Executive Compensation:
The View from General Equilibrium[*]

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Abstract

We study the dynamic general equilibrium of an economy where risk averse shareholders delegate the management of the firm to risk averse managers. The optimal contract has two main components: an incentive component corresponding to a non-tradable equity position and a variable 'salary' component indexed to the aggregate wage bill and to aggregate dividends. Tying a manager's compensation to the performance of her own firm ensures that her interests are aligned with the goals of firm owners and that maximizing the discounted sum of future dividends will be her objective. Linking managers' compensation to overall economic performance is also required to make sure that managers use the appropriate stochastic discount factor to value those future dividends.

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1   Introduction

Executive compensation is making headlines across the world. While the dramatic increase in the level of executive remuneration has been at the center of the controversy, other features have been noted as well. Large compensation payouts in times of poor performance, in particular, have fueled suspicions of managerial entrenchment, 'back-scratching', etc.

This paper makes a very simple but fundamental point. Internal incentive considerations imply that a manager's compensation must be tied to the performance of her own firm. Performance-based compensation ensures that her interests are aligned with the goals of firm owners and that maximizing the discounted sum of future dividends will be her objective. When viewed in the light of general equilibrium theory, however, incentive considerations also require that a manager's compensation be linked to aggregate economic performance. This is required to guarantee that managers use the appropriate stochastic discount factor to value those future dividends. Moreover, these two aspects of performance compensation must, in a sense to be made precise, be adapted to one another if self-interested managers with private information are to make the right intertemporal decisions on behalf of firm owners.

One striking implication of our perspective is that it may well be perfectly appropriate for the manager of an underperforming firm to receive an increase in her compensation package. Indeed, we will show that the requirements of an optimal contract will make this situation the norm rather than the exception.

We make our point in a simple infinite horizon dynamic general equilibrium model where both shareholders and managers are risk averse. The advantage of our set-up is that we can identify the contract that implements the first best allocation and, as a consequence, be fully specific as to the requirements of an optimal contract. Reality is likely to be more murky, in particular because firm owners' information on managers' private wealth and actions may be incomplete. Yet the lessons that we draw in our simple set-up remain applicable. To the best of our knowledge our model is a first application of dynamic agency theory in a world where both principal and agent are risk averse.

An outline of the paper is as follows. Section 2 spells out the model. Section 3 characterizes the first best allocation of resources. Section 4 argues that there exists an optimal contract decentralizing the first best allocation of resources and completely characterizes this optimal contract under the assumption that the manager's effort level is immaterial for production.

The optimal contract requires not only endowing the manager with a non-tradable equity share of the firm but also ensuring that the time series properties of the manager's stochastic discount factor, and thus her consumption, are identical to those of the firm owners. This latter condition in turn requires that the manager's remuneration includes a time-varying salary-like component whose properties are indexed to the aggregate wage bill. Section 5 generalizes this characterization to the situation where manager's (unobservable) effort is essential for production while Section 6 develops the case of an economy with multiple firms. The salary component of a manager's remuneration must then include a share in the aggregate economy-wide dividend payment but, rather strikingly, a manager's equity stake in the firm under management cannot exceed her share of the market portfolio. Section 7 reviews some related literature while Section 8 concludes.

2   The model

For ease of exposition we start with the assumption that the entire economy's output is produced by a single perfectly competitive firm. Section 6 discusses the extension to many firms. There is a continuum of identical agents of measure $(1 + \mu)$, a subset of which – of measure μ - are selected at the beginning of time to permanently manage the firm. The rest act as workers and shareholders. We entertain two views on the role of managers. In the first approach, managers are key to making the strategic employment and (especially) investment decisions of the firm, but they have no impact on static efficiency (on how capital and labor translate into output within the period of production). Under the second approach, managerial effort affects the total per period output that can be produced from a given quantity of capital and labor. In both situations, managers are self-interested and assumed to make all the relevant decisions in view of maximizing their own intertemporal utility. When they make the hiring and investing decisions on behalf of firm owners, managers are viewed as acting collegially and thus we may refer to them collectively as "the manager". We follow Raith (2005) in assuming the manager's participation constraint is not binding (see footnote 11).

At the center of our attention is the repeated principal-agent problem between the (risk averse) shareholders of the firm and the (risk averse) manager and its general equilibrium dimension. The moral hazard problem we focus on has two elements: the first is the familiar one that arises if the executive's effort choice is non-verifiable. The second results from the fact

that the manager possesses specific knowledge that she may not use in the best interest of shareholders. One of the main motives for delegation is, indeed, to relieve shareholders of the day-to-day operation of the firm and the information requirements it entails. This means that shareholders delegate to the manager the hiring and investment decisions and all that goes with them (human resource management, project evaluation, etc.) but that, as a by-product, they lose the informational base upon which to evaluate and monitor the manager's performance.

The firm is fully described by a constant returns to scale production function $f(k_t, n_t, \mu e_t)\lambda_t$ where k_t is capital stock available at the beginning of period t, n_t stands for employment, e_t is per capital managerial effort, and λ_t is the customary aggregate technology shock. The law of motion for capital stock is $k_{t+1} = (1 - \Omega) k_t + i_t$ where i_t is investment and Ω is the rate of depreciation.

At the beginning of period t, **the manager** privately observes the realization of the productivity parameter λ_t; she then makes her utility-maximizing decisions (c_t^m, e_t, n_t, i_t) in light of her remuneration contract, $g^m(x_t, \hat{s}_t)$. Here c_t^m is the manager's period t consumption while x_t is a measure of the firm's performance to be identified later. Managerial remuneration may also depend on other economic variables observable by the firm owners (and on which they may write contracts). We choose to denote the state of the economy as perceived by firm owners by the expression $\hat{s}_t$ while $s_t = (k_t, \lambda_t)$ represents the true state of the economy as perceived by the fully-informed managers: $\hat{s}_t$, in particular, differs from s_t in that it does not include λ_t since the latter is private information of the manager. The manager is not given access to capital markets and she has no outside source of income.[1] She therefore consumes the income she receives from the firm. This assumption is essential to be able to identify unambiguously the first best contract. Given that the contract we discuss is optimal, the assumption, in effect, is not restrictive. Our analysis can be extended without difficulty to situations where firm owners have full information on the manager's outside income and actions.

Given a level of effort e_t and in the absence of retained earnings, decisions (n_t, i_t) yield distributions or dividends

$$d_t = f(k_t, n_t, \mu e_t)\lambda_t - n_t w_t - \mu g^m(x_t, \hat{s}_t) - i_t \equiv \hat{d}_t - \mu g^m(x_t, \hat{s}_t),$$

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[1] In a companion paper we allow the manager to trade securities; see Danthine and Donaldson (2007).

