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## Optimally Designing Purpose and Meaning at Work

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# Optimally designing purpose and meaning at work\*

Antonio Cabrales<sup>†</sup>, Esther Hauk<sup>‡</sup>

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## Abstract

Many workers value purpose and meaning in their jobs alongside income, and firms need to align these preferences with profit goals. This paper develops a dynamic model in which firms invest in "purpose" to enhance job meaning and motivate effort. Workers, who differ in productivity, choose both productive and socialization effort, gaining utility from income and meaning. Purpose accumulates over time through firm investment and interacts with socialization to generate meaning, which boosts productivity. Firms invest in purpose only insofar as it raises profits. We characterize the unique equilibrium, including steady state and transition dynamics. Meaning and purpose rise with the importance workers place on meaning and with firm's patience, but fall with depreciation and socialization costs. The relationship with workers' share of output is non-monotonic. We also show that some intermediate level of heterogeneity in skills is best for performance. Compared to a worker-owned firm, profit-maximizing firms underinvest in purpose, highlighting a misalignment between firm incentives and worker preferences. The model provides insight into when and why firms adopt purpose-driven practices and underscores the role of diversity in fostering meaning at work.

**JEL Classification:** M50, M52, L23.

**Keywords:** Meaning at work, personnel motivation, diversity in work, investment in purpose.

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# 1 Introduction

There is a large body of evidence suggesting that individuals seek more from their jobs than financial compensation alone. Most workers aspire to roles that also offer a sense of purpose and meaning. As Blount and Leinwand (2019) argue, “Over the past decade, “purpose” has become a management watchword. Since 2010 it has appeared in the titles of more than 400 new business and leadership books and thousands of articles.” Despite this increased attention, aligning the search for purpose with a profit-making objective remains challenging. The same authors observe that a global survey of over 540 employees conducted by Strategy& found that only 28% felt fully connected to their company’s stated purpose. This disconnect highlights the difficulty firms face in incorporating meaning into the workplace in a way that aligns with profitability.

Firms have experimented with various strategies to bridge this gap. Some allow employees to allocate part of their time to self-directed projects that foster ownership and creativity, while others encourage engagement in community or charitable work during paid hours. In those activities, employees often collaborate with others in the company. Companies like Microsoft, Google, Salesforce, and Timberland offer structured programs in this spirit, sometimes matching employees’ time donations with monetary contributions and promoting team-based participation. Empirical evidence suggests that these efforts are not merely symbolic: they are associated with gains in productivity and profitability (Veleva et al. 2012; Boštjančič et al. 2018; Knox 2020).

This paper develops a formal model to understand how firms make optimal decisions about investing in purpose, taking into account that workers value meaning and adjust their effort accordingly. The model is inspired by the frameworks of Cabrales, Calvó-Armengol and Zenou (2011) and Albornoz, Cabrales and Hauk (2019), and introduces two forms of worker effort: productive effort and socialization effort. Both are costly, but both contribute to firm output. In addition, firms can make costly investments in “purpose,” which accumulates over time to generate an increased stock of job “meaning” and interacts with workers’ socialization efforts. Meaning, in turn, enhances worker utility and productivity, further incentivizing effort. That is, we call purpose the flow that converts into meaning, which is the stock that enhances utility and productivity.

We consider a setting where firms are infinitely lived and workers live for one period. Firms and workers make optimal decisions simultaneously within each period. Workers receive a share of output, derive utility from both income and job meaning, and bear the costs of effort. Firms maximize profits, defined as output net of worker compensation

and investment in purpose. Although firms do not value meaning per se, they invest in it when it contributes to increased productivity and, consequently, profitability. Worker productivity is heterogeneous, follows a continuous distribution, and is complementary with both effort and meaning.

We fully characterize the unique equilibrium of the model, including the steady state and the transition dynamics. Comparative statics reveal several key insights. In steady state, both job meaning and firm investment in purpose increase with the importance workers place on meaning in their utility function and with the firm's discount factor, and decline with the depreciation rate of meaning. Remember that meaning is the stock that enhances value, and it increases by investing in purpose. Hence the importance of the discount factor and the depreciation rate, in both the investment in purpose (the flow) and the final accumulated value (the meaning). It is also not surprising that when workers value meaning more, both the stock and the flow increase. These variables also decrease with the marginal cost to firms of providing purpose and with the cost of socialization effort to workers, but are unaffected by the marginal cost of productive effort. To understand this, notice that meaning is complementary to socialization effort but not to productive effort. The relationship of meaning and purpose with the worker's share of output is non-monotonic: both meaning and purpose rise with the share, provided that the overall weight of income and meaning in worker utility does not exceed a critical threshold. The reason for this is that an increase in worker's share increases the socialization effort directly, and through that, profitability. However, when the worker's share becomes too large, firm profits decline significantly, reducing investment in purpose. This, in turn, lowers socialization efforts and diminishes meaning.

To characterize the comparative statics of the ability variable, we consider the effects of a first order and second order stochastic dominant shift in the distribution of that variable. While a first order stochastic dominance shift always increases purpose and meaning, the effects of a second order stochastic dominance shift are nuanced. We show that increasing dispersion increases meaning, purpose, individual utility, and firm profits when the initial distribution is not too dispersed, but decreases them when the initial distribution is highly dispersed. We can conclude that some intermediate level of heterogeneity in skills seems to be best for performance. These results highlight the importance of diversity in ability for fostering purpose in the workplace. Notice that the diversity in our model is such that, everything else equal, some workers are more productive than others. In a sense, we are talking about vertical differentiation. Due to the interaction between output and the talent distribution in our model, these

effects can be complex.

The model also yields implications for firm profits and worker welfare when other parameters change. Profits and worker welfare increase with the value workers place on meaning and the firm's discount factor, and decrease with the depreciation rate of meaning, the firm's cost of providing purpose, and workers' effort costs. To understand this, notice that the utility of the worker and firm profits are increasing in the equilibrium level of purpose, meaning, and the firm production, which depend on production and socialization efforts. So these comparative statics are derived from those relating to investment in purpose, meaning, and the socialization efforts, discussed above.

The effect of the worker's output share on profits and worker welfare is ambiguous, but they increase with the share provided the combined weight on income and meaning in utility remains moderate (although this threshold combined weight would be different for profits and worker utility). This condition ensures that even a fully profit-maximizing firm would choose to allocate a positive share of output to workers. These results are related to the fact that the worker share increases socialization effort directly, incentivizing investments in purpose and through it increasing the stock of meaning. But when the worker share is too high, there is a reduction in profits reducing investment, which also hurts the worker utility.

Finally, we compare the benchmark case of profit-maximizing firms with a fully worker-owned firm. While the former does invest in purpose to induce effort, we find that workers would prefer a higher level of investment in meaning. This gap reflects a fundamental divergence between firm incentives and worker preferences in the provision of purpose, and suggests that ownership structure may play a significant role in shaping the extent to which firms cultivate meaningful work environments.

The rest of the paper is structured as follows: the next Section discusses the related literature. Section 3 presents and solves the model. In Sections 4 and 5 we perform the comparative static analysis. Section 6 analyzes the path to steady state. In Section 7 we solve for the worker-owned firm. Section 8 concludes and discusses future research.

## 2 Literature

This paper contributes to a growing literature on the role of purpose and meaning in the workplace, particularly in relation to worker motivation and firm performance. Much of the economic theory literature has focused on how organizations sort or match individuals with different intrinsic motivations to firm missions. For example, Besley and Ghatak (2005) develop a model of moral hazard in which both principals and

agents have mission preferences, and organizational alignment reduces agency frictions. Delfgaauw and Dur (2007) similarly consider a model with unobservable worker types, where contracts are used to screen for intrinsic motivation. Delfgaauw and Dur (2008) extend this framework to account for differences between public and private sector employment. In Cassar and Armouti-Hansen (2020) firms use meaning strategically to attract and motivate the "right" types of workers.

Our approach departs from this class of models in two important ways. First, we do not focus on sorting or matching between heterogeneous worker and firm types. Instead, we assume all workers value meaning and ask how profit-maximizing firms optimally choose investments in purpose. Second, the existing models are static and treat meaning as a purely individual trait or alignment. In contrast, we model meaning as a dynamic, accumulable construct that interacts with worker behavior—specifically socialization effort—to affect productivity. This focus on the endogenous creation of purpose within firms is aligned with insights from the management literature, but has received less attention in economic theory.

Cassar and Meier (2018) offer a theoretical framework in which work meaning enters utility additively alongside consumption and effort costs, and decompose meaning into four components: mission, autonomy, competence, and relatedness. Our model builds on this work by focusing on one empirically salient component—relatedness—which appears to be the dominant channel through which meaning affects outcomes. We provide a more structural account of how relatedness arises through social interaction, how it affects productivity, and how firms can influence it through investment in purpose. Our model thus complements and extends Cassar and Meier’s (2018) framework by offering a dynamic, micro-founded treatment of one key dimension of meaning.

