y_S). \quad (15)$$

If he moves, his reputation will be θ_H if project P_{ik1} succeeds, and θ_L if project P_{ik2} fails. From Lemma 1, a manager with reputation θ_H is always assigned to a risky project in period 2, and one with reputation θ_L is assigned to a risky project only if $\eta \geq 1 - \theta_L$. Hence, there are two cases to consider:

1. if $\eta \geq 1 - \theta_L$, then the expected utility from moving is:

$$pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(\bar{y} - (1 - \theta_L)c) \quad (16)$$

2. if $\eta < 1 - \theta_L$, then the expected utility from moving is:

$$pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(y_S) \quad (17)$$

Comparing the continuation payoffs from moving and staying, we can show:

Proposition 1 (Decision to move in period 1) *Manager i switches firm at the end of period 1 if and only if*

$$(1 - p)[u(\bar{y} - (1 - \theta_L)c) - u(y_S)] \geq p[u(\bar{y}) - u(\bar{y} - (1 - \theta_H)c)], \quad (18)$$

where $\theta_H \equiv \beta + (1 - \beta)p$ and $\theta_L \equiv (1 - \beta)p$. In all other cases, manager i does not move.

Switching firms before the project terminates provides insurance to the manager, in the form of a less variable continuation wage: instead of the payoffs $\bar{y}$ and y_S , the manager receives the less extreme payoffs $\bar{y} - (1 - \theta_H)c$ and $\bar{y} - (1 - \theta_L)c$, as $\bar{y} > \bar{y} - (1 - \theta_H)c > \bar{y} - (1 - \theta_L)c \geq y_S$. By moving, the manager trades a wage reduction $(1 - \theta_H)c$ in the state in which his type is G with a wage increase in the state in which his type is B ($\bar{y} - (1 - \theta_L)c - y_S$). The manager decides to move only when the expected benefit if his type is B exceeds the expected cost if his type is G . However, this insurance comes at the cost of a reduction in the expected wage, because a manager who does not move – being of known quality – is always assigned efficiently (to the risky project if good and to the safe one if bad), while a manager

who moves may be assigned inefficiently (to the risky project even if he is actually bad). As one would expect, this expected efficiency loss is an increasing function of the frequency of bad managers ($1 - p$), since these managers are inappropriately assigned to the risky project when they move.

Hence, the choice between moving and staying involves a trade-off between the insurance benefit of mobility and its efficiency cost. The manager's risk aversion is therefore the key parameter in the decision to move: for managers to prefer mobility, they must be sufficiently risk averse. Indeed, if they were risk neutral, they would choose not to move: by moving, they would suffer a reduction in the expected wage, but they do not value the implied insurance from moving.

The trade-off is also affected by other parameters, besides risk aversion. Mobility is more attractive if η is high, i.e. if the risky project is much more efficient than the safe one, even considering the losses from assigning it to bad managers. Conversely, an increase in the sensitivity of the risky project to its initiator's quality, β , makes mobility less attractive: intuitively, when the risky project's payoff is very informative about its initiator's talent even when he does not complete it, moving does not allow him to cover his track, and therefore provides little insurance.

We can characterize the decision to move in period 1 as follows:

Proposition 2 (Characterizing the decision to move) *(i) If a manager moves, his period-2 wage has lower mean and lower variance than if he does not. (ii) The expected gain from moving is increasing in the efficiency gain from the risky project (η), and is decreasing in the informativeness of the risky project's payoff (β). (iii) The expected gain from moving is increasing in the manager's risk aversion.*

Interestingly, in the proof of this proposition the assumption $p \leq 1/2$ guarantees that greater risk aversion makes mobility more attractive: intuitively, when “alpha” is not widespread, each manager will worry not to be one of the talented few, and therefore an increase in his risk aversion will lead him to value mobility more. As risk aversion increases, the trade-off gradually tilts in favor of managerial mobility, since the reduction in the variance of future compensation gets an increasing weight compared to the reduction of their expected compensation.

[Insert Figure 3: Moving decision and risk aversion in the 2-period model]

To illustrate this point, in Figure 3 we assume the constant relative risk aversion (CRRA) utility function $u(w_2) = (w_2^{1-\gamma} - 1)/(1 - \gamma)$, and vary risk aversion γ while holding the other parameters fixed at $\bar{y} = 3$, $y_S = 1$, $c = 2.5$, $p = 0.4$ and $\beta = 0.2$. As can be seen from the figure, moving dominates staying only if relative risk aversion γ exceeds 1.4. Ironically, as managers become more risk averse, society takes a greater amount of risk, since when they move across firms they are all assigned to the risky project: mobility gives managers insurance, at the cost of greater risk taking for the economy.

4.2 Non-competitive labor market

When there is no ex-post mobility of managers, each firm anticipates that any manager that it hires initially will stay both in period 1 and 2. Therefore it chooses the wage offer (w_{ik1}, w_{ik2}) to manager i that maximizes its profits over both periods:

$$E_0 [\pi(P_{ik1}|\theta_{i0}) + \pi(P_{ik2}|\theta_{i1}) - (w_{ik1} - w_{ik2})]. \quad (19)$$

Notice that, as the hiring decision is made only in period 1, the firm's belief $\theta_{i0} = p$ at the time of the wage offer is based on the unconditional distribution of managers' quality. Recall that firms are risk neutral, compete aggressively for managers and employ a large number of them. Hence, they will offer to the managers full insurance and they will bid wages up to the point where they earn zero expected profits:

$$w_{ik1} = E_0 [\pi(P_{ik1}|\theta_{i0})], \quad w_{ik2} = E_0 [\pi(P_{ik2}|\theta_{i1})]. \quad (20)$$

Hence, the equilibrium lifetime wage of manager i is the revenue he is expected to generate over his entire career at firm k . By symmetry, all firms pay an identical lifetime wage, implying that managers are indifferent between them. Moreover, managers are perfectly insured against the risk arising from their unknown quality: equation (20) implies that good managers subsidize bad ones.

Even though firm k does not know its managers' quality when it sets wages, the firm anticipates that in choosing the period-2 project, P_{ik2} , it will be able to condition on the true manager's quality. This is because, under assumption (5), it is optimal to assign the manager to a risky project in period 1 ($P_{ik1} = R$), and since the manager will stay until the completion of this project his quality will be known as of the beginning of period 2: $\theta_{i1} = q_i$. Hence, in period 2 the firm makes the assignment conditional on the manager's true quality, optimally assigning only risky projects to good managers and only safe projects to bad ones. Under this policy, the manager expects to generate revenues:

$$E_0 [\pi(P_{ik1}|p)] = \bar{y} - (1 - p)c = w_{ik1}, \quad E_0 [\pi(P_{ik1}|q_i)] = p\bar{y} + (1 - p)y_S = w_{ik2}. \quad (21)$$

The first term in (21) is expected profit from the risky project undertaken in period 1 by a manager of unknown quality; the second term is the expected continuation rev-

enues of the two (known) types of managers in period 2, weighted by their respective frequencies.

This equilibrium outcome is the first best: it features both (i) optimal risk-sharing, i.e., complete insurance of managers by firms (which are risk neutral); and (ii) productive efficiency, i.e., optimal choice of projects conditional on managers' quality. So in the non-competitive regime, the managers' expected utility is maximal, while firms earn zero expected profits.

This argument establishes the following result:

Proposition 3 (Equilibrium under no competition) *Without ex-post competition for managers, the first-best outcome is attained in equilibrium.*

4.3 Comparing labor market regimes

The optimal risk-sharing attained in the absence of ex-post competition requires the salary not to be conditional on employees' quality, even though in period 2 this information is used in the matching of managerial talent to projects. In other words, good managers subsidize bad ones: this cross-subsidy is feasible only because in the non-competitive regime good managers cannot leave for higher pay at other firms. Under the assumption of ex-post competition maintained in Section 4.1, this cross-subsidization could not be achieved, as any firm offering the wages (21) would lose all its good managers in period 2 and hence make losses: once the true quality of managers is known, other firms would offer the competitive wage $w_{ik2} = \bar{y}$ to good managers, outbidding the period-2 wage $p\bar{y} + (1 - p)y_S$ in (21). Hence, a firm that offered the wages in (21) would be left only with overpaid low-quality managers in

period 2.

It is worth noticing that under competition the first-best outcome cannot be attained not only when in the competitive equilibrium managers move across companies according to Proposition 1, but also when they do not, in particular, when condition (18) is violated: also in that case, in equilibrium good managers are paid period-2 wage $w_{ik2} = \bar{y}$ in line with their quality, because ex-post competition bids it to that level, even if they do not move to another firm. So, even when a competitive labor market features no mobility, optimal risk sharing cannot be achieved. But at least in that case managers are efficiently allocated, since without mobility firms can learn their true quality in period 1 and allocate them efficiently to projects in period 2. When instead a competitive labor market features mobility, i.e., if condition (18) holds, there is both inefficient assignment of managers to projects and incomplete risk sharing, even though mobility does provide some insurance compared to the case of no mobility.