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where w_t is the market equilibrium wage rate and $\hat{d}_t$ is free-cash-flow before payment to managers.

Let $u(\cdot)$ represents the manager's utility of consumption, $H(\cdot)$ her disutility of effort, β the discount factor common to all economic agents and $F(\cdot)$ the probability transition function on λ_t. The manager's problem then reads:

$$
\begin{aligned}
V^m\left(k_0, \lambda_0\right) &= \max_{\{n_t, i_t, c_t^m, e_t\}} E \sum_{t=0}^{\infty} \beta^t \left[u\left(c_t^m\right) - H(e_t)\right] \qquad (1) \\
&\text{s.t.} \\
c_t^m &= g^m\left(x_t, \hat{s}_t\right), \\
x_t &= x(i_t, n_t, e_t, s_t), \\
k_{t+1} &= \left(1 - \Omega\right)k_t + i_t, k_0 \text{ given} \\
c_t^m, e_t, i_t, n_t &\geq 0, \\
\lambda_{t+1} &\sim dF\left(\lambda_{t+1}; \lambda_t\right); \lambda_0 \text{ given.}
\end{aligned}
$$

The representative **shareholder-worker-consumer** is confronted with a work/leisure decision and a portfolio investment decision. The form of his optimization problem is standard although we initially remain vague as to the precise content of his information set. The representative shareholder-worker's problem reads:

$$
\begin{aligned}
V^s(\hat{s}_0) &= \max_{\{c_t^s, n_t^s, z_{t+1}\}} E \sum_{t=0}^{\infty} \beta^t [u(c_t^s) - \hat{H}(n_t^s)] \qquad (2) \\
&\text{s.t.} \\
c_t^s + q_t z_{t+1} &\leq \left(q_t + d_t\right) z_t + w_t n_t^s, \\
c_t^s, z_t, n_t^s &\geq 0, \forall t; \\
\hat{s}_{t+1} &\sim dG\left(\hat{s}_{t+1}; \hat{s}_t\right), \hat{s}_0 \text{ given.}
\end{aligned}
$$

In problem (2), $u(\cdot)$ is the consumer-worker-investor's (homogeneous) period utility of consumption function, $\hat{H}(\cdot)$ is his disutility of work function, c_t^s his period t consumption, n_t^s his period t labor supply, z_{t+1} the fraction of the single equity share purchased by him at the end of period t, while $G(.)$ describes the transition probabilities for the relevant state variables. Note that we assume both agent types have the same discount factor and the same preferences over consumption. The potential conflict of interests between the two agent classes - to be described shortly - arises endogenously

and is not a result of postulated differences in preferences (in contrast with much of the literature - see Section 7).

3 Characterizing the first best allocation

In this section we characterize the first best allocation for the economy of Section 2. Noting that the aggregate state of the economy is given by (k_t, λ_t), the central planner's problem is as follows:

$$\max_{\{n_t, i_t, c_t^m, c_t^s, e_t\}} E \sum_{t=0}^{\infty} \beta^t \left\{ \mu M[u(c_t^m) - H(e_t)] + (1-M)[u(c_t^s) - \hat{H}(n_t^s)] \right\}$$

(3)

$$\text{s.t.}$$
$$\mu c_t^m + c_t^s + i_t = f(k_t, n_t, \mu e_t)\lambda_t,$$
$$k_{t+1} = (1-\Omega)k_t + i_t, k_0 \text{ given,}$$
$$c_t^m, c_t^s, e_t, i_t, n_t \geq 0,$$
$$s_{t+1} \sim dF(\lambda_{t+1}; \lambda_t), \lambda_0 \text{ given,}$$

where M and $1-M$ are arbitrary welfare weights attributed to an individual manager and shareholder, respectively. We introduce the following assumptions:

A.1: $u(\cdot)$ is twice continuously differentiable, strictly concave and increasing on R^+; the Inada conditions hold.

A.2: $\hat{H}(\cdot)$ is twice continuously differentiable, strictly convex and increasing on R^+.

A.3: $f(\cdot, \cdot)$ is twice continuously differentiable, strictly concave and increasing on $R^+ \times R^+$; the Inada conditions hold.

A.4: $H(\cdot)$ is twice continuously differentiable, strictly increasing and convex on R^+.

A standard result follows.

Theorem 1. Suppose A.1-A.4 hold. Then there exist a differentiable value function $W(k_t, \lambda_t)$ and continuous policy functions $\{n(k_t, \lambda_t), e(k_t, \lambda_t), i(k_t, \lambda_t), c^m(k_t, \lambda_t), c^s(k_t, \lambda_t)\}$ which solve problem (3). Furthermore, there exist $\{\underline{k}, \overline{k}\}$ such that $\underline{k} \leq k_t \leq \overline{k}, \forall t$ provided $k_0 \in [\underline{k}, \overline{k}]$.

The recursive representation of problem (3) is

$$
\begin{aligned}
W(k_t, \lambda_t) = \max_{(e_t, i_t, n_t^s, c_t^m)} \{ &\mu M[u(c_t^m) - H(e_t)] \\
&+ (1-M)[u(f(k_t, n_t^s, \mu e_t)\lambda_t - i_t - \mu c_t^m) - \hat{H}(n_t^s)] \\
&+ \beta \int W((1-\Omega)k_t + i_t, \lambda_{t+1})\, dF(\lambda_{t+1}; \lambda_t) \} \quad (4)
\end{aligned}
$$

Under A.1-A.3, the necessary and sufficient F.O.C's for (4) are, $\forall t$,

$$
u_1(c_t^s) f_2(k_t, n_t^s, \mu e_t)\lambda_t = \hat{H}_1(n_t^s), \tag{5}
$$

$$
1 = \beta \int \frac{u_1(c_{t+1}^m)}{u_1(c_t^m)} [f_1(k_{t+1}, n_{t+1}, \mu e_{t+1})\lambda_{t+1} + (1-\Omega)] d\hat{F}(\lambda_{t+1}, \lambda_t), \tag{6}
$$

$$
(1-M)u_1(c_t^s) = M u_1(c_t^m), \text{ implying } \frac{u_1(c_{t+1}^s)}{u_1(c_t^s)} = \frac{u_1(c_{t+1}^m)}{u_1(c_t^m)}, \tag{7}
$$

$$
(1-M)u_1(c_t^s) f_3(k_t, n_t, \mu e_t)\lambda_t = M H_1(e_t), \tag{8}
$$

and

$$
\mu c_t^m + c_t^s + i_t = f(k_t, n_t, \mu e_t)\lambda_t \equiv y_t. \tag{9}
$$

Using (7), condition (8) can be written

$$
u_1(c_t^m) f_3(k_t, n_t, \mu e_t)\lambda_t = H_1(e_t). \tag{10}
$$

Condition (5) is the standard marginal condition determining the worker's optimal supply of labor. Condition (10) is the equivalent condition for the effort level of the manager. Equation (6) is an equally standard condition determining investment. Note that the relevant intertemporal rate of substitution is the manager's, but the Pareto Optimality condition (7) implies that this could equally well be the shareholder's. Finally equation (9) is the overall resource availability constraint. In the next section we discuss the optimal contract under the simplifying assumption that the effort of the manager plays no role in determining the period output of the firm.