Several recent applications build on Cassar and Meier’s (2018) framework. For instance, Armouti-Hansen et al. (2024) test the model experimentally, and Kesternich et al. (2021) extend it to incorporate fairness concerns and work norms. Nikolova and Cnossen (2020) suggest integrating insights from self-determination theory into this framework, and Cnossen and Nikolova (2024) develop such a model formally. We share with these papers an emphasis on non-monetary drivers of worker behavior but differ in our focus on firm-side dynamics and the strategic provision of meaning over time.

Cassar and Meier (2018) also compile an extensive set of stylized facts from the empirical literature, which inform the assumptions and mechanisms in our model. Nikolova and Cnossen (2020), using data from three waves of the European Working Conditions Survey, show that autonomy, competence, and relatedness explain around 60% of the variation in perceived work meaningfulness. They also construct an index

of meaningful work based on these dimensions. Our model is consistent with these empirical patterns and gives theoretical substance to the role of relatedness in particular.

Recent empirical work also supports the idea that increasing perceived meaning enhances performance. Ashraf et al. (2025) conduct a large-scale randomized controlled trial (RCT) in a multinational firm, where a treatment group is exposed to an intervention designed to help workers perceive the meaning of their work. The result is a significant increase in performance (in relative or within-group terms rather than absolute differences), due both to improved productivity among low performers and the voluntary exit of the least motivated employees. These effects are consistent with our model: we predict higher effort when meaning is more salient and, if a participation margin were added, our model would likely predict the departure of low-motivation workers, leading to higher average productivity.

The human resource management literature has long emphasized the importance of meaning at work, both for individual well-being and organizational performance. Steger (2016) provides a comprehensive overview of this literature and emphasizes that meaning is not merely a sorting mechanism but something that can be cultivated within organizations. This insight is central to our approach: unlike much of the economics literature, we model purpose as a strategic variable under firm control, shaped by investment and by organizational structure.

A growing empirical literature explores the relationship between firm-level purpose and performance. Gartenberg et al. (2019), using a dataset of nearly half a million workers, show that firms with a clearly articulated and widely shared sense of purpose outperform others in terms of stock market valuation, controlling for current fundamentals. Similarly, Gartenberg (2023), using a larger sample, finds that firms with high levels of intangible capital, innovation, and long-term investors are more likely to pursue purpose alongside profits. These firms do not treat purpose and profit as competing goals, but rather as complementary. Our model is consistent with these findings: we posit long-lived, profit-maximizing firms that invest in purpose because it increases productivity and ultimately improves long-run returns.

Finally, George et al. (2023) and Jasinenko and Steuber (2023) address concerns about the vague and often inconsistent definitions of purpose and meaning in the management literature. They propose validated constructs for empirical measurement. Our theoretical framework complements this effort by offering a precise and operational definition of purpose, focused on social interaction and its productivity-enhancing effects. We emphasize the relatedness dimension of meaning, in line with empirical evidence, and show how it interacts with firm behavior and output in a dynamic setting.

### 3 The model

We study how long-lived, profit-maximizing firms choose the optimal level of purpose in an environment where creating purpose entails costs but enhances worker motivation and, consequently, output. In our framework, purpose is not pursued for its own sake but as a strategic investment that complements traditional incentive mechanisms. The model reflects growing empirical evidence that purpose and profitability are not inherently at odds. Gartenberg et al. (2019) show that a stronger sense of purpose is associated with superior financial performance, while Gartenberg (2023) finds that this relationship is particularly pronounced in firms with long-term owners—precisely the type of firms our model is designed to capture. In line with these findings, we formalize how investment decisions on purpose can arise endogenously as part of a firm’s optimal profit-maximizing strategy.

The agents in our model are a firm and its workers. The firm maximizes its long-run profit by choosing how much to invest in its mission/purpose  $r_t$  each period  $t$ . The cost of providing purpose is given by

$$C(r_t) = \frac{C}{2}r_t^2.$$

The variable  $r_t$  is chosen by the firm at the beginning of the period and is observed by the workers at the time they make their choices.

Workers only live one period and each worker  $i$  maximizes their utility choosing how much work effort  $e_{i,t}$  to put into their tasks and how much socialization effort  $k_{i,t}$  they put into interacting with their co-workers. Both types of effort are costly and the cost functions are given by

$$c_{i,t}^e = \frac{A_e}{2}e_{i,t}^2 \text{ and } c_{i,t}^k = \frac{A_k}{2}k_{i,t}^2$$

where  $A_e$  and  $A_k$  are positive constants.

Work effort generates a productive return. In production, the socialization input  $s_{i,t}$  stems from socialization efforts and is defined as:

$$s_{i,t} = k_{i,t}^{1/2} \int k_{j,t}^{1/2} d_j \tag{1}$$

This input boosts productivity by strengthening the sense of meaning at work. Its specific functional form can be microfounded as in Albornoz et al. (2019), by assuming symmetry, anonymity and constant returns in socialization. The degree to which

socialization fosters meaning depends on the firm’s chosen level of purpose  $r_t$ . Such investment may involve initiatives like granting employees time to pursue personal projects or engage in volunteer activities. As documented by e.g. Veleva et al. (2012), Boštjančič et al. (2018), Knox (2020), this possibility has a positive impact on both productivity and motivation.

The purpose variable  $r_t$  is the flow of resources that forms the basis of the total job meaning of worker  $i$  in period  $t$ ,  $m_{i,t}$  which we assume is given by<sup>1</sup>

$$m_{i,t} = s_{i,t}r_t^{\frac{1}{2}} + \lambda\bar{m}_{t-1},$$

which can be rewritten using (1) as

$$m_{i,t} = k_{i,t}^{1/2} \int k_{j,t}^{1/2} d_j r_t^{\frac{1}{2}} + \lambda\bar{m}_{t-1} \quad (2)$$

Note that that meaning in period  $t$  for individual  $i$ , is influenced by average meaning in the group, from the previous period  $\bar{m}_{t-1}$

$$\bar{m}_{t-1} = \int m_{j,t-1} d_j$$

with a persistency factor  $\lambda$ . A higher  $\lambda$  implies that meaning decays (depreciates) more slowly from one period to the next. The concept of decay may be interpreted through the lens of employee turnover. The persistence of organizational culture is fundamentally contingent upon the tenure of employees, as sustained presence is required for cultural investments to become internalized within individual dispositions and operational practices. Firms characterized by high turnover and short tenure are therefore likely to exhibit a greater rate of cultural decay.

A central feature of our model is that job meaning arises through socialization efforts, rather than through directly productive efforts. This distinction is grounded in the human resources literature, which consistently emphasizes the social and relational dimensions of meaningful work. As Steger (2016) notes, individuals experience greater meaning when they transcend self-oriented concerns and engage with others in prosocial ways (see also Dik, Duffy, & Steger, 2012; Reker, Peacock, & Wong, 1987; Schnell, 2009; Steger, Kashdan, & Oishi, 2008). In his framework, the highest level of meaningful

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<sup>1</sup> $r_t$  has decreasing returns in meaning. This is probably realistic, but also technically important. Since  $k_{i,t}$  will be influenced by  $r_t$ , the overall influence of  $r_t$  on output exhibits weaker diminishing returns. If these returns were substantially higher, they would undermine the concavity of the dynamic programming problem.

work is associated with contributions to others or to the greater good. Furthermore, Steger (2016) emphasizes that, at the interpersonal level, meaningful work is fostered by respectful relationships, understanding of the organizational social context, and opportunities for mutual support, such as helping, mentoring, or being mentored. Our modeling choice reflects these insights by linking meaning to social interaction within the firm, rather than to the execution of individual productive tasks.

Meaning also exerts an independent influence on worker utility, as employees tend to derive greater satisfaction from tasks they perceive as meaningful. This reflects that the value of such work extends beyond its immediate output, encompassing broader personal and social impacts. A growing body of empirical research supports the relevance of this modeling choice. For example, Grueso et al. (2022), in their study of a supported employment program in Colombia, find a strong positive correlation between perceived meaningfulness of work and overall life satisfaction. Similarly, Allan et al. (2018) report that meaningful work is associated with lower levels of depression, particularly when accompanied by job satisfaction. Additional evidence indicates that meaningful work contributes to reduced stress and anxiety. Wandycz-Mejías et al. (2025) further show that employees who perceive their work as meaningful are less likely to express intentions to leave their organization and more likely to report high levels of job satisfaction. As Steger (2016) aptly notes: “If the primary incentive a company is offering to a worker to work hard and stay with the company is monetary, then what is to prevent the worker from taking a better deal elsewhere?” This body of evidence underscores the importance of intrinsic motivation—particularly through meaningful work—in shaping employee behavior and retention, thereby justifying its inclusion in the worker’s utility function.