To summarize:

Proposition 4 (Inefficiency of the competitive labor market) *The competitive equilibrium features inefficient project assignment and partial risk-sharing if managers move across firms, and efficient project assignment but no risk sharing if they do not.*

5 Extending the two-period model

In this section we consider several extensions of the baseline model. First, we will allow for pay to be conditional on the actual payoff of the project and on the decision

to leave or to move. Second, we will consider the impact of switching costs. Third, we will allow for asymmetric information.

5.1 Conditional pay

In the baseline version of the model, we assumed that the wage in period 1 cannot be contingent (i) on the actual payoff of the project assigned to the manager, or (ii) on the manager's decision to resign and leave the firm. In this section we remove this assumption and show that in equilibrium firms will not make pay conditional on these additional outcomes.

With conditional pay, the employer can defer compensation after the realization of the cash-flows and can choose a different pay when the manager stays or leaves. First, it is easy to show that even if managerial pay could be conditioned on the actual payoff of the project assigned to the manager, competition will induce firms to set pay equal to the manager's expected payoff from the project, given the manager's perceived quality: ex-ante competition for risk-averse managers will lead risk-neutral firms to offer contracts that are not performance-based, considering that there is no moral hazard.

Next, the employer (firm k) may want to choose a different pay when the manager stays or leaves. By doing so, firm k can increase the chances of retaining manager i by paying him a salary $w_{ik1} = 0$ if he leaves, and a fixed wage equal to the expected output $w_{ik1} = \bar{y} - (1 - p)c$ if he does not leave.

Given this contract, if the manager stays, his expected utility is

$$u(\bar{y} - (1 - p)c) + \rho[pu(\bar{y}) + (1 - p)u(y_S)], \quad (22)$$

since he is paid $\bar{y} - (1 - p)c$ at the end of the first period and his continuation utility in the second period is $u(\bar{y})$ with probability p (when his type is found to be G) and $u(y_S)$ with probability $1 - p$ (when his type is found to be B).

If he moves, his expected utility depends on whether θ_L is large enough that the manager is assigned to a risky project even when the period-1 payoff is low, which happens only if $\eta \geq 1 - \theta_L$. Hence, if $\eta \geq 1 - \theta_L$, the expected utility from moving is:

$$\rho[pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(\bar{y} - (1 - \theta_L)c)]; \quad (23)$$

if $\eta < 1 - \theta_L$, then the expected utility from moving is:

$$\rho[pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(y_S)]. \quad (24)$$

Comparing the equations above we can show:

Proposition 5 (Decision to move with conditional pay) *Manager i moves if and only if:*

$$(1 - p)[u(\bar{y} - (1 - \theta_L)c) - u(y_S)] \geq p[u(\bar{y}) - u(\bar{y} - (1 - \theta_H)c)] + \frac{u(\bar{y} - (1 - p)c)}{\rho},$$

where $\theta_H \equiv \beta + (1 - \beta)p$ and $\theta_L \equiv (1 - \beta)p$. In all other cases, manager i does not move.

Comparing Proposition 1 and 5, it is immediate that moving is less likely with conditional pay than without it. Moreover, only a sufficiently patient manager (with sufficiently high ρ) chooses to move.

Will firms use conditional pay? In the model, there is ex-ante competition for managers, who are a scarce resource. Hence, managers extract all the surplus.

Whether firms use conditional pay depends on whether this contract clause increases manager's expected utility.

Quite clearly, conditional pay will not be used when moving is optimal in Lemma 2. As a matter of fact, the expected utility with conditional pay in equation (23) is strictly lower than the expected utility without conditional pay in equation (16). Hence, competition will drive firms to offer pay that is unconditional on their moving decision.

The manager's expected utility is also strictly greater when condition (18) is met. To see this, notice that the expected utility from moving if there is no conditional pay is:

$$u(\bar{y} - (1 - p)c) + \rho[pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(\bar{y} - (1 - \theta_L)c)], \quad (25)$$

which is strictly larger than (22) whenever condition (18) is met.

Finally, the manager's expected utility is identical with and without conditional pay when (18) is violated. To summarize:

Proposition 6 (Equilibrium compensation) *In equilibrium, no firm will condition pay on the manager's decision to move to another firm.*

5.2 Switching costs

In Section 4.3 we have compared two extreme settings for the labor markets: one in which there is perfect ex-post competition and another where there is no competition at all. In this section we consider the intermediate case in which managers suffer a switching cost s if they switch employers. The cases analyzed so far correspond to the case in which $s = 0$ (perfect competition) and $s > u(\bar{y})$ (no competition).

With switching costs $s \in (0, u(\bar{y}))$, if the manager stays, his continuation utility is as in equation (15)). If he moves, his expected utility depends on both θ_L and s . If $\eta \geq 1 - \theta_L$, then the expected utility from moving is:

$$\max\{pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(\bar{y} - (1 - \theta_L)c) - s, 0\}; \quad (26)$$

if $\eta < 1 - \theta_L$, then the expected utility from moving is:

$$\max\{pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(y_S) - s, 0\} \quad (27)$$

Hence:

Proposition 7 (Decision to move with switching costs) *Manager i moves if and only if*

$$(1 - p)[u(\bar{y} - (1 - \theta_L)c) - u(y_S)] - s \geq p[u(\bar{y}) - u(\bar{y} - (1 - \theta_H)c)],$$

where $\theta_H \equiv \beta + (1 - \beta)p$ and $\theta_L \equiv (1 - \beta)p$. In all other cases, manager i does not move.

Comparing the condition in Propositions 7 with that in Proposition 1, it is immediate that the higher the switching costs s , the smaller the parameter region in which managerial mobility is worthwhile.

5.3 Asymmetric information

The assumption of symmetric information between firms and managers is critical to our results. If all managers knew their type, then in equilibrium no insurance could be obtained by moving: good managers would stay with their firms to reveal

themselves as good and get higher pay. Bad managers would then also be revealed and be assigned to safe projects from period 2 onwards.

A less extreme assumption is one where only a fraction ϕ of managers know their type from the start. In this case, moving decreases in equilibrium for two reasons: (i) mechanically, the fraction $p\phi$ of managers who know they are good will stick with their employer to demonstrate their type; and (ii) managers of unknown type will get pooled with those who know they are bad, and so will be less willing to move than in the baseline model.

This happens because the probabilities of the manager's type being good, conditional on the two observed outcomes of the risky project, change as follows:

$$\theta_H = \frac{(1 - \phi)[\beta + p(1 - \beta)]}{(1 - \phi)[\beta + p(1 - \beta)] + (1 - p)(1 - \beta)} \leq \beta + (1 - \beta)p, \quad (28)$$

which is strictly decreasing in ϕ , and

$$\theta_L = \frac{(1 - \phi)p(1 - \beta)}{(1 - \phi)p(1 - \beta) + \beta + (1 - p)(1 - \beta)} \leq (1 - \beta)p, \quad (29)$$

and decreasing in ϕ . Hence, the condition (18) in Proposition 1 is less likely to be met. To summarize:

Proposition 8 (Decision to move with asymmetric information) *Managers are less likely to move as the degree of asymmetric information ϕ increases.*

6 Three-period model

A limitation of the two-period model presented above is that it does not allow to analyze how changes in the reputation of managers affects their mobility decisions.

To this purpose, a multiperiod model is needed. To develop the intuition about the joint dynamics of reputation and mobility decisions, in this section we discuss the results from a three-period model similar to that presented so far. The detailed derivations are left to the appendix, where the model is solved by backward induction as in the two-period version of the model, although the complexity of the derivations increases substantially.

When firms and managers have a three-period horizon, the manager can switch employers twice in his career: before completing the period-1 project (as in the two-period model), and before completing the period-2 project, as illustrated in the time line shown in Figure 4.

[Insert Figure 4: Time line of the 3-period model]

In the three-period case, manager i 's expected utility (1) becomes $V_{i1} = u(c_{i1}) + \rho u(c_{i2}) + \rho^2 u(c_{i3})$. The manager starts working at firm k but can move to firm h in period 1 and to firm j in period 2. His reputation evolves as shown in Section 3.4: in particular, expressions (9) and (10) indicate how it evolves if he moves across firms.

The results from the analysis of the three-period model are best understood with the help of Figure 5, which is based on the numerical example with CRRA utility: $u(c) = (c^{1-\gamma} - 1)/(1-\gamma)$. The figure plots the expected utility from moving and from staying for different values of the coefficient of relative risk aversion γ , assuming the following parameters: $\bar{y} = 3$, $y_S = 1$, $c = 2.5$, $p = 0.4$ and $\beta = 0.2$. Panel A shows the expected utility from moving or staying in period 1, while Panel B shows the expected utility from moving or staying in period 2, conditional on the manager's reputation: the left-hand graph refers to a manager with a low reputation (θ_L), and

the right-hand graph to a manager with a high reputation (θ_H) at the end of period 1.

[Insert Figure 5: Moving decision and risk aversion in the 3-period model]

Clearly, in all the cases there is a cutoff value for risk aversion above which moving dominates staying, as in the two-period model. However, there are three novel results worth noticing.