4   The optimal contract: the no effort case

We take as a benchmark the situation where the effort of the manager is irrelevant. We assume $f_3 \equiv 0$ and drop the manager's effort from the production function for notational simplicity.

The representative shareholder's problem (2) has the following recursive representation

$$V^s(\hat{s}_t) = \max_{\{z_{t+1}, n_t^s\}} \{ u\left(z_t\left(d_t + q_t \right) + w_t n_t^s - q_t z_{t+1} \right) - \hat{H}\left(n_t^s \right) \quad (11)$$

$$+ \beta \int V^s\left(z_{t+1}, \hat{s}_{t+1} \right) dG\left(\cdot \right) \}$$

whose solution is characterized by:[2]

$$u_1(c_t^s) w_t = \hat{H}_1(n_t^s), \quad (12)$$

$$u_1(c_t^s) q_t = \beta \int u_1(c_{t+1}^s)[q_{t+1} + d_{t+1}] dG(\cdot). \quad (13)$$

Note, from (12), that worker-shareholders' (static) labor supply decisions are independent of the probability distribution summarizing their information. The same cannot be said of their portfolio investment decisions (equation (13)) which forms the basis for equity pricing. We elect not to be specific as to the exact information set of shareholders as we do not pursue the issue of asset pricing. Observe, however, that no information beyond what shareholders possess can be included in the stock price, so that the stock market is not informationally efficient in the sense of the stock price not being a sufficient statistic for the information held by insiders (the managers).

Under appropriate conditions, the manager's problem (1) has recursive representation:[3]

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[2]It follows from Blackwell's (1965) Theorem and the results in Benveniste and Scheinkman (1979) that a differentiable, bounded $V^s(\cdot)$ satisfying (11) exists together with unique policy functions characterized by (12) and (13) provided $u(\cdot)$ and $H(\cdot)$ are increasing, continuously differentiable and concave, $q(\cdot)$ and $w(\cdot)$ are continuous, and that $dG(\cdot)$ has the property that it is continuous and whenever $h(d, q, w)$ is continuous, $\int h(d', q', w') dG(d', q', w'; d, q, w)$ is continuous as a function of (d, q, w). The continuity of $q(\cdot)$ and $w(\cdot)$ is then confirmed in equilibrium.

[3]It again follows from Blackwell's (1965) Theorem and the results in Benveniste and Scheinkman (1979) that a differentiable, bounded $V^m(\ )$ exists that solves (14) provided $u(\cdot)$ and $f(\cdot)$ are increasing, continuous and bounded, and that $g^m(\cdot)$ is itself continuous

$$V^m(k_t, \lambda_t) = \max_{\{i_t, n_t\}} \left\{ u(c_t^m) + \beta \int V^m(k_{t+1}, \lambda_{t+1}) dF(\cdot) \right\}. \qquad (14)$$

The necessary and sufficient first order conditions to problem (14) can be written

$$u_1(c_t^m) g_1^m(x_t, \hat{s}_t) \frac{\partial x_t}{\partial n_t} = 0, \qquad (15)$$

$$-u_1(c_t^m) g_1^m(x_t, \hat{s}_t) \frac{\partial x_t}{\partial i_t} = \beta \int u_1(c_{t+1}^m) g_1^m(x_{t+1}, \hat{s}_{t+1})$$
$$[f_1(k_{t+1}, n_{t+1}) \lambda_{t+1} + (1 - \Omega)] dF(\cdot), \quad (16)$$

where this latter representation is obtained using a standard application of the envelope theorem.

We focus on contracts for which $g^m(x_t, \hat{s}_t)$ is linear in x_t, i.e., $g^m(x_t, \hat{s}_t) = A_t + \varphi x_t$, where $A_t = A(\hat{s}_t)$ is independent of variables under the manager's control.[4] We will show that a properly designed linear contract achieves the first best. In a companion paper we explore circumstances where the first best may also be approximated by contracts where the convexity of the relationship between the measure of performance and the manager's compensation makes up for plausible suboptimal features of the contract itself.

A comparison of equation (5) with (12) and (15) makes clear that for the standard optimality condition for employment to obtain, the measure of firm performance x_t must satisfy

$$\frac{\partial x_t}{\partial n_t} = [f_2(k_t, n_t)\lambda_t - w_t]$$

Similarly, for equation (6) to obtain from (16) it is necessary and sufficient that

$$\frac{\partial x_t}{\partial i_t} = -1.$$

Integrating these two conditions with respect to n_t and i_t, respectively, yields (up to a constant of integration):

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and that $dF(A', \lambda'; A, \lambda)$ is also continuous with the property that for any continuous $h(k', A', \lambda')$, $\int h(k', A', \lambda') dF(A', \lambda'; A, \lambda)$ is also continuous in k and λ. In order for (15) and (16) to characterize the unique solution, the differentiability of $u(\cdot)$, $g^m(\cdot)$ and $f(\cdot)$ is required and $u(g^m(\cdot))$ must be concave. The assumptions made in this and the preceding footnote are maintained throughout the paper.

[4]That is, under the usual assumption that the unique firm is representative of a large number of identical firms behaving competitively.

$$x_t = f(k_t, n_t)\lambda_t - w_t n_t - i_t + \text{ constant } \equiv \hat{d}_t + \text{ constant }.$$

In other words, if there is to be no first-order distortion in the decisions of the manager, the only appropriate measure of firm performance in our economy is free-cash-flow *before payments to managers*.

The intuition for this result is clear. Absent strong extraneous conflicts of interest, in order to align the interests of managers and shareholders, it is sensible to endow the former with a non-tradable equity position, hence to a claim to a fraction of present and future cash flows to capital. For the rest of the paper we adopt this identification which is also consistent with the minimal information requirement we may want to impose on worker-shareholders.

It thus appears that the manager's contract should be of the form:

$$c_t^m = \varphi \hat{d}_t + A_t,$$

for some constant scalar φ.