Denoting the output of the worker  $i$  by  $z_{i,t}(m_{i,t}, e_{i,t})$ , and the worker  $i$ ’s ability by  $b_{i,t}$  (which are distributed according to some distribution function), the utility of the worker  $i$  in period  $t$  can be written as:

$$u_{i,t}(e_{i,t}, k_{i,t}) = \beta b_{i,t} m_{i,t} + \alpha z_{i,t}(m_{i,t}, e_{i,t}) - \frac{A_e}{2} e_{i,t}^2 - \frac{A_k}{2} k_{i,t}^2 \quad (3)$$

where the term  $\beta b_{i,t} m_{i,t}$ , with  $\beta > 0$ , captures the intrinsic utility that a worker derives from job meaning, independent of material compensation. The parameter  $\alpha$  denotes the share of output that the worker is entitled to retain, thereby determining the worker’s compensation. This share reflects the worker’s bargaining power within the framework of Nash bargaining, which governs the negotiation process between firms and workers, after output has been produced. The costs of  $r_t$  and efforts,  $c_{i,t}^e$  and  $c_{i,t}^k$

are not included in the negotiation as they are not contractible.

From now on we suppress the integration variable for ease of notation.

Output produced by worker  $i$  in period  $t$  is

$$\begin{aligned} z_{i,t}(m_{i,t}, e_{i,t}) &= b_{i,t}(e_{i,t} + m_{i,t}) \\ &= b_{i,t}\left(e_{i,t} + k_{i,t}^{1/2} \int k_{j,t}^{1/2} r_t^{1/2} + \lambda \bar{m}_{t-1}\right) \end{aligned} \quad (4)$$

Notice that effort and meaning are perfect substitutes in this setup and are complements to ability  $b_{i,t}$ .

Thus, every period starts with the realized average meaning from last period,  $\bar{m}_{t-1}$ . Then, the firm chooses purpose  $r_t$  for the period. After that, the workers choose  $e_{i,t}$  and  $k_{i,t}$ . Then output  $z_{i,t}$  and payoffs realize, and  $\bar{m}_t$  is generated.

### 3.1 The decision of worker $i$

Introducing (2), (1) and (4) into (3), the worker optimization problem is to choose  $e_{i,t}$  and  $k_{i,t}$  to maximize

$$u_{i,t}(e_{i,t}, k_{i,t}) = (\alpha + \beta) b_{i,t} \left( \left( k_{i,t}^{1/2} \int k_{j,t}^{1/2} \right) r_t^{1/2} + \lambda \bar{m}_{t-1} \right) + \alpha b_{i,t} e_{i,t} - \frac{A_e}{2} e_{i,t}^2 - \frac{A_k}{2} k_{i,t}^2 \quad (5)$$

The resulting first order conditions are:

$$\alpha b_{i,t} - A_e e_{i,t} = 0 \text{ for } e_{i,t} \quad (6)$$

$$\frac{1}{2} (\alpha + \beta) b_{i,t} \left( r_t^{1/2} \left( k_{i,t}^{-1/2} \int k_{j,t}^{1/2} \right) \right) - A_k k_{i,t} = 0 \text{ for } k_{i,t}. \quad (7)$$

**Lemma 1** *Each worker  $i$ 's choice problem has a unique (interior) solution. In particular*

$$e_{i,t} = b_{i,t} e_t \text{ where } e_t = \frac{\alpha}{A_e} \quad (8)$$

$$k_{i,t} = b_{i,t}^{2/3} k_t \text{ where } k_t = \frac{\alpha + \beta}{2A_k} r_t^{1/2} \left( \int b_j^{1/3} \right) \quad (9)$$

where  $e_t$  and  $k_t$  are identical to all workers of the firm.

**Proof.** See the Appendix. ■

**Empirical Implication 1** *Socialization effort is complementary to the firm's investment in purpose, i.e., when purpose increases, so does socialization effort.*

This is important to understand why factors that lead to an increase of investment in purpose will also increase socialization effort and vice versa.

Allan et al. (2019) show in a meta-analysis of 44 papers that meaningful work correlates positively with outcomes like organizational citizenship behavior (OCBs) (i.e., discretionary helpful, cooperative behavior toward coworkers).

Lemma 1 also implies that more talented individuals make higher productive and socialization efforts. In addition, the individual talent in the group has externalities, since the average talent in the group also increases socialization effort.

**Empirical Implication 2** *Average talent is complementary to the firm's investment in purpose, which is more impactful in highly talented groups.*

Gartenberg et al. (2019) show that meaningfulness positively affects performance where employees have discretion and complex problem-solving in their roles (mid-level/professional jobs).

Having solved each worker's maximization problem we are now in a position to rewrite the meaning for each worker  $i$  in his job in period  $t$  (2) as a function of  $r_t$

$$m_{i,t} = k_{i,t}^{1/2} \int k_{j,t}^{1/2} r_t^{\frac{1}{2}} + \lambda \bar{m}_{t-1} = \frac{\alpha + \beta}{2A_k} r_t \left( b_{i,t}^{\frac{1}{3}} \right) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2 + \lambda \bar{m}_{t-1}$$

### 3.2 Decision of the firm in terms of $r_t$

While the workers maximize their one period utility, the firm chooses  $r_t$  to maximize its lifetime utility given by:

$$\sum_{t,i_t} \delta^{t-1} (1 - \alpha) (z_{i,t}(m_{i,t}, e_{i,t})) - C(r_t) \quad (10)$$

Using the worker's optimal socialization and work efforts, each worker's output can be expressed as

$$z_{i,t}(m_{i,t}, e_{i,t}) = b_{i,t} \left( b_{i,t} \frac{\alpha}{A_e} + \frac{\alpha + \beta}{2A_k} r_t \left( b_{i,t}^{\frac{1}{3}} \right) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2 + \lambda \bar{m}_{t-1} \right) \quad (11)$$

Notice that in equation (11), the individual talent parameter  $b_{i,t}$  appears squared in the first term and raised to the power of 4/3 in the second. When this is aggregated to the total output of the firm, we will have terms with  $\int b_{j,t}^{\frac{4}{3}}$  and  $\int b_{j,t}^2$ , in addition to  $\int b_{j,t}^{\frac{1}{3}}$  which comes from  $k_t$ .

**Empirical Implication 3** *More talented groups are more productive, and past meaning ( $\bar{m}_{t-1}$ ) is particularly important for the more productive individuals.*

This suggests that young talented workers might be especially attracted to high meaning firms. In two online-labor-market field experiments Burbano (2016) found that telling applicants the employer was socially responsible reduced the wage premium demanded by the highest performers—i.e., top performers were willing to work for less when the job signaled meaning/purpose.

As we have seen, talented people make higher efforts, and they also create externalities in the group. In addition, the fact that different moments of the distribution of  $b_{j,t}$  affect the output will mean that the impact of changes in its dispersion (which we can call diversity) are also relevant, in nuanced ways we will discuss later.

Introducing individual productivity (11) into (10), the firm's optimization problem is to choose  $\alpha$  and  $r_t$  each period to maximize

$$\sum_t \left( \delta^{t-1} (1-\alpha) \left( \int b_{j,t}^2 \frac{\alpha}{A_e} + \frac{\alpha+\beta}{2A_k} r_t \left( \int b_{j,t}^{\frac{4}{3}} \right) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2 + \lambda \int b_{j,t} \bar{m}_{t-1} \right) \right) - \delta^{t-1} \frac{C}{2} r_t^2 \quad (12)$$

where the law of motion of  $\bar{m}_t$  is given by

$$\bar{m}_t = \frac{\alpha+\beta}{2A_k} r_t \left( \int b_{j,t}^{\frac{1}{3}} \right)^3 + \lambda \bar{m}_{t-1}. \quad (13)$$

**Proposition 1** *In steady state*

$$\bar{m}^* = \frac{(1-\alpha) \int b_j^{\frac{4}{3}} (\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5}{C 4A_k^2 (1-\lambda)} + \frac{(1-\alpha) \delta \lambda \int b_j (\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}{C (1-\delta\lambda) 4A_k^2 (1-\lambda)} \quad (14)$$

while

$$r^* = \frac{(1-\alpha) \int b_{j,t}^{\frac{4}{3}} (\alpha+\beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{(1-\alpha) \delta \lambda \int b_{j,t} (\alpha+\beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}{2CA_k (1-\delta\lambda)} \quad (15)$$

and

$$k^* = \frac{(1-\alpha)^{\frac{1}{2}} (\alpha+\beta)^{\frac{3}{2}}}{2A_k} \left( \int b_j^{\frac{1}{3}} \right) \left( \int b_j^{\frac{2}{3}} \right) \left( \frac{\int b_j^{\frac{4}{3}} \left( \int b_j^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{\delta \lambda \int b_j \left( \int b_j^{\frac{1}{3}} \right)^3}{2CA_k (1-\delta\lambda)} \right)^{\frac{1}{2}} \quad (16)$$

**Proof.** See Appendix ■

## 4 Comparative statics

We are now in a position to determine how steady state average meaning in the firm  $\bar{m}^*$  given by (14) as well as the steady state investment in purpose  $r^*$  given by (15) and the average socialization effort  $k^*$  given by (16) varies with the underlying parameters.