First, mobility is serially correlated, and decreases over the manager's career. A manager moves in period 2 only if he has also moved in the period 1: once he stops moving, his type becomes known, so that churning any further serves no purpose. In the graph, this is captured by the fact that the cutoff above which the manager moves in period 2 (shown in Panel B) is at least as large as that applying to period 1 (shown in Panel A): since in period 1 managers move only if their risk aversion exceeds 1.2 (marked by the vertical line), the risk-aversion cutoff for their period-2 decision will be at least as large. In fact, the period-2 cutoff is strictly larger than that in period 1 for a low-reputation manager, as shown in the right-hand graph of panel B: if such manager's risk aversion is between 1.2 and 2.1, in period 3 he will prefer to remain with his period-2 employer, even though he did switch employers between periods 1 and 2. This is an instance of the Hirshleifer effect: as information about the manager's ability become more precise over time, there is less scope for insurance, hence less use for mobility.

Second, the reputation θ_L or θ_H acquired by the manager at the end of period 1 affects mobility in period 2. For a low-reputation manager, mobility is warranted

only for greater risk aversion than for a high-reputation manager: if $\theta_{i1} = \theta_L$, moving is optimal only if $\gamma \geq 2.1$; if instead $\theta_{i1} = \theta_H$, it is optimal whenever risk aversion is above 1. Intuitively, high-performance managers are more likely to move than low-performance ones: a manager is more interested in slowing down learning if he has gained a good reputation than a bad one.

Thirdly, comparing Panel A of Figure 5 with the two-period case shown in Figure 3 shows that lengthening the horizon expands the scope for mobility as insurance mechanism. In the three-period model, the cutoff for risk aversion in period 1 is 1.2, lower than in the two-period model, where it is 1.4. The rationale for this result is that, if the manager's residual career is longer, the benefit of mobility is greater, as it provides insurance for a greater number of periods.

7 Infinite horizon

As shown above, the analysis becomes quickly more complex if the manager's horizon increases while staying finite. This is because the decision problem faced by the manager is not stationary: as the number of periods increases, the number of contingencies to be considered in previous decisions escalates. In contrast, when the manager's horizon becomes infinite, the problem is stationary, so that one can define stationary cutoffs for the manager's reputation that determine his decision to move or stay. The key additional insight from this analysis is that mobility occurs only if his reputation lies in an intermediate range: for extreme values of his reputation, the insurance gain stemming from mobility is too low, because the information publicly available about the manager's ability is already quite precise – another instance of the Hirshleifer effect.

If the horizon is infinite, the manager maximizes the expected utility from his future wages as of period t , conditional on his belief about his quality, θ_{t-1} , which is a sufficient statistic of his past employment history:⁸

$$V(\theta_{t-1}) = E \left[\sum_{s=0}^{\infty} \rho^{t+s} u(w_{t+s}) | \theta_{t-1} \right] = u(w_t) + \rho E [V(\theta_t) | \theta_{t-1}] , \quad (30)$$

where in the second step the manager's expected utility is shown in recursive form.

We analyze the model by considering a generic period t as described in Figure 6:

[Insert Figure 6: Time line of the model with infinite horizon]

7.1 Manager's reputation

At the beginning of the period, the manager's reputation coincides with the common belief about his quality θ_{t-1} . His current employer, firm k , assigns the manager to a safe or risky project. Before completion of the project, the manager can move to firm j . At the end of period t , the project's payoff $y_t = \{\bar{y} - c, y_S, \bar{y}\}$ is realized and the manager's reputation is updated according to equation (13) derived in Section 3.4.

We proceed in two steps. First, we consider which project the current employer assigns to the manager at the beginning of period t , based on his reputation θ_{t-1} (dropping the manager's index i to simplify notation). Second, we analyze his decision to stay or move to a new firm, based on how this choice is expected to impact his future reputation and continuation utility.

⁸Recall that in each period the manager is assumed to consume all of his wage income, so that his consumption equals his wage.

7.2 Project choice

The project $P_{kt} = \{R, S\}$ to which the manager is assigned to by firm k depends on the manager's reputation as of the previous period, θ_{t-1} :

$$P_{kt} = \begin{cases} R & \text{if } \eta \geq 1 - \theta_{t-1}, \\ S & \text{if } \eta < 1 - \theta_{t-1}. \end{cases}$$

Because of perfect competition for managers, the manager is paid his expected productivity:

$$w_t = \begin{cases} \bar{y} - (1 - \theta_{t-1})c & \text{if } P_{kt} = R \text{ and manager expected to stay at } t, \\ \bar{y} - [1 - \beta\theta_{t-1} - (1 - \beta)p]c & \text{if } P_{kt} = R \text{ and manager expected to move at } t, \\ y_S & \text{if } P_{kt} = S. \end{cases} \quad (31)$$

7.3 Manager's decision to move or stay

When he takes his decision to move or stay in period t , the manager conditions on his past reputation θ_{t-1} , but takes into account that his decision will affect his future reputation θ_t .

If $\theta_{t-1} < 1 - \eta$, he does not benefit from moving, since his current employer assigns him to the safe project. Hence, by equation (13) his reputation remains unchanged: $\theta_t = \theta_{t-1}$.

If instead $\theta_{t-1} \geq 1 - \eta$, the current employer decides to assign the manager to the risky project, so that some updating of the manager's reputation occurs by the end of period t . Hence, in every period the manager can decide to delay learning about his true quality: it is revealed if he stays, while it is delayed if he moves.

Specifically, if the manager stays, his continuation utility is

$$\theta_{t-1}V_H + (1 - \theta_{t-1})V_L, \quad (32)$$

where $V_H \equiv \frac{u(\bar{y})}{1-\rho}$ and $V_L \equiv \frac{u(y_S)}{1-\rho}$ are the present discounted utilities from being identified as type H and a type L , respectively. As $V_H > V_L$, his continuation utility from staying is strictly increasing in his past reputation θ_{t-1} .

If the manager moves instead, his continuation utility can be written as

$$[\beta\theta_{t-1} + (1-\beta)p]V(\theta_t^U) + [1-\beta\theta_{t-1} - (1-\beta)p]V(\theta_t^D). \quad (33)$$

Hence, the manager's utility in (30) must be rewritten taking into account that his continuation utility takes two different forms depending on whether he stays or moves. It is the sum of the utility from consuming his current wage, $u(w_t)$, and the discounted value of the maximum of the continuation utilities if he stays or moves:

$$V(\theta_{t-1}) = u(w_t) + \rho \max\{\theta_{t-1}V_H + (1-\theta_{t-1})V_L, \quad (34)$$

$$[\beta\theta_{t-1} + (1-\beta)p]V\left(\theta_{t-1}\frac{1+\delta^+}{1+\theta_{t-1}\delta^+}\right) + [1-\beta\theta_{t-1} - (1-\beta)p]V\left(\theta_{t-1}\frac{1-\delta^-}{1-\theta_{t-1}\delta^-}\right)\}.$$

To derive the manager's optimal decision regarding moving or staying, it is useful to characterize the function $V(\theta)$:

Lemma 9 *The manager's utility $V(\theta)$ is increasing in his reputation θ , and is bounded between V_L and V_H .*

Using these results, we can now establish the manager's optimal stopping rule:

Proposition 10 (Manager's reputation and mobility) *Define the upper and lower bounds for the manager's reputation:*

$$\underline{\theta} = \frac{[\beta\underline{\theta} + (1-\beta)p][V\left(\frac{\underline{\theta}(1+\delta^+)}{1+\underline{\theta}\delta^+}\right) - V_L]}{V_H - V_L}$$

and

$$\bar{\theta} = \frac{[1 - \beta\bar{\theta} - (1 - \beta)p][V\left(\frac{\bar{\theta}(1-\delta^-)}{1-\bar{\theta}\delta^-}\right) - V_L](1 + \bar{\theta}\delta^+)}{(V_H - V_L)\{[1 - \beta\bar{\theta} - (1 - \beta)p](1 + \delta^+) - (1 - \bar{\theta})\delta^+\}},$$

where $0 < \underline{\theta} < p$ and $0 < \underline{\theta} < \bar{\theta}$. Then, if $p \leq \bar{\theta}$, the manager moves in period t if and only if $\theta_{t-1} \in [\underline{\theta}, \bar{\theta}]$; if $p > \bar{\theta}$, the manager never moves.

Hence, if the probability of being a good manager is sufficiently low ($p \leq \bar{\theta}$), i.e. if “alpha” is sufficiently rare, the manager chooses to buy insurance by moving across firms only when his reputation has “intermediate” values, namely falls in the interval $(\underline{\theta}, \bar{\theta})$. Intuitively, when his reputation drops to the lower bound $\underline{\theta}$, he stops moving because the wage that he would get by moving to a new firm is close to the wage that he would get if he stays with his current employer and is revealed as a bad type: hence, the insurance gain from moving is too modest compared with the implied inefficiency in project assignment, a result already found in the two-period and in the three-period model. When instead the manager’s reputation rises to the upper bound $\bar{\theta}$, he stops moving because he is sufficiently likely to be revealed as a good type, so that the wage that he can expect if his true quality is revealed is likely to be the high wage $\bar{y}$: also in this case, the insurance gain from moving is too modest compared with the implied inefficiency in project assignment.

If instead the probability of being a good manager is sufficiently high ($p > \bar{\theta}$), i.e. if “alpha” is sufficiently widespread, the manager prefers not to buy insurance by moving across firms, because the risk of being revealed to be a bad type is low enough to be borne by the manager.