The last piece of the puzzle is to make sure that condition (7) obtains. To discuss this issue, note that in equilibrium, at all dates t,

$$n_t^s = n_t, \tag{17}$$

$$z_t = 1, \text{ and} \tag{18}$$

$$y_t \equiv f(k_t, n_t)\lambda_t = c_t^s + \mu c_t^m + i_t \tag{19}$$

Equation (19) implies that condition (7), which requires that the two agents' intertemporal marginal rates of substitution are equal, reads:

$$
\begin{aligned}
\frac{u_1(c_{t+1}^m)}{u_1(c_t^m)} &= \frac{u_1\left(\varphi\hat{d}_{t+1} + A_{t+1}\right)}{u_1\left(\varphi\hat{d}_t + A_t\right)} \\
&= \frac{u_1(y_{t+1} - i_{t+1} - \mu c_{t+1}^m)}{u_1(y_t - i_t - \mu c_t^m)} = \frac{u_1(c_{t+1}^s)}{u_1(c_t^s)}.
\end{aligned}
\tag{20}
$$

The homogeneity property of $u(\cdot)$ in turn implies that equality (20) will be satisfied if the consumptions of the two agents are proportional to one another and thus to aggregate consumption, $c_t = y_t - i_t$. Consider the following equalities

$$
\begin{aligned}
c_t^m &= \varphi \hat{d}_t + A_t \\
&= \varphi[y_t - w_t n_t - i_t] + A_t \\
&= \varphi(y_t - i_t) - \varphi w_t n_t + A_t \qquad (21) \\
c_t^s &= y_t - i_t - \mu c_t^m \\
&= y_t - i_t - \mu[A_t + \varphi(y_t - i_t) - \varphi w_t n_t] \\
&= (1 - \mu\varphi)(y_t - i_t) + \mu\varphi w_t n_t - \mu A_t. \qquad (22)
\end{aligned}
$$

These relations indicate that

$$
A_t = \varphi w_t n_t.
$$

It follows that $c_t^m = \varphi(y_t - i_t)$ and $c_t^s = (1 - \varphi)(y_t - i_t)$ and the first best obtains. We summarize these results in

Theorem 2. Suppose A.1-A.4 are satisfied and manager's effort is immaterial to production. Then there exists a unique first best contract, $g^m(x_t, \hat{s}_t) = \varphi \hat{d}_t + \varphi w_t n_t$, under which the competitive equilibrium delivers the first best allocation of resources. [5,6]

Theorem 2 makes three assertions:

(i) the optimal contract includes a "salary component" in addition to the incentive element $\varphi \hat{d}_t$;

(ii) the salary component is linearly related to the aggregate wage bill; and

(iii) the power of the incentive component, φ, also defines the exposure of the salary component to the aggregate wage bill.

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[5] In all our model constructs, the first-order conditions are necessary and sufficient under maintained assumptions A.1 -A.4. Providing a contract under which the first-order conditions for the Pareto Optimum coincide with those of the competitive equilibrium is thus sufficient to guarantee these two economic constructs have identical properties. We appeal to this logic throughout the paper.

[6] We argue for uniqueness in the following way. By the concavity of the objective function in problem (3), the associated policy functions $\{n(k_t, \lambda_t), i(k_t, \lambda_t), c^m(k_t, \lambda_t), c^s(k_t, \lambda_t)\}$ are all unique. Furthermore, by the argument above, $\hat{d}_t = \hat{d}(k_t, \lambda_t)$ is the unique aggregate on which incentive pay can be based. Since $c_t^m = \varphi \hat{d}_t + A_t$, $A_t = A(k_t, \lambda_t)$ is also unique and must equal $\varphi w_t n_t$. The parameter $\varphi = \varphi(M, \mu)$ is then uniquely determined by the optimality condition (8).

The general message from this first discussion may be summarized as follows. Contracting in general equilibrium requires not only aligning the "micro incentives" of managers and firm owners but also aligning their stochastic discount factors. To insure that the trade-offs internal to the firm are properly appraised by the manager, it is appropriate to entitle her to a (non tradeable) share of dividends. This will naturally guarantee that the manager will want to maximize the discounted sum of future expected dividends. In a multi-period world of risk aversion, however, this is not sufficient. Shareholders want to ensure that the same stochastic discount factor as their own is applied by managers when tallying up future dividends. This is the sense of condition (20). If the stochastic factors are to be aligned, the total compensation package of managers must be such that their consumption is proportional to aggregate consumption, that is, to $y_t - i_t = d_t + w_t n_t$. Since the incentive part of their remuneration is a fraction of $\hat{d}_t$, the salary part of their remuneration must be the same fraction of the aggregate wage bill. In order to select the investment and hiring policies the shareholder-workers would like, the manager must receive an income stream with identical characteristics. Since shareholder-workers receive the bulk of their income in the form of wage payments, the manager must as well.[7]

In the next section, the exposure to dividends will be determined by the extent of the moral hazard problem. But the central message will remain: in the general equilibrium of a world with a representative shareholder-worker, the various components of the manager's remuneration have to be "adapted" to one another in order to form an overall package that is proportional to aggregate consumption.

One interesting characteristic of this first-best contract is that it does not require the manager to communicate with the principal after observing the realization of the productivity shock. The first-best contract remains valid even if one interprets the signal λ_t as specific knowledge in the sense of Fama and Jensen (1983) and Jensen and Meckling (1992). There are a number of reasons for such an interpretation to be desirable. As emphasized by Jensen and Meckling (1992), knowledge transfer may involve costly delays. In addition, a particular value of λ_t and its implications for future productivity are meant to summarize a set of soft (in the sense of Stein (2003)) and continuously evolving elements of information on which it would be impossible

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[7]We note that a choice of M sufficiently large will guarantee that the manager's welfare exceeds that of a representative shareholder. As a result agents would willingly become managers. By equations (7) and (21)-(22) each M translates into a corresponding φ.

or costly to base a compensation contract.

Theorem 2 has the following interesting corollary:

Theorem 3 (Equivalence Theorem). Suppose the manager is of measure $\mu = 0$. Then under the linear contract $g^m(d_t) = A_t + \varphi d_t$ with $A_t = \varphi w_t n_t$ the delegated management economy exhibits the same time series properties as, and is thus observationally equivalent to, the representative agent (real) business cycle model.[8]

The contribution of Theorem 3 is to extend the realm of application of the standard business cycle model. The measure zero assumption is made for convenience only to facilitate comparison with the standard representative agent model. With a positive measure of managers, it would be necessary to increase the productivity of factors to make up for their consumption in a way such that the consumption level of shareholder-workers, and consequently their labor supply decision, remain unchanged in equilibrium.

In the next two sections we confirm the essential intuition obtained here and extend the main result in two directions. First we deal with the case where managerial effort is a required input in the production process. In this case we show the essentials of the prior contract are preserved. Additional constraints, however, are placed on the share parameter φ leading to the necessary inclusion of an additional term in the remuneration package. We subsequently relax the assumption of a single firm and identify the first best contract in a world with multiple firms subject to idiosyncratic risk.