**Proposition 2**  *$\bar{m}^*$ ,  $r^*$  and  $k^*$  are increasing in  $\beta$ , in the discount factor  $\delta$  and in the persistency factor of meaning  $\lambda$ . They are also decreasing in the firm's marginal cost of providing purpose  $C$ , the individual marginal socialization cost  $A_k$  and independent of the individuals marginal work effort cost  $A_e$ . Concerning the share of output  $\alpha$  given to the workers*

$$\frac{\partial \bar{m}^*}{\partial \alpha} > 0 \Leftrightarrow 2 > 3\alpha + \beta$$

while

$$\frac{\partial r^*}{\partial \alpha} > 0 \Leftrightarrow 1 > 2\alpha + \beta$$

and

$$\frac{\partial k^*}{\partial \alpha} > 0 \Leftrightarrow 3 > 4\alpha + \beta$$

**Proof.** See the appendix ■

The impact of the discount factor  $\delta$  and in the persistency factor of meaning  $\lambda$  on the investment  $r^*$  and the stock  $\bar{m}^*$  are easy to understand. Since the socialization effort  $k^*$  which directly enhances production is complementary to  $\bar{m}^*$  (through  $r^*$ ), those variables are an investment into the profitability of the firm. So an improvement in the discount factor or the persistency factor of meaning will tend to increase them, and through the complementarity, they also increase  $k^*$ . The influence of  $\alpha$  is naturally more nuanced. On the one hand, we can see from Lemma 1 that an increase in  $\alpha$  increases  $k^*$  directly, and through that, profitability. However, when  $\alpha$  becomes excessively large, firm profits decline substantially, which in turn constrains investment  $r^*$ . This reduction subsequently leads to decreases in  $k^*$  and  $\bar{m}^*$ .

Proposition 2 has a series of empirical implications:

**Empirical Implication 4** *Firms who emphasize the long-run horizon invest more in purpose.*

Empirical evidence links a long-term orientation to greater investment in purpose-driven, meaning-enhancing practices. Using a regression discontinuity on close-call shareholder votes for long-term executive compensation, Flammer and Bansal (2017)

show that firms pushed toward longer horizons subsequently increase stakeholder engagement - especially toward employees and the natural environment - and see operating gains two years later, consistent with purposeful, non-myopic investment patterns. At the cultural level, a large-sample study of Chinese listed firms by Fang, Wen, and Xu (2024) text-mines annual reports to construct a long-term orientation culture index and finds that more long-term oriented firms boost innovation via mechanisms such as upgrading employees' educational qualifications and strengthening internal controls, with effects intensifying under performance pressure - signals of organization-wide investments that support meaningful work systems.

**Empirical Implication 5** *Investment in meaning is decreasing with the employee turnover in a sector.*

Sectors with higher employee turnover tend to invest less in initiatives that enhance job meaning or purpose, as the expected return on such investments is discounted when employee tenure is short. Retail, hospitality, and call centers in the US exemplify the pattern. Retail and hospitality have historically relied on extrinsic motivators such as pay adjustments and scheduling flexibility, while purpose-driven strategies and intrinsic motivators like autonomy and development opportunities remain limited (Gitnux, 2025; Work Institute, 2025). Call centers, where annual turnover averages 40–45% and first-year attrition can exceed 70%, face similar challenges; although engagement programs exist, they often emphasize operational efficiency rather than intrinsic motivators, despite evidence that autonomy, mastery, and purpose significantly improve retention (Insignia Resources, 2025; Anwar et al., 2018, Farrell, 2024). In contrast, high-tech industries - where voluntary turnover averages around 13%, far below these sectors - invest heavily in intrinsic motivators such as meaningful projects, autonomy, and career development, recognizing their role in innovation and retention (Mercer, 2025, Vazquez, 2025).

**Empirical Implication 6** *There is an inverted U-shaped / relationship between workers' share of output and their level of socialization, as well as with the meaning and purpose.*

We have not been able to find studies that are directly testing this implication, but there is some evidence pointing in this direction. Wang et al. (2015) show that pay dispersion, which is somewhat related to the workers' share in revenues, and employee participation show an inverted-U connection. In firm data, moderate within-firm pay

gaps maximize participation, which in turn boosts innovation - both are socialization/cooperation outcomes. This implication is intriguing and it may be a relevant target of future research.

In the next subsection we show that these comparative statics are largely inherited in firm profits and worker utility, confirming the above intuition.

#### 4.1 Worker utility and firm profits in steady state

Introducing (8) and (9), the worker utility (5) in steady state can be rewritten as:

$$\begin{aligned}
u^* &= b_{i,t}^{\frac{4}{3}} \left( \frac{(\alpha + \beta)^2}{2A_k} \left( \int b_j^{\frac{1}{3}} \right)^2 \right) r^* + \lambda(\alpha + \beta)b_{i,t}\bar{m}^* \\
&\quad + \alpha b_{i,t}^2 \frac{\alpha}{A_e} - \frac{A_e}{2} b_{i,t}^2 \left( \frac{\alpha}{A_e} \right)^2 - \frac{A_k}{2} b_{i,t}^{\frac{4}{3}} \left( \frac{\alpha + \beta}{2A_k} \right)^2 r^* \left( \int b_j^{\frac{1}{3}} \right)^2 \\
&= b_{i,t}^{\frac{4}{3}} \left( \frac{3(\alpha + \beta)^2}{8A_k} \left( \int b_j^{\frac{1}{3}} \right)^2 \right) r^* + \lambda(\alpha + \beta)b_{i,t}\bar{m}^* + \frac{b_{i,t}^2 \alpha^2}{2 A_e} \tag{17}
\end{aligned}$$

From Proposition 2 it is easy to see that steady state worker utility is increasing in  $\beta$ , in the discount factor  $\delta$  and in the persistency factor of meaning  $\lambda$ . It is decreasing in the firm's marginal cost of providing purpose  $C$ , the individual marginal socialization cost  $A_k$  and decreasing in the individuals marginal work effort cost  $A_e$ . These results are easy to understand by noticing that the utility of the worker is increasing in  $\bar{m}^*$ ,  $r^*$  and the firm production, which depends on production and socialization efforts. So these comparative statics are inherited from those of  $\bar{m}^*$ ,  $r^*$  and  $k^*$  that are discussed in Proposition 2.

Concerning the share of output  $\alpha$  given to the workers

$$\begin{aligned}
\frac{\partial u^*}{\partial \alpha} &= b_{i,t}^{\frac{4}{3}} \left( \left( \frac{3(\alpha + \beta)}{4A_k} \left( \int b_j^{\frac{1}{3}} \right)^2 \right) r^* + \left( \frac{3(\alpha + \beta)^2}{8A_k} \left( \int b_j^{\frac{1}{3}} \right)^2 \right) \frac{\partial r^*}{\partial \alpha} \right) \\
&\quad + \lambda b_{i,t} \bar{m}^* + \lambda(\alpha + \beta)b_{i,t} \frac{\partial \bar{m}^*}{\partial \alpha} + b_{i,t}^2 \frac{\alpha}{A_e}
\end{aligned}$$

a sufficient condition  $\frac{\partial u^*}{\partial \alpha} > 0$  is  $\alpha < \frac{1-\beta}{2}$  since  $\frac{\partial \bar{m}^*}{\partial \alpha} > 0 \Leftrightarrow 2 > 3\alpha + \beta$ ;  $\frac{\partial r^*}{\partial \alpha} > 0 \Leftrightarrow 1 > 2\alpha + \beta$ . Again, these more nuanced results are related to the fact that  $\alpha$  increases  $k^*$  directly, incentivizing investments in  $r^*$  and through it increases in  $\bar{m}^*$ . But when  $\alpha$  is too high, the hit to profits can reverse those investments, which hurts the utility.