It is also interesting to note that the upper bound $\bar{\theta}$ defined by Proposition 9 may equal or even exceed 1, so that mobility will occur in the interval $(\underline{\theta}, 1)$. In this case,

while the manager will eventually stop moving if his reputation becomes sufficiently bad, a manager with good enough reputation will never stop moving across firms.

8 Conclusions

Firms are strongly motivated to gather information about their employees' talents and use it to allocate them efficiently to projects. The efficient allocation of talent is also considered to be the prime function of a competitive market for managers (see Gabaix and Landier, 2008, among others). Here, however, we show that when projects have risks that materialize only in the long term, there may be a dark side to competition for managers: by destroying the boundary of the firm that encapsulates its employees, short-run labor market opportunities interfere with the long-run information-gathering function of the firm. And managers can exploit this dark side by taking on risky projects and using the labor market to move from firm to firm to cover their tracks, delaying the resolution of uncertainty about their talent.

In addition to producing a number of testable predictions, our model also carries policy implications for the financial sector, where projects with long-run risk are often available. In our inefficient churning equilibrium, no individual financial institution has the incentive to deviate and unilaterally stop competing for other the others' managers: as in the epigraph from Tett (2009), banks "feel utterly trapped", and only the intervention of a public authority (like the FIFA for soccer or the US major league baseball organization) can stop banks from poaching one another's managers. No employer can insulate itself from such competition unless all its employees signed a no-compete clause that is enforceable – a possibility that is precluded in our regime with ex-post competition. And in fact, in the real world such no-compete clauses

are rare in finance, presumably because of a scarcity of talented managers and their low loyalty to employers. The outcome is that in our setting policies that discourage managerial mobility – say, taxing managers who switch jobs at a higher rate than loyal ones – can improve efficiency: if such a surtax were high enough, it would effectively move the economy to the first best, although in equilibrium it would not be paid, since managers would not switch jobs. In short, a policy prescription deriving from the model is to “throw sand in the wheels” of the managerial labor market.

Another policy proposal is capping managerial compensation in banks. How would this change the equilibrium in our model with managerial competition? Would it make churning – and the associated excessive risk-taking – less attractive to managers? In the model, capping managers’ pay at the first-best level would prevent employers from poaching good managers in the competitive regime and make the perfect risk-sharing and no-churning outcome sustainable in equilibrium. Hence, capping the pay of the top financial managers may respond not only to ethical or political concerns but also to an efficiency rationale. Indeed, according to the model, an appropriate pay cap would raise the expected utility of managers themselves.⁹

Another common proposal in the debate on executive compensation is partial deferral (“claw back”) and indexation of the deferred portion to long-term performance. Our model shows that, even though making pay contingent on actual outcomes would reduce mobility and the associated inefficiency, competition will deter firms from doing so.

Admittedly, in more elaborate models some of these policy interventions would

⁹Interestingly, also in the setting of Bénabou and Tirole (2012) a cap on managerial pay, hence a reduction in its sensitivity to performance, can restore the first-best outcome.

entail efficiency costs. Either a salary cap or an equivalent surtax on managerial mobility would redistribute income from good to bad managers, which could decrease efficiency in a model in which managers themselves invest in their own quality *ex ante* – by taking an MBA, say. In this case, capping their salary (or concealing MBA grades from employers) would reduce the “average alpha” of managers in equilibrium. Moreover, preventing the reallocation of managerial talent could have efficiency costs that are not captured by our model: if both managers *and* firms are heterogeneous, they may both learn gradually about the quality of their match, so that it may be efficient for bad matches to be dissolved and new ones formed. Finally, limiting managerial mobility may give market power to firms and create hold-up problems. In our setting, this is inconsequential because of *ex-ante* competition, but in reality this assumption too might not hold. Such considerations warrant further modeling in our framework, which focused exclusively on one dark side to managerial mobility.

Appendix A: Proofs

Proof of Lemma 1. If the manager stays, his type is revealed. In this case, if $\theta = 1$, the manager is assigned to the risky project; if instead $\theta = 0$, he is assigned to the safe project.

If the manager moves, the project allocation depends on the realized period-1 payoff. If the period-1 project was successful ($y_{ik1} = \bar{y}$), so that his reputation is $\theta_H > p$, the manager is assigned to the risky project, because the assumption $\eta > 1 - p$ in (6) implies $\eta > 1 - \theta_H$. If the period-1 project failed ($y_{ik1} = \bar{y} - c$), so that the manager's reputation is θ_L , he is assigned to the risky project only if $\eta \geq 1 - \theta_L$. ■

Proof of Proposition 1. Comparing (15) with (17), it is immediate that the manager does not move if $\eta < 1 - \theta_L$. This happens because the payoff in the good state (which happens with probability p) is strictly lower if the manager moves, while the payoff in the bad state (which happens with probability $1 - p$) is the same.

The manager moves only if $\eta \geq 1 - \theta_L$ and the expected utility in (16) exceeds the expected utility in (15). This second condition, as stated in the Proposition, is more stringent than the first. ■

Proof of Proposition 2. We assume that $\eta \geq 1 - \theta_L$, since otherwise the manager never moves, by Proposition 1. If the manager moves his period-2 wage is

$$w_M = \begin{cases} w_{MH} = \bar{y} - (1 - \beta - (1 - \beta)p)c & \text{if } y_{i1} = \bar{y}, \\ w_{ML} = \bar{y} - (1 - (1 - \beta)p)c & \text{if } y_{i1} = \bar{y} - c, \end{cases} \quad (35)$$

where we substituted θ_H and θ_L from (9), the subscript M stands for “moving”, and the subscripts H and L refer to the high and low payoffs of the period-1 risky

project, respectively (while we have dropped the time and the manager's subscripts to simplify notation). If instead the manager stays, his period-2 wage is

$$w_S = \begin{cases} w_{SH} = \bar{y} & \text{if } y_{i1} = \bar{y}, \\ w_{SL} = y_S & \text{if } y_{i1} = y_S, \end{cases} \quad (36)$$

where the subscript S stands for “staying”, and the subscripts H and L are defined as in the previous expression.

(i) To show that by moving a manager receives a payoff with lower expected value but higher variance, it is convenient to introduce the following notation for the expected value and the variance of period-2 wage when moving and staying:

$$\begin{aligned} \bar{w}_M &\equiv pw_{MH} + (1-p)w_{ML}, & \sigma_M^2 &\equiv p(w_{MH} - \bar{w}_M)^2 + (1-p)(w_{ML} - \bar{w}_M)^2, \\ \bar{w}_S &\equiv pw_{SH} + (1-p)w_{SL}, & \sigma_S^2 &\equiv p(w_{SH} - \bar{w}_S)^2 + (1-p)(w_{SL} - \bar{w}_S)^2. \end{aligned}$$

If the manager moves, the expected payoff of the project is $\bar{w}_M = \bar{y} - (1-p)c$, as can be seen by using (9) in (16), while it is $\bar{w}_S = p\bar{y} + (1-p)y_S$ if he stays with his former employer: the difference between these two expressions is $\bar{w}_M - \bar{w}_S = (1-p)(\bar{y} - c - y_S) < 0$ by assumption (5). The absolute value of this difference is increasing in the frequency of bad managers, $1-p$. To establish that $\sigma_M^2 < \sigma_S^2$, it is sufficient to show that $w_{MH} - \bar{w}_M < w_{SH} - \bar{w}_S$ and that $\bar{w}_M - w_{ML} < \bar{w}_S - w_{SL}$. The first inequality can be rewritten as $(1-p)(\beta - \eta)c < 0$, and the second as $p(\beta - \eta)c < 0$, and both of these inequalities hold since we are assuming $\eta \geq 1 - \theta_L = (1-p) + \beta p > \beta$.

(ii) To perform comparative statics, let us denote by Δ the gain from moving, i.e. the change in the expected continuation utility when moving (16) relative to staying (15):

$$\begin{aligned} \Delta &\equiv \mathbb{E}[u(w^M)] - \mathbb{E}[u(w^S)] \\ &= (1-p)[u(\bar{y} - (1-\theta_L)c) - u(y_S)] - p[u(\bar{y}) - u(\bar{y} - (1-\theta_H)c)]. \end{aligned} \quad (37)$$

To show that Δ is increasing in $\eta \equiv (\bar{y} - y_S)/c$, notice that it is increasing in $\bar{y}$ and decreasing in y_S and c :

$$\frac{\partial \Delta}{\partial \bar{y}} = p[u'(w_{MH}) - u'(w_{SH})] + (1-p)u'(w_{ML}) > 0,$$

since $w_{MH} < w_{SH}$;

$$\frac{\partial \Delta}{\partial y_S} = -(1-p)u'(w_{SL}) < 0;$$

and

$$\frac{\partial \Delta}{\partial c} = -[pu'(w_{MH})(1-\beta) + (1-(1-\beta)p)u'(w_{ML})](1-p) < 0.$$

Moreover, Δ is decreasing in β because

$$\frac{\partial \Delta}{\partial \beta} = [u'(w_{MH}) - u'(w_{ML})]p(1-p)c < 0,$$

since $w_{MH} > w_{ML}$.