5   The optimal contract: unobservable effort

In this section we focus on the main formulation of our problem where the manager's effort is an essential element in the production process. Our main result is expressed in

Theorem 4. If A.1-A.4 are satisfied, then there exists a unique first best contract $g^m(x_t, \hat{s}_t)$ sufficient for the competitive equilibrium to deliver the first best allocation of resources. The optimal contract possesses the following distinguishing features:

(i) $g^m(x_t, \hat{s}_t) = \varphi \hat{d}_t + A_t$ where A_t does not depend on variables under the manager's control;

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[8]As such this paper offers an alternative decentralization scheme to those of Prescott and Mehra (1980) and Brock (1982). Shorish and Spear (2005) also propose an agency theoretic extension of the Lucas (1978) asset pricing model.

(ii) $\mu\varphi = 1$;

(iii)$A_t = \varphi w_t n_t + \xi(y_t - i_t), \xi \ll 0$.

Proof:

To prove our result we simply assume that the contract has the stated form and show that the equilibrium conditions of the decentralized economy then coincide with the optimality conditions of the planner's problem.

Problem (2) of the shareholder is unchanged. The corresponding FOC's continue to be (12) and (13).

Under the proposed contract conditions (and taking note that, with full information, the relevant aggregate state variables are, again, $s_t = (k_t, \lambda_t)$), the manager's problem has recursive representation:[9]

$$V^m(k_t, \lambda_t) = \max_{\{e_t, i_t, n_t\}} u\left(\varphi\hat{d}_t + A_t\right) - H(e_t)$$
$$+ \beta \int V^m((1-\Omega)k_t + i_t, \lambda_{t+1})dF(\cdot), \quad (23)$$

The necessary and sufficient first order conditions to problem (23) can be written[10]

$$u_1(c_t^m)\varphi[f_2(k_t, n_t, \mu e_t)\lambda_t - w_t] = 0, \quad (24)$$

$$-\varphi u_1(c_t^m) + \beta \int V_1^m(k_{t+1}, \lambda_{t+1})dF = 0, \text{ where} \quad (25)$$

$$V_1(k_t, \lambda_t) = \varphi u_1(c_t^m)[f_1(k_t, n_t, \mu e_t) + (1-\Omega)] \quad (26)$$

$$u_1(c_t^m)\mu\varphi f_3(k_t, n_t, \mu e_t)\lambda_t = H_1(e_t). \quad (27)$$

Market clearing conditions (17),(18) and (19) apply. Equations (25) and (26) together imply that condition (6) is satisfied. Similarly, equation (24)

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[9]It again follows from Blackwell's (1965) Theorem and the results in Benveniste and Scheinkman (1979) that a continous, bounded $V^m(\ )$ exists that solves (23) provided $u(\cdot)$ and $f(\cdot)$ are increasing, continuous and bounded, and that $g^m(\cdot)$ is itself continuous and that $dF(A', \lambda'; A, \lambda)$ is also continuous with the property that for any continuous $h(k', A', \lambda')$, $\int h(k', A', \lambda')dF(A', \lambda'; A, \lambda)$ is also continuous in k and λ. In order for (24) and (25) to characterize the unique solution, the differentiability of $u(\cdot)$, $g^m(\cdot)$ and $f(\cdot)$ is required and $u(g^m(\cdot))$ must be concave. The assumptions made in this and the preceding footnote are maintained throughout the paper.

[10]In the usual spirit of a one representative competitive firm the firm's manager does not take account of the impact of her effort on the A_t term of her remuneration.

together with (12) implies condition (5). Equation (27) reduces to (10) if and only if $\mu\varphi = 1$.

Finally, for condition (7) to hold given (9) , one must have

$$\varphi\hat{d}_t + A_t = \varphi(y_t - w_t n_t - i_t) + A_t = \Delta(y_t - i_t),$$

for some scalar Δ. That is,

$$A_t = (\Delta - \varphi)(y_t - i_t) + \varphi w_t n_t \equiv \xi(y_t - i_t) + \varphi w_t n_t,$$

with $\xi = \Delta - \varphi$.

That $\xi \ll 0$ follows from the fact that the condition $\mu\varphi = 1$ implies that the two first elements of the first best contract $\varphi\hat{d}_t + \varphi w_t n_t$ exhausts total output. There would be no value added remaining with which to compensate workers in the absence of the extra correction term.

In substance the main difference with the case of the previous section is as follows: in order to obtain the first best effort level, the share of free-cash-flow to be awarded to managers is not indeterminate but must be such as to elicit the right level of effort. Depending on the cost of effort and on the role of managers in production, it may well be - as is the case in our formulation - that the entire free-cash-flows must be awarded to them ($\mu\varphi = 1$). If it is the case, the general equilibrium condition uncovered in Section 4, which states that the salary component must be adapted to the incentive component of managers' remuneration, implies that managers should be entitled to the entire $\hat{d}_t$ *and* to the entire wage bill.

As is, we are led to the conclusion that the collective of managers should receive the entire value added which is of course not possible. But there is a way out. It consists in the portion of manager's remuneration which is exogenous to her own decisions being corrected by a term that is negative and proportional to $(y_t - i_t)$: $\xi \ll 0$. This is the essence of condition (iii).

In words, the first-best contract stipulates that the managers' remuneration should change one-to-one with variations in $\hat{d}_t$ (without limited liability) with a salary component engineered to make sure that the time series property of the manager's total remuneration is proportional to aggregate consumption.[11]

Note that we have maximized the possible moral hazard problem here. If either effort is partially observable or if there is a maximum possible level of effort, then it is conceivable that the share of free-cash-flows to be allocated

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[11]Introducing a participation constraint for the manager would lead to pinning down a single value for ξ and thus the level of manager's remuneration as well as its dynamic properties.

to managers will be significantly less than 1 and a contract close to the one derived in the previous section, with a component proportional to the wage bill but without the negative corrective term, may be feasible.

In Figure 1, we plot a representative sequence of A_t, $\varphi \hat{d}_t$ and total manager's compensation. As should be clear by now, the entire package is designed to generate a smooth consumption series for the manager, a series with the same intertemporal characteristics as the consumption series of the shareholder-worker. Here we have arbitrarily decided that the class of managers have exactly the same consumption level as the class of shareholder-workers. The incentive portion of management's remuneration is $\varphi \hat{d}_t$. It is significantly more variable than the consumption series. The difference between the two series is A_t which almost appears to move one for one in the opposite direction as the $\hat{d}_t$ series as must be the case if the sum of the two series is to acquire the smoothness of the consumption series. Note, however, that the two series are determined independently: in particular the A_t portion of the remuneration is part of the manager's contract whatever the performance of her own firm. It is nevertheless clear that there will be many instances where the manager will make up with the salary component of her remuneration the loss in her performance-based remuneration induced by poor firm performance. Yet, the fact that the salary part of the remuneration depends on the aggregate state of the economy means that were the manager to deviate from the optimal hiring and investment decisions, a policy that would lead on average to a deterioration of the results of her firm, her own remuneration would be affected and (on average) fall below the first-best performance-based remuneration depicted here.[12]

In general, the main message resulting from the general equilibrium dimension of our inquiry is that there must be a balance between the performance based and the non-performance based elements of the manager's remuneration. Given that the consumption series of the manager should be suitably smooth - because it must replicate the dynamic properties of the consumption of the representative shareholder - and that the measures of the firm performance are bound to be highly variable, it is necessarily the case that the salary component of the manager's remuneration will more often than not cushion the impact of the performance-based remuneration on the manager's overall compensation package.