We now turn to the firm's profits given by (12). In Appendix E.1 we show that

steady states profits after introducing  $m^*$ ,  $r^*$ ,  $k^*$  and  $e^*$  can be written as:

$$\begin{aligned} \Pi^* &= \frac{(1-\alpha)\alpha}{1-\delta} \frac{1}{A_e} \left( \int b_j^2 \right) + \frac{(1-\alpha)^2(\alpha+\beta)^2}{(1-\delta)4CA_k^2} \\ &\times \left( \frac{1}{2} \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda(1+2\delta-3\delta\lambda)}{(1-\lambda)(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\ &\left. + \frac{\lambda^2\delta(2-\delta-\lambda\delta)}{2(1-\delta\lambda)^2(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right) \end{aligned} \quad (18)$$

This allows us to perform comparative statics on the parameters.

**Proposition 3**  $\Pi^*$  is increasing in  $\lambda, \beta, \delta$ . A sufficient condition for  $\Pi^*$  to be increasing in  $\alpha$  is that  $(1-2\alpha-\beta) > 0$ , and a sufficient condition for  $\Pi^*$  to be decreasing in  $\alpha$  is that  $1-2\alpha < 0$ .  $\Pi^*$  is decreasing in  $A_e$  and  $A_k$ . It is also decreasing in  $C$ .

**Proof.** See the Appendix. ■

The effects of the different variables are, as for  $u^*$ , inherited from those of  $\bar{m}^*$ ,  $r^*$  and  $k^*$  and their signs have very similar intuitions, adapted to the different functional form of profits.

## 5 Comparative statics with respect to the talent distribution

To derive comparative statics with respect to the talent distribution, we will consider what happens when workers become more skilled as represented by a first-order stochastic dominance shift or when dispersion changes which can be captured by second-order stochastic dominance. The following Lemma will be crucial for establishing the results.

**Lemma 2** a) Let  $X$  and  $Y$  be real-valued random variables with cumulative distribution functions  $F_X$  and  $F_Y$ . Assume that  $Y$  first-order stochastically dominates  $X$ . for every exponent  $p \in (0, \infty)$

$$\mathbb{E}(Y^p) \geq \mathbb{E}(X^p).$$

b) Let  $X$  and  $Y$  be real-valued random variables with cumulative distribution functions  $F_X$  and  $F_Y$ . Assume that  $Y$  second-order stochastically dominates  $X$ , i.e.

$$\int_{-\infty}^t F_Y(s) ds \leq \int_{-\infty}^t F_X(s) ds \quad \text{for every } t \in \mathbb{R}.$$

Suppose further that  $X$  and  $Y$  are integrable and non-negative a.s. Then for every exponent  $p \in (0, 1)$

$$\mathbb{E}(Y^p) \geq \mathbb{E}(X^p).$$

and for then for every exponent  $p \in (1, \infty)$

$$\mathbb{E}(Y^p) \leq \mathbb{E}(X^p).$$

**Proof.** a) First-order stochastic dominances (FOSD) is equivalent to

$$\mathbb{E}(u(Y)) \geq \mathbb{E}(u(X)) \quad \text{for every increasing } u.$$

For  $0 < p < \infty$  the map  $u_p(x) = x^p$  is increasing on  $\mathbb{R}_+$ , hence the results follows immediately.

b) Second -order dominance (SOSD) is equivalent to the inequality

$$\mathbb{E}(u(Y)) \geq \mathbb{E}(u(X)) \quad \text{for every increasing, concave } u.$$

For  $0 < p < 1$  the map  $u_p(x) = x^p$  is both increasing and concave on  $\mathbb{R}_+$ , hence the first inequality follows immediately. We also have that

$$\mathbb{E}(u(Y)) \leq \mathbb{E}u(X) \quad \text{for every increasing, convex } u.$$

For  $1 < p < \infty$  the map  $u_p(x) = x^p$  is both increasing and convex on  $\mathbb{R}_+$ , hence the second inequality follows immediately. ■

Since the expressions for  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  are all increasing functions of  $\int b_j^p$  functions, the following Corollary is immediate from Lemma 2.

**Corollary 1** *If the distribution of  $b_j$  experiences a FOSD shift,  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  increase.*

In other words, if the talent distribution shifts upwards (i.e. workers become more skilled) meaning, purpose, socialization, utility and profits all increase.

**Empirical Implication 7** *Investing in talent development (e.g., training) enhances the returns to purpose-driven strategies.*

Empirical evidence supports the idea that investment in purpose is closely linked to firms' broader human capital strategies. For instance, the SHRM & TalentLMS (2022)

Workplace Learning and Development Trends Report<sup>2</sup> finds that 83% of HR managers believe training helps attract talent, and 76% of employees are more likely to stay with a company that offers continuous learning—suggesting that educational investment is perceived as part of a meaningful work environment. Similarly, empirical evidence from Harvard Business Publishing (2025) confirms that purpose-driven organizations systematically integrate educational investment into their talent strategies. McKinsey (2024) further emphasizes that purpose-driven transformation programs often include capability building and leadership development as core components, reinforcing the strategic link between purpose and talent.

The situation is more nuanced when the talent distributions experience a SOSD shift. The  $\int b_j^p$  functions have some exponents  $p < 1$  and others  $p > 1$ . However, we can get a definite sign for the change when we make assumptions on what the baseline distribution is.

**Proposition 4** *If the distribution of  $b_j^{\frac{1}{3}}$  undergoes a SOSD shift, then,  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  decrease. If the distribution of  $b_j^2$  undergoes a SOSD shift, then,  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  increase.*

**Proof.** *The result follow from Lemma 2, by noting that all the  $\int b_j^p$  expressions in  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  integrate convex transformations of  $b_j^{\frac{1}{3}}$  and concave transformations of  $b_j^2$ . ■*

In Appendix F we discuss a couple of relevant cases including an intermediate one, using the lognormal distribution, to get more intuition.

To understand what is going on in this problem, remember that individual output can be written as:

$$z_{i,t}(m_{i,t}, e_{i,t}) = b_{i,t} \left( b_{i,t} \frac{\alpha}{A_e} + \frac{\alpha + \beta}{2A_k} r_t \left( b_{i,t}^{\frac{1}{3}} \right) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2 + \lambda \bar{m}_{t-1} \right) \quad (19)$$

Notice that in the equation (19) for individual output the individual talent parameter  $b_{i,t}$  is squared from the first term and to the power  $4/3$  from the second term. When this is aggregated to the total output of the firm this means we will have terms with  $\int b_{j,t}^{\frac{4}{3}}$  and  $\int b_{j,t}^2$ , in addition to  $\int b_{j,t}^{\frac{1}{3}}$  which comes from  $k_t$  and the  $\bar{m}_{t-1}$  also has a  $\int b_{j,t}$  term. These different terms have different reactions to the decrease in dispersion as per Lemma 2, which is why the Proposition 4 depends on whether the distributions of the random variables  $b_{j,t}^2$ , or  $b_{j,t}^{\frac{1}{3}}$  are the baseline.

<sup>2</sup><https://www.shrm.org/content/dam/en/shrm/research/2022-Workplace-Learning-and-Development-Trends-Report.pdf>

Notice that when the support of the distribution starts at 1, if the baseline distribution is for  $b_j^{\frac{1}{3}}$ , it is a more concentrated distribution than for  $b_j^p$  for a higher power. So a SOSD shift decreases dispersion from a lower base. On the contrary, if the baseline distribution is for  $b_j^2$  it is a less concentrated distribution than for  $b_j^p$  for a lower power. So a SOSD shift decreases dispersion from a higher base. This suggests that increasing dispersion will increase  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  when the starting point is not too disperse, and will decrease  $\bar{m}^*$ ,  $r^*$ ,  $k^*$ ,  $u^*$  and  $\Pi^*$  when the starting distribution is more disperse. We can conclude that

**Empirical Implication 8** *Some intermediate level of heterogeneity in skills seems to be best for performance.*

Companies around the world are now more sensitive to diversity in talents. Usually this means that they try to foster an environment in which different ideas and perspectives are valued, perhaps because they can contribute to generate new lines of business, or more productive project. The kind of diversity we contemplate here is different in nature. Everything else equal, some workers are more productive than others. In a sense, we are talking about vertical differentiation, whereas the more standard discourse is about horizontal diversity. Because of the way output (as shown in equation (19)) interacts with the distribution of talent in potentially complicated ways, the vertical differentiation also matters, and companies need to pay attention to it.

To our knowledge, no study directly tests the empirical implication 8 that intermediate levels of skill heterogeneity maximize firm performance by enhancing employees' sense of meaning and purpose. The closest evidence is provided by Iranzo et al. (2008), who analyze employer–employee matched data from Italian manufacturing firms. They construct a latent skill index from wage regressions and quantify within-firm skill dispersion. Their results indicate that productivity increases with dispersion within occupational groups (e.g., among production workers) but decreases when dispersion occurs across groups (e.g., between production and non-production workers). This pattern implies a nonmonotonic relationship between skill heterogeneity and performance—structured diversity within roles is beneficial, whereas excessive dispersion across roles is detrimental. Nevertheless, these findings do not constitute a direct test of our proposed mechanism, and further research is needed.