(iii) Finally, we wish to identify whether the gain from moving Δ in equation (37) is increasing in the manager's risk aversion. Using the mean value theorem (as Δ is a continuous function),

$$\begin{aligned} \Delta &= (1-p)u'(w_1)(\eta - 1 + \theta_L)c - pu'(w_2)(1 - \theta_H)c \\ &= c[(1-p)u'(w_1)(\eta - 1 + (1-\beta)p) - pu'(w_2)(1-p)(1-\beta)] \\ &= c(u'(w_1) - u'(w_2))p(1-p)(1-\beta) - c(1-p)(1-\eta)u'(w_1) \end{aligned}$$

where $w_1 \in [y_S, \bar{y} - (1 - \theta_L)c]$, $w_2 \in [\bar{y} - (1 - \theta_H)c, \bar{y}]$, and therefore $u'(w_1) > u'(w_2)$ in case of risk-averse managers.

Therefore,

$$Sign(\Delta) = Sign\left(\frac{u'(w_1) - u'(w_2)}{u'(w_1)}p(1-\beta) - (1-\eta)\right).$$

This expression is increasing in $\frac{u'(w_1)-u'(w_2)}{u'(w_1)}$, which is itself increasing the risk aversion, as it is the slope of the marginal utility. ■

Proof of Proposition 5. Comparing (22) with (24), it is immediate that the manager does not move if $\eta < 1 - \theta_L$. This happens because the payoff in the good state (which occurs with probability p) is strictly lower if the manager moves, while the payoff in the bad state (which occurs with probability $1 - p$) is the same.

The manager moves only if $\eta \geq 1 - \theta_L$ and the expected utility in (23) exceeds the expected utility in (22). The second condition simplifies to the one stated in the Proposition. ■

Proof of Proposition 7. As before, the manager does not move if $\eta < 1 - \theta_L$. If instead $\eta \geq 1 - \theta_L$ and $s < pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(y_S)$, the manager moves only if (26) exceeds the expected utility in (15). The latter condition simplifies to the one stated in the Proposition. ■

Proof of Lemma 2. To show that $V(\theta)$ is increasing in θ , note that it increases both the manager's future wages and the conditional probabilities of good outcomes relative to bad ones. First, each of the instantaneous utility functions $u(w_t)$ in expression (30) is increasing in w_t , and the wages w_t are increasing in the manager's reputation θ_t by (31). Second, an increase in θ_{t-1} raises reputation at each future date $\{\theta_t, \theta_{t+1}, \theta_{t+2}, \dots\}$, by expression (12). Hence, it increases the conditional probability of the good outcome $\bar{y}$ and decreases that of the bad outcome $\bar{y} - c$, which raises expected utility.

To show that $V(\theta)$ is bounded above by V_H , notice that, by expressions (30) and

(34), $V(\theta_{t-1}) - V_H$ can be written as follows:

$$\begin{aligned} V_H - V(\theta_{t-1}) &= [u(\bar{y}) - u(w_t)] + \rho \max\{(1 - \theta_{t-1})(V_H - V_L), \\ &\quad [\beta\theta_{t-1} + (1 - \beta)p]E \left[\sum_{s=0}^{\infty} \rho^s [u(\bar{y}) - u(w_{t+1+s})] \mid \theta_t^U \right] \right. \\ &\quad \left. + [1 - \beta\theta_{t-1} - (1 - \beta)p]E \left[\sum_{s=0}^{\infty} \rho^s [u(\bar{y}) - u(w_{t+1+s})] \mid \theta_t^D \right] \right\}. \end{aligned}$$

This expression is strictly positive, as each of the differences that enter it is strictly positive, recalling expression (31) for the wages. Symmetrically, $V(\theta_{t-1}) - V_L$ can be written as follows:

$$\begin{aligned} V(\theta_{t-1}) - V_L &= [u(w_t) - u(y_S)] + \rho \max\{\theta_{t-1}(V_H - V_L), \\ &\quad [\beta\theta_{t-1} + (1 - \beta)p]E \left[\sum_{s=0}^{\infty} \rho^s [u(w_{t+1+s}) - u(y_S)] \mid \theta_t^U \right] \right. \\ &\quad \left. + [1 - \beta\theta_{t-1} - (1 - \beta)p]E \left[\sum_{s=0}^{\infty} \rho^s [u(w_{t+1+s}) - u(y_S)] \mid \theta_t^D \right] \right\}. \end{aligned}$$

Also this expression is strictly positive, as each of the differences entering it is strictly positive, again using expression (31) for the wages. ■

Proof of Proposition 9. Suppose that $\frac{\theta_{t-1}(1-\delta^-)}{1-\theta_{t-1}\delta^-} < 1 - \eta$. Then the continuation utility is $V(\theta_t 1 - \theta_{t-1}\delta^-) = V_L$ if $\theta_t = \frac{\theta_{t-1}(1-\delta^-)}{1-\theta_{t-1}\delta^-}$. Hence, there is a value $\theta = \underline{\theta}$ such that the manager is indifferent between staying and moving: $\underline{\theta}(V_H - V_L) = [\beta\underline{\theta} + (1 - \beta)p][V(\frac{\underline{\theta}(1-\delta^-)}{1-\underline{\theta}\delta^-}) - V_L]$. Notice that $\underline{\theta} > 0$. Since $V(\frac{\underline{\theta}(1-\delta^-)}{1-\underline{\theta}\delta^-}) < V_H$, we have that $\underline{\theta}(V_H - V_L) < [\beta\underline{\theta} + (1 - \beta)p](V_H - V_L)$, so that $\underline{\theta} < p$. Because $V(\theta)$ is increasing in θ , for all $\theta < \underline{\theta}$, staying dominates moving. Notice that, by construction $\underline{\theta} < \frac{1-\eta}{1-\eta\delta^-}$, i.e. the manager will be assigned to the safe project if he moves.

Consider next a relatively high value $\theta_{t-1} = \bar{\theta}$ such that the manager is indifferent between staying and leaving. For $\theta > \bar{\theta}$, because $V(\theta)$ is increasing in θ , staying

dominates moving. Therefore, $\bar{\theta}(V_H - V_L) = [\beta\bar{\theta} + (1 - \beta)p]^{\frac{\bar{\theta}(1+\delta^+)}{1+\bar{\theta}\delta^+}}(V_H - V_L) + [1 - \beta\bar{\theta} - (1 - \beta)p][V\left(\frac{\bar{\theta}(1-\delta^-)}{1-\bar{\theta}\delta^-}\right) - V_L]$. Notice that $\bar{\theta} > 0$ and that $\bar{\theta} \geq \frac{1-\eta}{1-\eta\delta^-}$, i.e. the manager will be assigned to the risky project even if his project yields $\bar{y} - c$ after he moves. ■

Appendix B: Derivations for the three-period model

In this appendix, we analyze the model in the three-period case, solving it by backward induction. Hence, we start from the firm's choice of project in period 3.

A. Period 3

The choice of the project P_{i3} is independent of the firm (k, h, j) by which manager i is employed. As in the second period of the two-period model, the final project assignment depends only on the reputation θ_{i2} acquired by the manager up to that point:

$$P_{i3} = \begin{cases} R & \text{if } \eta \geq 1 - \theta_{i2}, \\ S & \text{if } \eta < 1 - \theta_{i2}. \end{cases}$$

Since there is perfect competition for managers, manager i is paid his expected productivity:

$$w_{i3} = \begin{cases} \bar{y} - (1 - \theta_{i2})c & \text{if } P_{i3} = R \\ y_S & \text{if } P_{i3} = S \end{cases}$$

The reputation θ_{i2} can take one of six values:

- (i) $\theta_{i2} = 1$ if the type is known to be G , which happens if manager i stayed in period 1, completed the risky project P_{ik1} and generated payoff $\bar{y}$;
- (ii) $\theta_{i2} = \theta_{HH}$ if manager i moved twice and the payoffs of the risky projects (P_{i1}, P_{i2}) were $(\bar{y}, \bar{y})$;
- (iii) $\theta_{i2} = \theta_{HL}$ if manager i moved twice and the payoffs of the risky projects (P_{i1}, P_{i2}) were $(\bar{y}, \bar{y} - c)$ or $(\bar{y} - c, \bar{y})$;
- (iv) $\theta_{i2} = \theta_L$ if manager i moved in period 1, the payoff of the risky project P_{i1} was $\bar{y} - c$, and he was assigned to the safe project in period 2;

(v) $\theta_{i2} = \theta_{LL}$ if manager i moved twice and the payoffs on the risky projects (P_{i1}, P_{i2}) were $(\bar{y} - c, \bar{y} - c)$;

(vi) $\theta_{i2} = 0$ if the type is known to be B , which happens if manager i stayed in period 1, completed the risky project P_{i1} and generated payoff $\bar{y} - c$.

Notice that we have made use of the result obtained in Lemma 1 that a manager is assigned to the risky project whenever $P_{i1} = \bar{y}$.