---

[12]A short-lived manager could deviate and gain in the short run. Here we focus on permanent managerial contracts. In general, short term bias induced by short term contracts would have to be corrected by an average compensation package that would be rising over time.

Note that the most implausible aspect of the contract illustrated in Figure 1, that the salary component is always negative, is partly an artifact of our definition of the variables. Assume indeed that $\hat{d}_t$ takes values in an interval $[\hat{d}_{min}, \hat{d}_{max}]$, then the performance based component of the first-best contract could equally be defined as $\mu\varphi(\hat{d}_t - \hat{d}_{min})$ while the salary component would be $A_t + \hat{d}_{min}$ which, depending on circumstances, may always be positive. If $\hat{d}_{min} = 0$, on the other hand, then it is easy to show that A_t cannot always be negative.

In concluding this section it is worth stressing that the optimal contract must be understood as one where the incentive component depends on firm level performance as measured by free-cash-flow while the 'salary' component depends on the *aggregate* wage bill. In the next section we formalize this distinction in a more realistic economy with many firms each with a separate manager.

6 Many firms

We now extend our analysis to the case of a large number J of competitive firms. The management of each firm is of measure $\mu \neq 0$ and the total measure of the managerial class is μJ. Firm j is characterized by technology $f(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j$ on the basis of which it distributes

$$d_t^j = f(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j - n_t^j w_t - \mu g^j(d_t^j, s_t) - i_t^j = \hat{d}_t^j - \mu g^j(d_t^j, s_t).$$

Optimality conditions are straightforward generalizations of those obtained in Section 3, that is, $\forall t$ and $j = 1, .., J$,

$$u_1(c_t^s)f_2(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j = \hat{H}_1(n_t^s), \tag{28}$$

$$1 = \beta \int \frac{u_1(c_{t+1}^j)}{u_1(c_t^j)} \left[f_1(k_{t+1}^j, n_{t+1}^j, \mu e_{t+1}^j)\lambda_{t+1}^j + (1-\Omega) \right] d\hat{F}(\cdot,\cdot), \tag{29}$$

$$(1-M)u_1(c_t^s) = Mu_1(c_t^j), \tag{30}$$

$$u_1(c_t^j)f_3(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j = H_1(e_t). \tag{31}$$

Our main result is

Theorem 5. If A.1-A.4 are satisfied, then there exists a first best contract $g^j(x_t, \hat{s}_t), \forall j$, sufficient for the competitive equilibrium to deliver the first best allocation of resources. The optimal contract possesses the following distinguishing features:

(i) $g^j(x_t, \hat{s}_t) = \varphi \hat{d}_t^j + A_t^j$, where A_t^j does not depend on variables under the manager's control;

(ii) $\mu\varphi = 1,$;

(iii) $A_t^j = \varphi w_t n_t + \varphi d_t^{\tilde{j}} + \xi(y_t - i_t), \xi \ll 0$, for $d_t^{\tilde{j}} \equiv \sum_{i \neq j} d_t^i$.

(iv) $c_t^j = c_t^m$, i.e., as a result of the above, all managers have the same consumption stream as required by equation (30).

Proof: As before we postulate the form of the optimal contract and show that indeed this contract implements the first-best allocation. Under the postulated contract the representative manager j solves

$$V^j(k_0^j, \lambda_0^j, A_0^j; w_t) = \max_{\{c_t^j, e_t^j, n_t^j, i_t^j\}} E \sum_{t=0}^{\infty} \beta^t [u(c_t^j) - H(e_t^j)] \qquad (32)$$

$$\text{s.t.}$$
$$c_t^j = g^j(d_t^j, s_t) = \varphi \hat{d}_t^j + A_t^j$$
$$d_t^j = f(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j - n_t^j w_t - \mu g^j(d_t^j, s_t) - i_t^j$$
$$k_{t+1}^j = (1 - \Omega)k_t^j + i_t^j; k_0^j \text{ given.}$$
$$c_t^j, d_t^j, i_t^j, n_t^j, e_t^j \geq 0$$
$$(s_{t+1}, \lambda_{t+1}^j) \sim dF(s_{t+1}, \lambda_{t+1}^j; s_t^j, \lambda_t^j) \qquad (33)$$

Worker-shareholders are perfectly diversified. They collectively hold the market and are thus entitled to the aggregate dividend that we continue to identify as d_t. They consume the unique consumption good and equally share their working time n_t^s across all firms. Under these assumptions, problem (2) still perfectly represents the problem of the representative worker-shareholder. In particular condition (12) still holds.

The market clearing conditions are (18) and

$$\sum_{j=1}^{J} n_t^j = n_t^s$$

$$\sum_{j=1}^{J} i_t^j = i_t$$

$$\sum_{j=1}^{J} f(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j = y_t = c_t^s + \mu \sum_{j=1}^{J} c_t^j + i_t \qquad (34)$$

Problem (33) yields the following conditions applying to all firms $j = 1, .., J$:

$$w_t = f_2(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j \qquad (35)$$

which, in conjunction with(12), results in

$$\hat{H}_1(n_t^s) = u_1(c_t^s)f_2(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j.$$

This is the optimality condition (28). Optimal investment is determined by

$$1 = \beta \int \frac{u_1(c_{t+1}^j)}{u_1(c_t^j)} \left[f_1(k_{t+1}^j, n_{t+1}^j, \mu e_{t+1}^j)\lambda_{t+1}^j + (1 - \Omega) \right] dF^j(.), \qquad (36)$$

which is nothing but optimality condition (29).

The level of effort is given by the condition

$$u_1(c_t^j)f_3(k_t^j, n_t^j, \mu e_t^j)\lambda_t^j \mu \varphi = H_1(e_t^j), \qquad (37)$$

from which one sees that

$$\mu \varphi = 1$$

is required to obtain the first best condition (31)[13].