## 6 Path to steady state

In our reformulation of the firm's problem, the firm maximizes the objective function  $\max_{\{\bar{m}_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^{t-1} F(\bar{m}_{t-1}, \bar{m}_t, z)$ . An inspection of  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  shows that this function is quadratic in  $\bar{m}_{t-1}$  and  $\bar{m}_t$ . Since the problem is quadratic we know from Anton et al. (1998) that the roots of the characteristic equation determine the approach to the steady state. In Appendix G we show that

$$\bar{m}_t = \bar{m}^* + \mu_2^t (\bar{m}_0 - \bar{m}^*)$$

with

$$\mu_2 = \frac{1}{2} \left( \frac{1 + \delta\lambda^2}{\delta\lambda} - \sqrt{\left( \frac{1 + \delta\lambda^2}{\delta\lambda} \right)^2 - \frac{4}{\delta}} \right)$$

Note that  $\mu_2 < 1$  iff  $\delta\lambda < 1$ , so the solution approaches the steady state monotonically from the initial condition.

## 7 The worker-owned firm

While both workers and firms benefit from operating in an environment imbued with positive meaning or purpose, this alignment does not necessarily imply a convergence of interests or the absence of tensions regarding the value each party places on such meaning. One way to illustrate this divergence is by comparing the decisions made by a for-profit firm with those that might be expected from a firm that is entirely owned and operated by its workers. In the worker-owned firm, clearly, the workers would keep all the output, so  $\alpha = 1$  in the worker utility (3), but also, since the workers are now the firm  $1 - \alpha = 1$  in the objective function of the firm (12). To be clear,  $\alpha$  is renormalized independently in (3) and in (12). Thus the solutions to the worker-owned firm in steady state are as follows:

- for meaning  $\bar{m}_{wo}^*$

$$\bar{m}_{wo}^* = \frac{\int b_j^{\frac{4}{3}} (1 + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5}{C 4A_k^2 (1 - \lambda)} + \frac{\delta\lambda \int b_j (1 + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}{C (1 - \delta\lambda) 4A_k^2 (1 - \lambda)}$$

- for steady state investment in purpose  $r_{wo}^*$

$$r_{wo}^* = \frac{\int b_{j,t}^{\frac{4}{3}} (1 + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{\delta \lambda \int b_{j,t} (1 + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}{2CA_k (1 - \delta \lambda)}$$

- for socialization  $k_{wo}^*$

$$k_{wo}^* = \frac{1 + \beta}{2A_k} \left( \int b_j^{\frac{1}{3}} \right) \left( \int b_j^{\frac{2}{3}} \right) \left( \frac{\int b_j^{\frac{4}{3}} (1 + \beta) \left( \int b_j^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{\delta \lambda \int b_j (1 + \beta) \left( \int b_j^{\frac{1}{3}} \right)^3}{2CA_k (1 - \delta \lambda)} \right)^{\frac{1}{2}}$$

Simple inspection shows that  $k_{wo}^* \geq k^*$ ,  $r_{wo}^* \geq r^*$ , and  $\bar{m}_{wo}^* \geq \bar{m}^*$  which implies that there will be some kind of friction between management and workers about this issue. The firm invests less in purpose than the worker-owned firm would, resulting in a lower common component for socialization and in lower meaning.

**Empirical Implication 9** *Worker owned firms invest more in purpose and meaning than traditional firms.*

Evidence suggests that worker-owned firms tend to institutionalize practices that reinforce organizational purpose and employee meaning more than conventional firms, though most studies are descriptive. Case studies of Mondragón, a group of 96 cooperatives in the Basque Country, show that worker ownership is tied to strong investments in socialization and meaning-building—through cooperative education programs, participatory governance structures, and initiatives to transmit cooperative values across contexts (Flecha and Ngai, 2014; Morlà-Folch et al., 2021). Meta-analyses show that employee ownership is linked to higher organizational commitment (Wagner et al., 2015) and modest improvements in firm performance (O’Boyle et al., 2016).

## 8 Conclusions

We have developed a dynamic model in which a profit-maximizing firm invests in workplace purpose to enhance the motivation and effort of workers who value meaning in their jobs. In our framework, meaning emerges endogenously from the interaction between firm investment and workers’ socialization effort, and it directly contributes to both worker utility and firm productivity. A central result is that meaning and purpose

are increasing in the workers' share of output, but only up to a point: when the share is moderate, meaning and profit incentives are complementary; when the share becomes too high, they act as substitutes. This highlights a subtle trade-off in the use of monetary and non-monetary incentives to motivate workers. Another key finding is that some intermediate level of heterogeneity in skills seems to be best for performance leading to higher levels of purpose, socialization, productivity, individual utility and firm's profits. This provides a theoretical rationale for the increasing emphasis on choosing the correct mix of diversity in firms and organizations, particularly those aiming to foster purpose-driven cultures.

Several directions for future research naturally emerge from our analysis. First, we have treated workers' concern for meaning as exogenous, whereas in practice firms may influence this through hiring policies or by cultivating a preference for meaning internally. Selective recruitment strategies or internal messaging efforts could be incorporated into the model to study how firms shape preferences over time. Second, while our model allows for heterogeneity in worker ability, all workers are assumed to care about meaning to the same degree. Introducing heterogeneity in preferences for meaning, alongside differences in productivity, would be relevant in environments where firms differ in their specialization and may wish to attract specific types of employees. Although our model focuses on a single representative firm, extending it to a setting with multiple firms and a competitive labor market would allow for a richer analysis of sorting and matching. Finally, future work could consider multi-dimensional heterogeneity, where workers differ not only in their overall productivity but also in how effective they are at productive tasks versus socialization. This would provide a deeper understanding of how organizations allocate roles and design incentives in the presence of complex trade-offs between purpose and performance.

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## Appendix

### A Proof of Lemma 1

We conjecture that

$$e_{i,t} = b_{i,t}^\rho e_t; k_{i,t} = b_{i,t}^\eta k$$

and show that it indeed holds. We introduce this conjecture into (6) and (7) and get

$$\alpha b_{i,t} - A_e b_{i,t}^\rho e_t = 0$$

and

$$\frac{1}{2} (\alpha + \beta) b_{i,t} \left( r_t^{\frac{1}{2}} \left( b_{i,t}^{\eta(-\frac{1}{2})} k^{-\frac{1}{2}} \int b_{j,t}^{\frac{\eta}{2}} k^{\frac{1}{2}} \right) \right) - b_{i,t}^\eta A_k k = 0$$

respectively. These new conditions coincide with the original first order conditions if

$$\begin{aligned} 1 &= \rho \\ 1 + \eta \left( -\frac{1}{2} \right) &= \eta \\ \eta &= \frac{2}{3} \end{aligned}$$

Hence  $k_t = \frac{\alpha+\beta}{2A_k} r_t^{\frac{1}{2}} \left( \int b_{j,t}^{\frac{1}{3}} \right)$  and  $e_t = \frac{\alpha}{A_e}$ .

## B Proof of Proposition 1

Isolating  $r_t$  from the law of motion (13) we get

$$r_t = \frac{2A_k(\bar{m}_t - \lambda\bar{m}_{t-1})}{(\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3} \geq 0 \quad (20)$$

Since  $r_t \geq 0$  it is also true that  $\bar{m}_t \geq \lambda\bar{m}_{t-1}$ .

We now reformulate our problem using Anton et al. (1998) and write the maximization problem as a function of  $\bar{m}_{t-1}, \bar{m}_t$ . Our problem therefore becomes

$$\begin{aligned} & \max_{\{\bar{m}_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^{t-1} F(\bar{m}_{t-1}, \bar{m}_t, z) \\ & \text{such that } \bar{m}_t \geq \lambda\bar{m}_{t-1} \\ & \text{and } \bar{m}_o \text{ given} \end{aligned}$$

where  $z$  refers to any of our exogenous parameters in the model and  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  is a quadratic function in  $\bar{m}_t$  and  $\bar{m}_{t-1}$  given by

$$\begin{aligned} F(\bar{m}_{t-1}, \bar{m}_t, z) &= (1 - \alpha) \left( \int b_{j,t}^2 \frac{\alpha}{A_e} + \frac{(\bar{m}_t - \lambda\bar{m}_{t-1})}{\int b_{j,t}^{\frac{1}{3}}} \left( \int b_{j,t}^{\frac{4}{3}} \right) + \lambda \int b_{j,t} \bar{m}_{t-1} \right) \\ &\quad - \frac{C}{2} \left( \frac{2A_k(\bar{m}_t - \lambda\bar{m}_{t-1})}{(\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3} \right)^2 \end{aligned} \quad (21)$$

From now on we assume the type distribution is stationary, and thus all the  $\int (b_{j,t+1})^x = \int (b_j)^x$ .