Lemma 3 (Project choice in period 3) *There are three cases to consider:*

1. If $\eta \geq 1 - \theta_{LL}$, then $P_{i3} = \begin{cases} R & \text{if } \theta_2 \in \{1, \theta_{HH}, \theta_{HL}, \theta_L, \theta_{LL}\}, \\ S & \text{otherwise.} \end{cases}$
2. If $1 - \theta_L \leq \eta < 1 - \theta_{LL}$, then $P_{i3} = \begin{cases} R & \text{if } \theta_2 \in \{1, \theta_{HH}, \theta_{HL}, \theta_L\} \\ S & \text{otherwise.} \end{cases}$
3. If $\eta < 1 - \theta_L$, then $P_{i3} = \begin{cases} R & \text{if } \theta_2 \in \{1, \theta_{HH}, \theta_{HL}\} \\ S & \text{otherwise.} \end{cases}$

Proof. The case in which $\theta_{i2} = 1$ or $\theta_{i2} = 0$ are as in Lemma 1: the manager is assigned to the risky project if $\theta_{i2} = 1$, and to the safe project if $\theta_{i2} = 0$.

If the manager moves in period 1, project allocation depends on the realized output and on the implied reputation θ_{i2} . If the period-1 project is successful ($y_{i1} = \bar{y}$), the manager is assigned to the risky project both in period 2 and in period 3. This follows from the observation that $\eta > 1 - p$ and $\theta_{HL} \geq p$ imply that $\eta \geq 1 - \theta_{HL}$. Hence, the manager is assigned to a risky project in period 3 when $\theta_{i2} \in \{1, \theta_{HH}, \theta_{HL}\}$.

The two remaining cases to consider are those in which $\theta_{i2} = \theta_{LL}$ and $\theta_{i2} = \theta_L$. The manager is assigned to the risky project for both of these values of θ_{i2} if $\eta \geq$

$1 - \theta_{LL}$. He is assigned to the risky project only for $\theta_{i2} = \theta_L$ if $1 - \theta_L \leq \eta < 1 - \theta_{LL}$. He is assigned to the safe project otherwise. ■

Hence, the lower the risky project's risk-adjusted efficiency gain, the more demanding is the reputation θ_{i2} required for him to be assigned to the risky project in period 3: when the efficiency ratio is highest ($\eta \geq 1 - \theta_{LL}$), the manager is always assigned to a risky project, unless he was revealed to be bad; when it is lowest ($\eta < 1 - \theta_L$), he is assigned to a risky project if at least one of his previous risky projects was successful.

B. Period 2

In this period, we consider first the decision of the manager whether to stay in firm k or h or to move to firm j . Then, we look at the choice of project.

B1. Manager's decision to move or stay

In period 2, the manager's reputation θ_{i1} can take one of four values:

(i) $\theta_{i1} = 1$ if the manager i stayed in period 1 and the payoff of the risky project P_{i1} was $\bar{y}$;

(ii) $\theta_{i1} = \theta_H$ if manager i moved in period 1 and the payoff of the risky project P_{i1} was $\bar{y}$;

(iii) $\theta_{i1} = \theta_L$ if manager i moved in period 1 and the payoff of risky project P_{i1} was $\bar{y} - c$;

(iv) $\theta_{i1} = 0$ if the manager i stayed in period 1 and the payoff of the risky project P_{i1} was $\bar{y} - c$.

If the manager stays with his current employer until the end of period 2, his

continuation utility (i.e., his expected utility in period 3) is

$$\theta_{i1}u(\bar{y}) + (1 - \theta_{i1})u(y_S), \quad (38)$$

as with probability θ_{i1} his type is found to be G , so that he will be paid $w_{i3} = \bar{y}$, while with probability $1 - \theta_{i1}$ his type is found to be B , so that he will be paid $w_{i3} = y_S$.

In the two extreme cases (i) and (iv) above, where $\theta_{i1} \in \{0, 1\}$, the manager's type is already known, so that he does not gain from moving: his continuation payoffs from moving would be the same as those from staying in expression (38).

In case (ii), where $\theta_{i1} = \theta_H$, the continuation utility from moving is

$$p_H u(\bar{y} - (1 - \theta_{HH})c) + (1 - p_H)u(\bar{y} - (1 - \theta_{HL})c), \quad (39)$$

where $p_H \equiv \beta\theta_H + (1 - \beta)p < \theta_H$.

In case (iii), where $\theta_{i1} = \theta_L$, there are two subcases to consider: if $\eta \geq 1 - \theta_{LL}$, then the continuation utility from moving is

$$p_L u(\bar{y} - (1 - \theta_{HL})c) + (1 - p_L)u(\bar{y} - (1 - \theta_{LL})c), \quad (40)$$

where $p_L \equiv \beta\theta_L + (1 - \beta)p > \theta_L$; if $\eta < 1 - \theta_{LL}$, then the continuation utility from moving is

$$p_L u(\bar{y} - (1 - \theta_{HL})c) + (1 - p_L)u(y_S). \quad (41)$$

Comparing the continuation payoffs from moving and staying, one can show that the decision to move in period 2 depends on θ_{i1} :

(i) if $\theta_{i1} = \theta_H$, manager i moves if and only if $(1 - \theta_H)[u(\bar{y} - (1 - \theta_{HL})c) - u(y_S)] \geq p_H[u(\bar{y}) - u(\bar{y} - (1 - \theta_{HH})c)] + (\theta_H - p_H)[u(\bar{y}) - u(\bar{y} - (1 - \theta_{HL})c)]$ and stays otherwise;

(ii) if $\theta_{i1} = \theta_L$, manager i moves if and only if $(p_L - \theta_L)[u(\bar{y} - (1 - \theta_{HL})c) - u(y_S)] \geq \theta_L[u(\bar{y}) - u(\bar{y} - (1 - \theta_{HL})c)] - (1 - p_L) \max\{0, [u(\bar{y} - (1 - \theta_{LL})c) - u(y_S)]\}$, and stays otherwise.

B.2 Project choice

The choice of project P_{i2} depends on the manager's reputation θ_{i1} at that stage:

$$P_{i2} = \begin{cases} R & \text{if } \eta \geq 1 - \theta_{i1}, \\ S & \text{if } \eta < 1 - \theta_{i1}. \end{cases}$$

Because of perfect competition for managers, manager i is paid his expected productivity:

$$w_{i2} = \begin{cases} \bar{y} - (1 - \theta_1)c & \text{if } P_{i2} = R \text{ and } i \text{ is expected to stay,} \\ \bar{y} - [1 - \beta\theta_1 - (1 - \beta)p]c & \text{if } P_{i2} = R \text{ and } i \text{ is expected to move,} \\ y_S & \text{if } P_{i2} = S. \end{cases}$$

From Lemma 1, it follows that there are two cases to consider for the choice of period-2 projects:

$$\begin{aligned} \text{(i) If } \eta \geq 1 - \theta_L, \text{ then } P_{i2} &= \begin{cases} R & \text{if } \theta_{i1} \in \{1, \theta_H, \theta_L\}, \\ S & \text{otherwise.} \end{cases} \\ \text{(ii) If } \eta < 1 - \theta_L, \text{ then } P_{i2} &= \begin{cases} R & \text{if } \theta_{i1} \in \{1, \theta_H\}, \\ S & \text{otherwise.} \end{cases} \end{aligned}$$

We can then define the continuation utility for period 2 and 3 conditional on $\theta_{i1} = \theta_H$ as:

$$\begin{aligned} V(\theta_H) &\equiv u(\bar{y} - (1 - \theta_H)c) + \rho \max\{\theta_H u(\bar{y}) + (1 - \theta_H)u(y_S), \\ &\quad p_H u(\bar{y} - (1 - \theta_{HH})c) + (1 - p_H)u(\bar{y} - (1 - \theta_{HL})c)\} \end{aligned} \quad (42)$$

and the continuation utility conditional on $\theta_{i1} = \theta_L$ as:

$$V(\theta_L) \equiv \begin{cases} u(\bar{y} - (1 - \theta_L)c) + \rho \max\{\theta_L u(\bar{y}) + (1 - \theta_L)u(y_S), p_L u(\bar{y} \\ \quad -(1 - \theta_{HL})c) + (1 - p_L) \max\{u(y_S), u(\bar{y} - (1 - \theta_{LL})c)\} & \text{if } \eta \geq (1 - \theta_L) \\ V_L & \text{if } \eta < (1 - \theta_L) \end{cases} \quad (43)$$

C. Period 1

The choice of project P_{i1} is trivial. Since the type is unknown, by assumption (5), it is optimal to assign a risky project to manager i : $P_{i1} = R$. The corresponding wage is his expected output $w_{i1} = \bar{y} - (1 - p)c$.

If the manager stays, his continuation utility (i.e., his expected utility in period 2 and 3) is

$$pV_H + (1 - p)V_L, \quad (44)$$

where $V_H \equiv (1 + \rho)u(\bar{y})$ and $V_L \equiv (1 + \rho)u(y_S)$ are the continuation utilities if the manager's type $\theta_{i1} = 1$ and $\theta_{i1} = 0$, respectively.

If the manager moves, his continuation utility is

$$pV(\theta_H) + (1 - p)V(\theta_L), \quad (45)$$

where $V(\theta_H)$ is given in equation (43) and $V(\theta_L)$ is given in equation (43).