Finally, we have to show that the Pareto Optimal risk sharing condition (30) is satisfied in equilibrium. To that end, let us first observe that the consumption of shareholders is proportional to $(y_t - i_t)$. From the definition of the managers' contract, we have

$$c_t^j = \varphi \left[\hat{d}_t^j + w_t n_t + d_t^{\tilde{j}} \right] + \xi(y_t - i_t) \qquad (38)$$

$$= \varphi \left[d_t + w_t n_t \right] + \mu \varphi c_t^j + \xi(y_t - i_t) \qquad (39)$$

$$0 = \varphi c_t^s + \xi(y_t - i_t), \qquad (40)$$

---

[13]This result implies that it would not be possible for managers to receive a firm-specific share of their firm's free-cash-flow

from which one obtains

$$c_t^s = -\frac{\xi}{\varphi}(y_t - i_t) = -\mu\xi(y_t - i_t).$$

Our second step is to note that the goods market clearing condition (34) implies that if the consumption of the shareholders is proportional to $(y_t - i_t)$, then the total consumption of management is as well:

$$
\begin{aligned}
\mu\sum_{j=1}^{J} c_t^j &= y_t - i_t - c_t^s \\
&= (1 - \mu\xi)(y_t - i_t).
\end{aligned}
$$

The last step consists of observing all managers' consumption levels are identical. This directly follows from

$$
\begin{aligned}
c_t^j &= \varphi\left[\hat{d}_t^j + w_t n_t + d_t^{\tilde{j}}\right] + \xi(y_t - i_t) \\
&= \varphi\left[d_t + w_t n_t\right] + \mu\varphi c_t^j + \xi(y_t - i_t) \\
&= \varphi[y_t - i_t - \mu\sum_{j=1}^{J} c_t^j + \mu c_t^j] + \xi(y_t - i_t) \\
&= (\varphi + \xi)(y_t - i_t) - \mu\sum_{i \neq j}^{J} c_t^i, \quad j = 1, .., J
\end{aligned}
\tag{41}
$$

Taking any arbitrary pair of equations in (41), say the *kth* and *lth* such equations and substract one from the other, one obtains

$$c_t^k(1 - \mu) + (\mu - 1)c_t^l = 0,$$

from which it is clear that $c_t^k = c_t^l$ and, as a consequence,

$$c_t^m = c_t^j = \frac{1}{1 + \mu J}(\varphi + \xi)(y_t - i_t), \text{ for } j = 1, 2, .., J.$$

This section confirms the message of the previous two sections: aligning the interests of principal and agent in general equilibrium requires going beyond the typical conditions identified in partial equilibrium. Making sure that the managers do perceive the firm-internal trade-offs in the same way as firm owners is only the first step. Aligning the discount factors of the two agent types is the second.

Here the exact same logic as before requires not only giving the manager a share of the aggregate wage bill but also a share of the aggregate stock market.

Furthermore, the manager's compensation must be as sensitive to the aggregate wage bill *and* to the aggregate dividend payment made by other firms (or, by approximation, to the economy's total GDP net of aggregate investment) as it is to the measure of performance of the firm she manages. Equivalently the optimal contract stipulates that *a manager's (direct or indirect) exposure to the equity value of the firm she manages should not exceed her exposure to the world market portfolio.* This prescription is very intuitive in the context of our model economy.

The presence of an effort dimension further results in the condition that the collective of managers must be exposed, at the margin, to the full increase in dividends resulting from their effort. These requirements together imply that they should be attributed the entire world GDP! Hence, the necessity of a (negative) corrective term, which must be designed to preserve the fractional proportionality of the managers' consumption to aggregate consumption, arises.

One of the important lessons of our exercise is that being careful to align the stochastic discount factor necessarily means not tying up the manager's remuneration exclusively to the performance of her own firm. On the contrary, the overall package must have dynamic properties comparable to those of aggregate consumption. This necessarily means that if the economy is doing well while an individual firm is doing badly, the manager of this particular firm may in fact see an increase in her overall compensation. It is not necessarily an abuse of the system if a well-compensated manager sees her overall compensation package increase even when her own firm is faltering.

Two final observations are in order. First, our contract specifies the same contract parameters, φ and ξ, for all firms. This is unlikely to be the case in reality. First, the implicit coordination necessary for firms to offer identical compensation contracts would constitute employment collusion and likely be illegal. A second, more relevant, reason is that across-firm differences in monitoring regimes or in the severity of firm-specific incentive problems may make the condition $\varphi\mu = 1$ unnecessary from the perspective of aligning the micro incentives of the manager with those of the shareholder- worker. In the same vein, if stock holding is not uniform across the population (limited stock market participation), the two elements of the manager's remuneration should not be weighted as per the aggregate NIPA income shares, but rather tailored to the distribution of wage income relative to

capital income effective for the firm's average shareholder (which may differ from firm to firm). Finally, one frequently observes firms offering contracts that are not linear but convex. In Danthine and Donaldson (2007), we show that the incentives provided by convex contracts may, in some circumstances, well approximate the incentives provided by linear ones and make up for sub-optimal characteristics of the salary element of a manager's compensation package.

A second issue is the following: does the absence of full information on the private wealth of the manager and on her market actions (including savings) detract from our message? This is a difficult question that has eluded the literature. We note the existence of two conflicting views. Some authors argue that the fact that managers are privately wealthy implies that they should be almost risk neutral at the margin. Although shareholders are supposed to be well diversified, they are not, however, risk neutral. Therefore if managers behave as if they are, they are not taking the decisions shareholders would want them to take. At the opposite extreme, the quiet life hypothesis argues that, compared to shareholders, managers are excessively invested in their own firm and thus insufficiently diversified. This, it is argued, suggests that they are likely to be excessively prudent, a fact that may justify convex performance based contracts. Our interpretation is that these two incompatible views reflect the fact that the principal-agent literature is ill-at-ease with the main lesson from asset pricing: the stochastic discount factor matters. In this paper we confront this difficult issue head on. The fact that managers may take private actions should not lead us to conclude that the stochastic discount factors of shareholders and managers will automatically be aligned. And the purported size of managers' income and wealth cannot mean that monetary incentives do not matter (or else the whole incentive debate is misguided!). If they do, it must be that even if managers' consumption is not tightly constrained by their compensation package, the latter indicates to them how the principals want them to view the world and in which light they should make the firm relevant decisions.