In order to apply the solution techniques developed in Anton et al. (1998) we need to make sure that the required assumptions stated in the paper hold. We show in section C that these assumptions indeed hold if we assume that

$$-\frac{\int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} + \int b_j > 0 \quad (22)$$

which we do from now on.

The Euler equation of this maximization is

$$0 = F_{\bar{m}_t}(\bar{m}_{t-1}, \bar{m}_t, z) + \delta F_{\bar{m}_t}(\bar{m}_t, \bar{m}_{t+1}, z) \quad (23)$$

And the transversality condition is given by

$$\lim_{t \rightarrow \infty} \delta^t F_{\bar{m}_{t-1}}(\bar{m}_{t-1}, \bar{m}_t, z) \bar{m}_{t-1} = 0 \quad (24)$$

We need to use the Euler equation at steady state where  $\bar{m}^* = \bar{m}_{t-1} = \bar{m}_t = \bar{m}_{t+1}$ . While  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  is given by equation (21), we also need to define  $F(\bar{m}_t, \bar{m}_{t+1}, z)$  as

$$\begin{aligned} F(\bar{m}_t, \bar{m}_{t+1}, z) &= (1 - \alpha) \left( \int b_{j,t+1}^2 \frac{\alpha}{A_e} + \frac{(\bar{m}_{t+1} - \lambda \bar{m}_t)}{\int b_{j,t+1}^{\frac{1}{3}}} \left( \int b_{j,t+1}^{\frac{4}{3}} \right) + \lambda \int b_{j,t} \bar{m}_t \right) \\ &\quad - \frac{C}{2} \left( \frac{2A_k (\bar{m}_{t+1} - \lambda \bar{m}_t)}{(\alpha + \beta) \left( \int b_{j,t+1}^{\frac{1}{3}} \right)^3} \right)^2 \end{aligned}$$

Therefore

$$\begin{aligned} F_{\bar{m}_t}(\bar{m}_t, \bar{m}_{t+1}, z) &= \frac{\partial F(\bar{m}_t, \bar{m}_{t+1}, z)}{\partial \bar{m}_t} = (1 - \alpha) \left( -\frac{\lambda \int b_{j,t+1}^{\frac{4}{3}}}{\int b_{j,t+1}^{\frac{1}{3}}} + \lambda \int b_{j,t+1} \right) \\ &\quad + C \frac{4A_k^2 \lambda (\bar{m}_{t+1} - \lambda \bar{m}_t)}{(\alpha + \beta)^2 \left( \int b_{j,t+1}^{\frac{1}{3}} \right)^6} \end{aligned}$$

and

$$F_{\bar{m}_t}(\bar{m}_{t-1}, \bar{m}_t, z) = \frac{\partial F(\bar{m}_{t-1}, \bar{m}_t, z)}{\partial \bar{m}_t} = (1 - \alpha) \left( \frac{\int b_{j,t}^{\frac{4}{3}}}{\int b_{j,t}^{\frac{1}{3}}} \right) - C \frac{4A_k^2 (\bar{m}_t - \lambda \bar{m}_{t-1})}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6}$$

We assume the type distribution is stationary, and thus all the  $\int (b_{j,t+1})^x = \int (b_j)^x$ .

Using a stationary type distribution in the Euler equation at steady state where  $\bar{m}^* = \bar{m}_{t-1} = \bar{m}_t = \bar{m}_{t+1}$ , we get

$$(1 - \alpha) \left( \frac{\int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} \right) - C \frac{4A_k^2 ((1 - \lambda) \bar{m}^*)}{(\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6} + \delta \left( (1 - \alpha) \left( -\frac{\lambda \int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} + \lambda \int b_j \right) + C \frac{4A_k^2 \lambda (1 - \lambda) \bar{m}^*}{(\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6} \right) = 0$$

$$(1 - \alpha)(1 - \delta\lambda) \left( \frac{\int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} \right) + (1 - \alpha)\delta\lambda \int b_j = C(1 - \delta\lambda) \frac{4A_k^2(1 - \lambda)\bar{m}^*}{(\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}$$

Isolating  $\bar{m}^*$  we find

$$\bar{m}^* = \frac{(1 - \alpha)(1 - \delta\lambda) \left( \frac{\int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} \right) + (1 - \alpha)\delta\lambda \int b_j}{C(1 - \delta\lambda) \frac{4A_k^2(1 - \lambda)}{(\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}}$$

which can be rewritten as (14). Using (14) the steady state investment in purpose  $r^* = \frac{2A_k(1 - \lambda)\bar{m}^*}{(\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}$  is expressed in primitives of the model as (15). Introducing (15) into

$k^* = \frac{\alpha + \beta}{2A_k} (r^*)^{\frac{1}{2}} \left( \int b_j^{\frac{1}{3}} \right)$  as derived in (9) delivers (16).

We now show that the transversality condition (24) holds. We need to calculate

$$F_{\bar{m}_{t-1}}(\bar{m}_{t-1}, \bar{m}_t, z) = (1 - \alpha) \left( -\frac{\lambda \int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} + \lambda \int b_j \right) + C \frac{4A_k^2 \lambda (\bar{m}_t - \lambda \bar{m}_{t-1})}{(\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}$$

Since the first term is a constant the transversality condition (24) will be satisfied if

$$\lim_{t \rightarrow \infty} \delta^t (\bar{m}_t - \lambda \bar{m}_{t-1}) \bar{m}_{t-1} = 0.$$

This is trivially satisfied in our case, since we focus on a stationary solution, and  $\lim_{t \rightarrow \infty} \bar{m}_t = \bar{m}^*$  is a constant.

In section C.1 we show that the steady state  $\bar{m}^*$  exhibits saddle point stability since it satisfies condition (4.7) in Anton et al. (1998) given by

$$\frac{\partial^2 F}{\partial \bar{m}_t^2} + \delta \frac{\partial^2 F}{\partial \bar{m}_{t-1}^2} + \left| \frac{\partial^2 F}{\partial \bar{m}_t \partial \bar{m}_{t-1}} \right| (1 - \delta) < 0. \quad (25)$$

## C Checking the conditions in Anton et al. (1998)

To apply Anton et al. (1998) the following conditions have to be satisfied.

**A1**  $F$  is continuous and continuously differentiable in the interior of the domain with respect to  $(\bar{m}_{t-1}, \bar{m}_t)$ , for each  $z$

**A2** The domain is a subset of the positive reals.

**A3** For each  $\bar{m}_t, z$  a,  $F(\cdot, \bar{m}_t, z)$  is strictly increasing in its first argument

**A4** For each  $z$ ,  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  is concave in  $\bar{m}_{t-1}, \bar{m}_t$

**A5** For each  $z$ , and  $\delta \in (0, 1)$ , there exists a unique  $\bar{m}^*$  satisfying  $F_{\bar{m}_t}(\bar{m}^*, \bar{m}^*, z) + \delta F_{\bar{m}_t}(\bar{m}^*, \bar{m}^*, z) = 0$

**A6**  $F$  is twice continuously differentiable in the domain

A1, A2 and A6 clearly hold. For A3 first we need to check

$$\begin{aligned} F_{\bar{m}_{t-1}}(\bar{m}_{t-1}, \bar{m}_t, z) &= \frac{\partial F(\bar{m}_{t-1}, \bar{m}_t, z)}{\partial \bar{m}_{t-1}} \\ &= (1 - \alpha) \lambda \left( -\frac{\int b_j^{\frac{4}{3}}}{\int b_j^{\frac{1}{3}}} + \int b_j \right) + C \lambda \frac{4A_k^2 (\bar{m}_t - \lambda \bar{m}_{t-1})}{(\alpha + \beta)^2 \left( \int b_{j,t+1}^{\frac{1}{3}} \right)^6} \end{aligned}$$

We can guarantee that this is positive if we assume condition 22 given  $(\bar{m}_t - \lambda \bar{m}_{t-1}) = \bar{s}_t r_t^{\frac{1}{2}} \geq 0$ , so that A3 holds.

A4 is true because the first term  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  is linear in  $\bar{m}_{t-1}, \bar{m}_t$ , and the second term is strictly concave in  $\bar{m}_{t-1}, \bar{m}_t$ .

Our stationary solution to the maximization problem satisfies A5.