Comparing these expressions, one can show that manager i moves only if $\eta \geq 1 - \theta_L$: otherwise, moving is strictly worse than staying, as it leads to a lower expected utility if the manager's type is G , and leaves expected utility unchanged if the manager's type is B . To see this, notice that the second period utility is $pu(\bar{y} - (1 - \theta_H)c) + (1 - p)u(y_S)$ if the manager moves and $pu(\bar{y}) + (1 - p)u(y_S)$ if he stays. Staying dominates moving because the utility if the manager's type is G is strictly lower when he moves than when he stays; while the utility if the manager's type is B is the same. The expected utility in the third period is $p \max\{\theta_H u(\bar{y}) + (1 - \theta_H)u(y_S), p_H u(\bar{y} - (1 - \theta_{HH})c) + (1 - p_H)u(\bar{y} - (1 - \theta_{HL})c)\} + (1 - p)u(y_S)$ if he moves and $pu(\bar{y}) + (1 - p)u(y_S)$ if he stays. Staying dominates moving because the utility if the manager's type is G (which happens with probability p) is strictly

lower when he moves than when he stays; while the utility if the manager's type is B is the same.

Moreover, managers move for a wider set of parameters than that identified by Proposition 1 for the 2-period model. This follows from the observation that when the manager prefers not to move in period 2, his choice is identical to that analyzed in Proposition 1 (noticing that $p\theta_H + (1-p)\theta_L = p$). But, when the manager moves in period 2, now he gains insurance against period-3 wage risk (obviously absent in the 2-period model), so that the expected utility from moving is greater than in the 2-period case.

Comparing the expected utility from staying and moving, we can state the explicit condition for moving in period 1:

Proposition 10 (Decision to move in period 1 in the three-period model)

Manager i moves in period 1 iff

$$\begin{aligned}
& (1-p)[u(\bar{y} - (1-\theta_L)c) - u(y_S)] + \rho(1-p) \max\{\theta_L[u(\bar{y}) - u(y_S)], \\
& p_L[u(\bar{y} - (1-\theta_{HL})c) - u(y_S)] + (1-p_L) \max\{0, u(\bar{y} - (1-\theta_{LL})c) - u(y_S)\} \\
\geq & p[u(\bar{y}) - u(\bar{y} - (1-\theta_H)c)] + p\rho[u(\bar{y}) - \max\{\theta_H u(\bar{y}) + (1-\theta_H)u(y_S), \\
& p_H u(\bar{y} - (1-\theta_{HH})c) + (1-p_H)u(\bar{y} - (1-\theta_{HL})c)\}].
\end{aligned}$$

Even though this condition is more complex than its analogue in Proposition 1, it is based on the same idea: the manager decides to move only when the expected benefit if he is a low-quality manager exceeds the expected cost if the manager is high-quality.

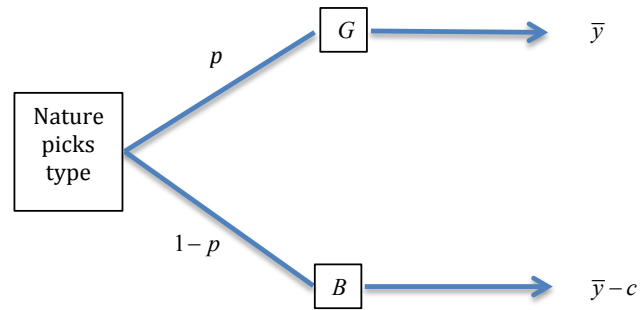
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Risky project, if completed by its initiator:



Risky project, if not completed by its initiator:

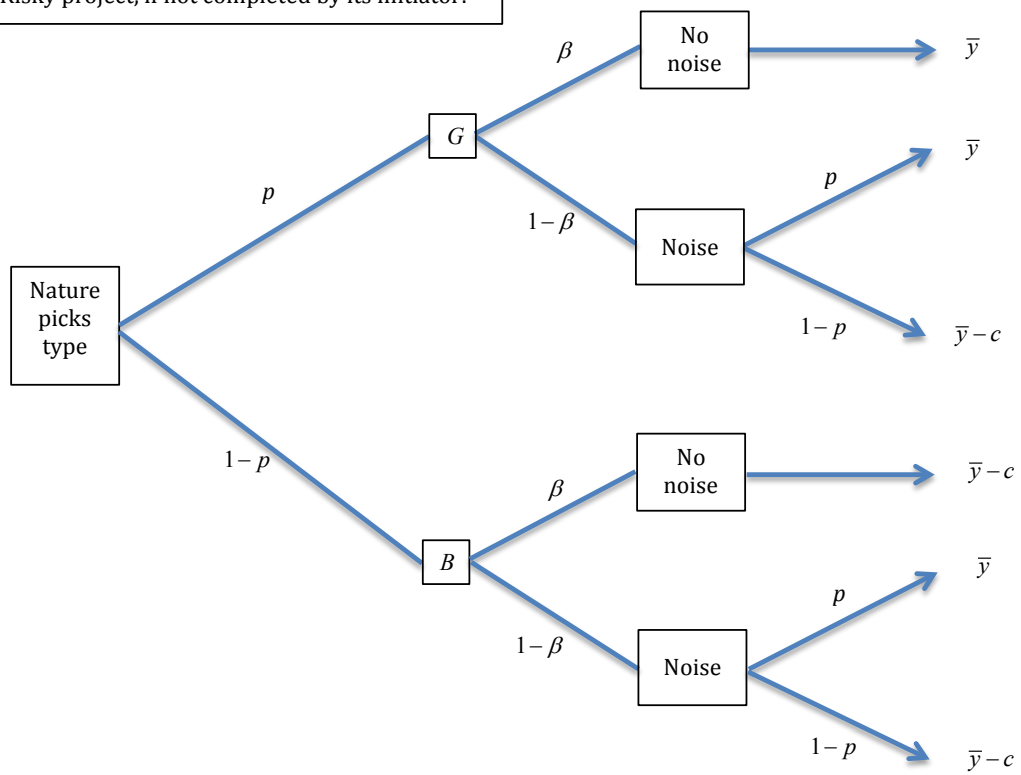


Figure 1: Risky project tree

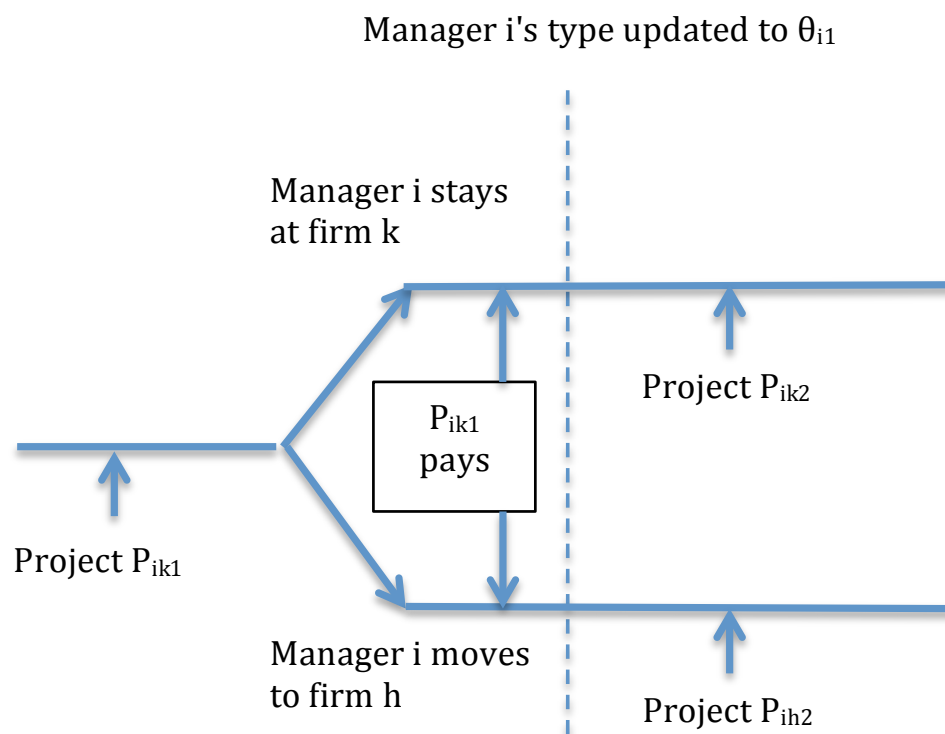


Figure 2: Time line of the 2-period model

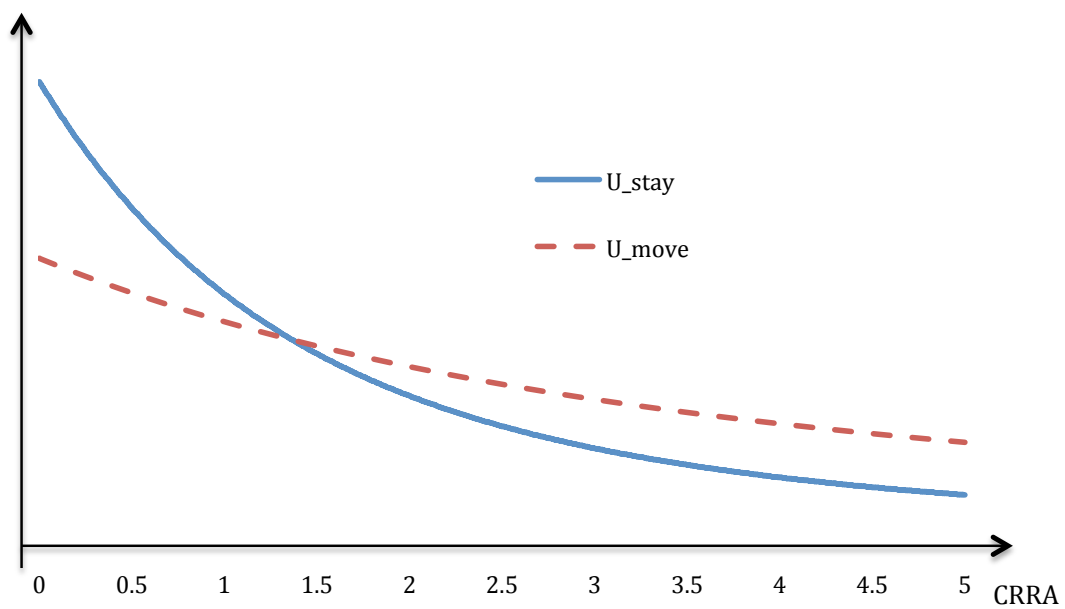


Figure 3: Moving decision and risk aversion in the 2-period model

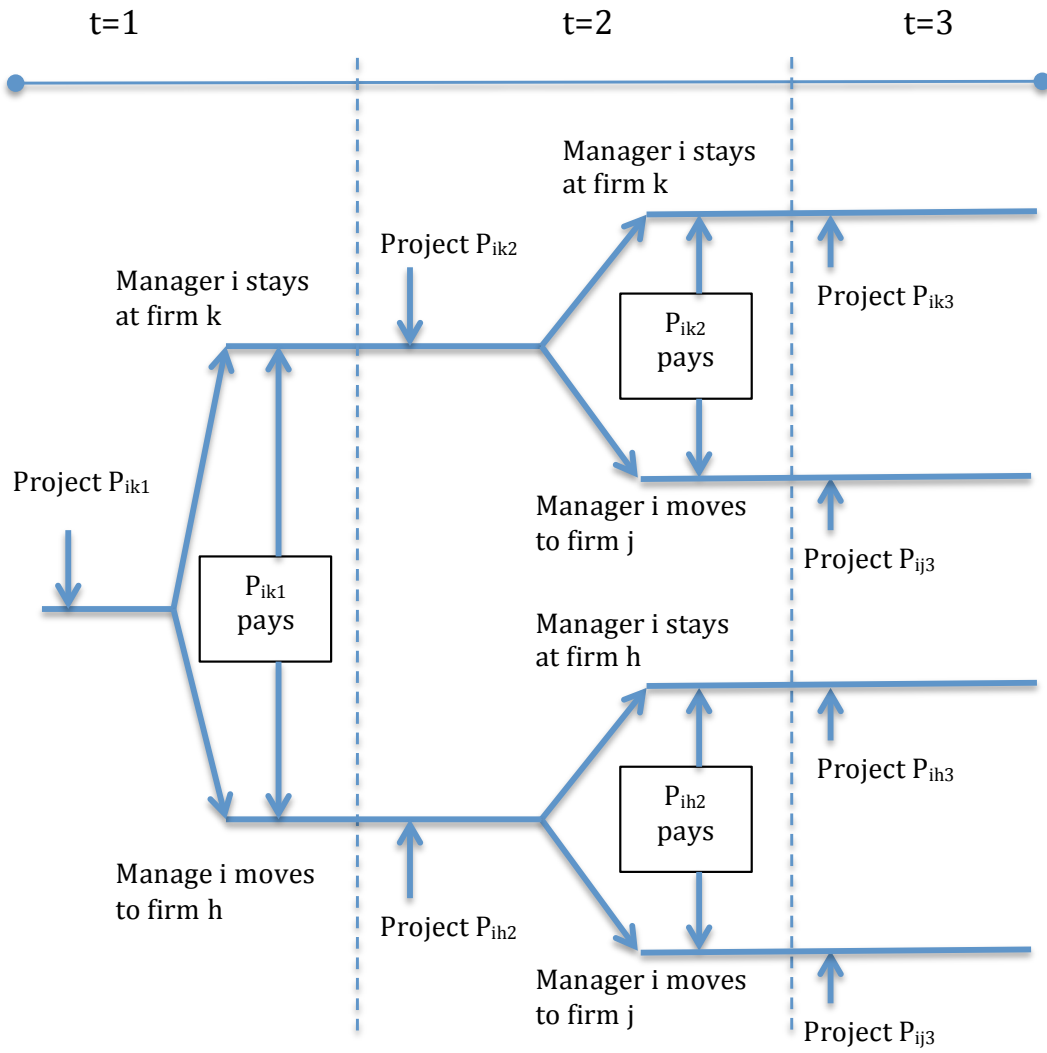
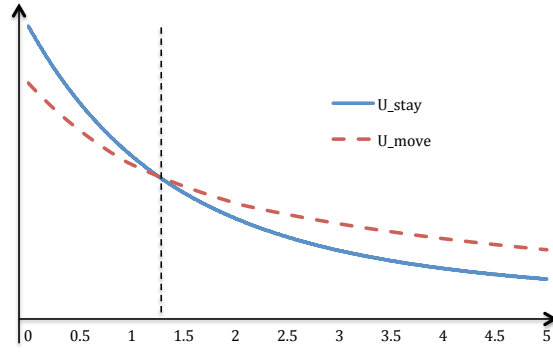


Figure 4: Time line of the 3-period model

Panel A: Expected utility from staying (in blue) and moving (in red) as a function of CRRA in period 1



Panel B: Expected utility from staying (in blue) and moving (in red) as a function of CRRA in period 2

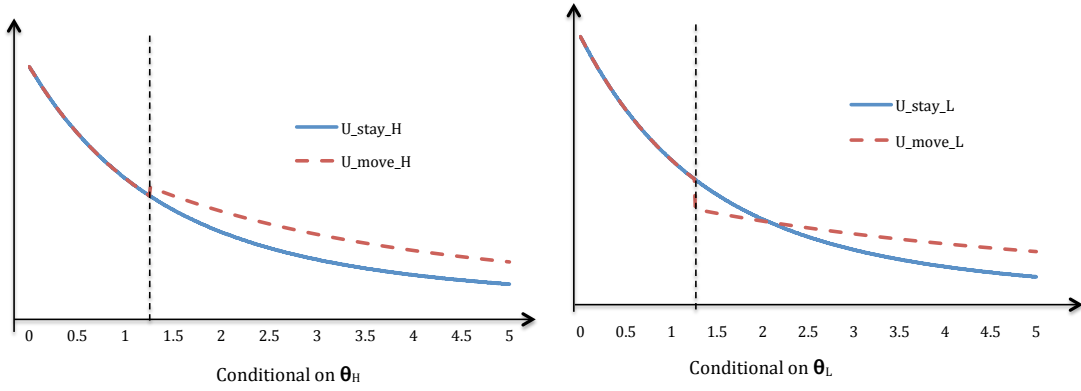


Figure 5: Moving decision and risk aversion in the 3-period model

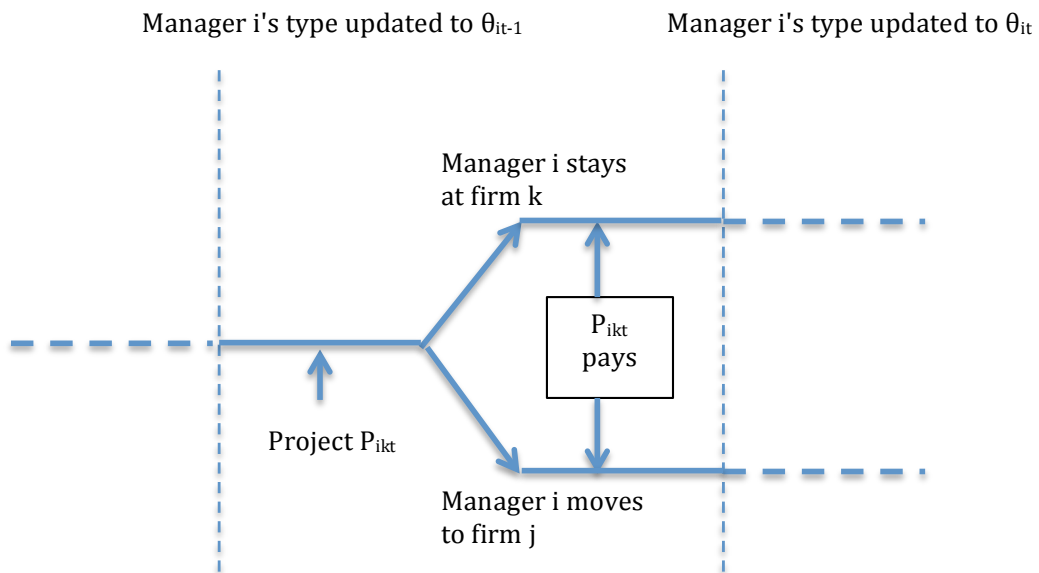


Figure 6: Time line of the model with infinite horizon