7   Related literature

Our emphasis has been to consider the implication of delegated management directly within the standard neoclassical paradigm. Under the optimal contract, the dynamics of the delegated management economy reproduce the stylized facts of the business cycle. Aside from the basic informational asymmetry, the structure of the economy is entirely conventional. By way of

contrast, one particular hypothesis prevalent in the corporate finance literature asserts that managers are 'empire builders' (Jensen (1986)) who tend to over-invest and over-hire rather than return cash to the shareholders. A small number of studies have sought to explore the implications of this hypothesis within the dynamic equilibrium paradigm. In Philippon (2006), managers have an inherent preference for size (firms with capital stock and labor resources exceeding their profit maximizing levels). Shareholders are more willing to tolerate such excesses in good times, a fact that tends to amplify the effects of aggregate shocks. In Dow et al. (2005), managers also prefer to maximize firm size. Their propensity to invest all available firm resources is held in check by the arrival, in the subsequent period, of costly auditors with the power to sequester excessive output. Albuquerque and Wang (2007) hypothesize a group of controlling shareholders (effectively acting as managers) who pursue private benefits by diverting resources from the firm. Such diversions are held in check by investor protections which vary across countries in their strength and effectiveness. Consistent with empirical regularities, their model demonstrates that countries with weaker investor protections should display overinvestment, larger risk premia etc. As made clear, we eschew these empire building or corrupt manager class of models, and postulate only that managerial preferences are defined over their own private consumption streams in a manner consistent with standard axiomatic foundations.

A much larger literature has been concerned with optimal contracting between investors and firm managers in the context of static one period partial equilibrium models. Analyzing as it does a wide range of principal-agent relationships, this literature is too large to be summarized here. In effect it has been concentrating on the performance-based element of a manager's remuneration and as such is somewhat orthogonal to the issue we have sought to confront. See Bolton and Dewatripont (2005) for a masterful review of this literature.

Another large and important literature focuses on the use of debt contracts and other mechanisms to align incentives between entrepreneurs and investors (e.g., Diamond (1984), and Gale and Hellwig (1985)). Related work places this discussion within the context of the choice of a firm's capital structure. Harris and Raviv (1990) explore the idea that debt in a firm's capital structure allows investors to discipline managers and provides information, especially in the context of bankruptcy, for doing so. Stulz (1990) focuses on financing policies as a device for discouraging managerial overinvestment; Aghion and Bolton (1992) and Zender (1991) emphasize bankruptcy as a mechanism to transfer control from shareholders to cred-

itors. Here again the dominant context is one period partial equilibrium so that the general equilibrium intertemporal considerations that form the heart of our discussion cannot be addressed.

A final segment of literature attempts to rationalize the growing magnitude of executive compensation in particular as a multiple of worker compensations. Explanations run the gamet from rent extraction facilitated by enhanced managerial entrenchment (e.g., Bertrand and Mullainathan (2003)) to the demand for top talent which is better able to manage a larger resource base (Gabaix and Landier (2006); see this same reference for an excellent survey of the literature). Our decision to ignore the participation constraint of the manager constrains us from commenting on these issues.

8   Conclusions

In this paper we have studied the dynamic general equilibrium of an economy where risk averse shareholders delegate the management of the firm to risk averse managers. Our economy has both asymmetric information - the manager is better informed than shareholders - and moral hazard - the non-observable effort of the manager is an indispensable input in production. We have derived the properties of the manager's optimal contract. This contract attains the first best and it results in an observational equivalence between the delegated management economy and the standard representative agent business cycle model.

The optimal contract has two main components: an incentive component that is proportional to free-cash-flow and is akin to a non-tradable equity position in the firm. And a variable 'salary' component that is indexed to the aggregate wage bill and to aggregate dividends and may need to be corrected by a negative term proportional to aggregate consumption.

In our general equilibrium context it is thus not sufficient to resolve the 'micro' level agency issues raised by delegation. Giving a share of dividends to self-interested managers with private information is an important requirement. Depending on the nature of the moral hazard and of the information problem, the share of free cash flows allocated to managers indeed may be very high. Yet, a simple minded application of this principle leads to endowing the manager with the wrong incentives. Because of the income position she thus inherits, the manager will view the risks facing the firm through a lens - her own stochastic factor - that will possibly be widely at variance with the lens firm owners would like her to use. Aligning the stochastic discount factor is an essential component of the incentive problem.

This second objective delineates the properties of the state dependent salary component. In our economy with a representative shareholder-worker, it is a linear function of the aggregate wage bill, the aggregate dividend and aggregate consumption.

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Figure 1: Manager's consumption and its components
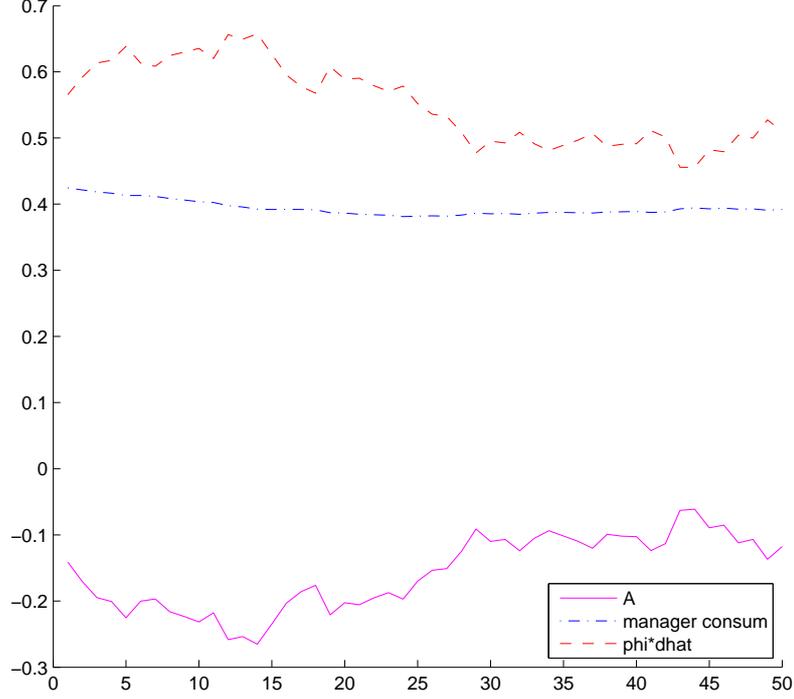
Note: Manager's consumption is depicted as the smooth middle-curve; it is the sum of $\varphi \hat{d}_t$ with $\varphi = 5$, which is the top line in the graph and A_t. The latter is negative for the case here depicted. The functional forms and parameter values underlying this case are as follows: $u(c) = \frac{c^{1-\eta}}{1-\eta}, H(e_t) = ze_t^{\gamma}, \hat{H}(n_t) = -Bn_t$, $f(k_t, n_t, \mu e_t)\lambda_t = k_t^{1-\alpha-\kappa}n_t^{\alpha}(\mu e_t)^{\kappa}\lambda_t$, $\alpha = .64, \beta = .99$, $B = 2.85$, $\Omega = .025$, $\eta = 1$, $\mu = .2$, $\kappa = .1$, $\gamma = 1.75$, $z = .67$, $\lambda_t = \rho\lambda_{t-1} + \tilde{\epsilon}_t, \epsilon_t \sim N(0, \sigma_t^2)$ with $\rho = .95$ and $\sigma_{\varepsilon}^2 = .00712$.