## C.1 Proof that the condition (4.7.) in Anton et al. (1998) is satisfied

The condition is:

$$\frac{\partial^2 F}{\partial \bar{m}_t^2} + \delta \frac{\partial^2 F}{\partial \bar{m}_{t-1}^2} + \left| \frac{\partial^2 F}{\partial \bar{m}_t \partial \bar{m}_{t-1}} \right| (1 + \delta) < 0.$$

To see this is true we first calculate the respective derivatives

$$\begin{aligned} \frac{\partial^2 F}{\partial \bar{m}_t \partial \bar{m}_{t-1}} &= C \frac{4A_k^2 \lambda}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} > 0 \\ \frac{\partial^2 F}{\partial \bar{m}_t^2} &= -C \frac{4A_k^2}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} < 0 \\ \frac{\partial^2 F}{\partial \bar{m}_{t-1}^2} &= -C \frac{4A_k^2 \lambda^2}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} < 0 \end{aligned}$$

and then substitute them into (25).

$$\begin{aligned}
& -C \frac{4A_k^2}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} - \delta C \frac{4A_k^2 \lambda^2}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} + (1 + \delta) C \frac{4A_k^2 \lambda}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} \\
= & -4CA_k^2 \frac{(1 - \lambda)(1 - \lambda\delta)}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6}
\end{aligned}$$

which is clearly negative. Condition (4.7) in Anton et al. (1998) is satisfied.

## D Proof Proposition 2

The signs follow by simple differentiation. The only more involved cases are

$$\begin{aligned}
\frac{\partial \bar{m}^*}{\partial \alpha} &= -\frac{\int b_j^{\frac{4}{3}} (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5}{C4A_k^2 (1 - \lambda)} + \frac{2(1 - \alpha) \int b_j^{\frac{4}{3}} (\alpha + \beta) \left( \int b_j^{\frac{1}{3}} \right)^5}{C4A_k^2 (1 - \lambda)} \\
&\quad - \frac{\delta \lambda \int b_{j,t} (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}{C(1 - \delta\lambda) 4A_k^2 (1 - \lambda)} + \frac{2(1 - \alpha) \delta \lambda \int b_j (\alpha + \beta) \left( \int b_j^{\frac{1}{3}} \right)^6}{C(1 - \delta\lambda) 4A_k^2 (1 - \lambda)} \\
&= (2(1 - \alpha) - (\alpha + \beta)) \frac{\int b_{j,t}^{\frac{4}{3}} (\alpha + \beta) \left( \int b_j^{\frac{1}{3}} \right)^5}{C4A_k^2 (1 - \lambda)} \\
&\quad + (2(1 - \alpha) - (\alpha + \beta)) \frac{\delta \lambda \int b_{j,t} (\alpha + \beta) \left( \int b_j^{\frac{1}{3}} \right)^6}{C(1 - \delta\lambda) 4A_k^2 (1 - \lambda)} \\
\frac{\partial \bar{m}^*}{\partial \alpha} &> 0 \Leftrightarrow 2 > 3\alpha + \beta
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \bar{m}^*}{\partial \lambda} &= \frac{(1-\alpha) \int b_{j,t}^{\frac{4}{3}} (\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^5}{C4A_k^2 (1-\lambda)^2} \\
&+ \frac{(1-\alpha) \delta \int b_{j,t} (\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6}{C4A_k^2} \frac{(1-\delta\lambda)(1-\lambda) - \lambda(-\delta(1-\lambda) - (1-\delta\lambda))}{(1-\delta\lambda)^2 (1-\lambda)^2} \\
&= \frac{(1-\alpha) \int b_{j,t}^{\frac{4}{3}} (\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^5}{C4A_k^2 (1-\lambda)^2} \\
&+ \frac{(1-\alpha) \delta \int b_{j,t} (\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6}{C4A_k^2} \frac{(1-\lambda^2\delta)}{(1-\delta\lambda)^2 (1-\lambda)^2} \\
&> 0
\end{aligned}$$

$$\begin{aligned}
\frac{\partial r^*}{\partial \alpha} &= \frac{(-(\alpha + \beta) + (1-\alpha)) \int b_{j,t}^{\frac{4}{3}} \left( \int b_{j,t}^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{(-(\alpha + \beta) + (1-\alpha)) \delta \lambda \int b_{j,t} \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}{2CA_k (1-\delta\lambda)} \\
&= (1-\beta-2\alpha) \left( \frac{\int b_{j,t}^{\frac{4}{3}} \left( \int b_{j,t}^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{\delta \lambda \int b_{j,t} \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}{2CA_k (1-\delta\lambda)} \right) > 0 \Leftrightarrow 1 > 2\alpha + \beta
\end{aligned}$$

Observe that if  $\beta < 1 - 2\alpha < 2 - 3\alpha$  both  $\frac{\partial r^*}{\partial \alpha} > 0$  and  $\frac{\partial \bar{m}^*}{\partial \alpha} > 0$  while for  $1 - 2\alpha < \beta < 2 - 3\alpha$  we get  $\frac{\partial r^*}{\partial \alpha} < 0$  and  $\frac{\partial \bar{m}^*}{\partial \alpha} > 0$  and for  $\beta > 2 - 3\alpha$  both  $\frac{\partial r^*}{\partial \alpha} < 0$  and  $\frac{\partial \bar{m}^*}{\partial \alpha} < 0$

Observe that sign of

$$\text{sign} \frac{\partial k^*}{\partial \alpha} = \text{sign} \left( \frac{3}{2} \sqrt{\alpha + \beta} \sqrt{1 - \alpha} - \frac{1}{2} \frac{(\alpha + \beta)^{\frac{3}{2}}}{\sqrt{1 - \alpha}} \right)$$

and

$$\begin{aligned}
\frac{3}{2} \sqrt{\alpha + \beta} \sqrt{1 - \alpha} - \frac{1}{2} \frac{(\alpha + \beta)^{\frac{3}{2}}}{\sqrt{1 - \alpha}} &> 0 \\
\frac{3}{2} \sqrt{\alpha + \beta} \sqrt{1 - \alpha} &> \frac{1}{2} \frac{(\alpha + \beta)^{\frac{3}{2}}}{\sqrt{1 - \alpha}} \\
3(1 - \alpha) &> \alpha + \beta \\
3 &> 4\alpha + \beta
\end{aligned}$$

## E Profits in steady state and its comparative statics

### E.1 Calculating profits in steady state

Substituting  $m^*$ ,  $r^*$ ,  $k^*$  and  $e^*$  into profits we get:

$$\begin{aligned}
 \Pi^* &= \frac{(1-\alpha)}{1-\delta} \left( \int b_j^2 \frac{\alpha}{A_e} \right) \tag{26} \\
 &+ \frac{(1-\alpha)}{1-\delta} \left( \frac{(1-\alpha)(\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2}{4CA_k^2} + \frac{(1-\alpha)\delta\lambda(\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \left( \int b_j^{\frac{4}{3}} \right)}{4CA_k^2(1-\delta\lambda)} \right) \\
 &+ \frac{(1-\alpha)}{1-\delta} \left( \left( \frac{(1-\alpha)\lambda(\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}}}{C4A_k^2(1-\lambda)} + \frac{(1-\alpha)\delta\lambda^2(\alpha+\beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2}{C(1-\delta\lambda)4A_k^2(1-\lambda)} \right) \right) \\
 &- \frac{1}{1-\delta} \frac{C}{2} \left( \frac{(1-\alpha)(\alpha+\beta) \left( \int b_j^{\frac{1}{3}} \right)^2 \int b_j^{\frac{4}{3}}}{2CA_k} + \frac{(1-\alpha)\delta\lambda(\alpha+\beta) \left( \int b_j^{\frac{1}{3}} \right)^3 \int b_j}{2CA_k(1-\delta\lambda)} \right)^2
 \end{aligned}$$

Combining lines 2 and 3 above

$$\frac{(1-\alpha)^2(\alpha+\beta)^2}{(1-\delta)4CA_k^2} \left( \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda(1-2\delta\lambda+\delta)}{(1-\lambda)(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} + \frac{\delta\lambda^2 \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2}{(1-\delta\lambda)(1-\lambda)} \right)$$

so that

$$\begin{aligned}
 \Pi^* &= \frac{(1-\alpha)}{1-\delta} \left( \int b_j^2 \frac{\alpha}{A_e} \right) \\
 &+ \frac{(1-\alpha)^2(\alpha+\beta)^2}{(1-\delta)4CA_k^2} \left( \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda(1-2\delta\lambda+\delta)}{(1-\lambda)(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
 &\quad \left. + \frac{\delta\lambda^2 \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2}{(1-\delta\lambda)(1-\lambda)} \right) \\
 &- \frac{(1-\alpha)^2(\alpha+\beta)^2}{(1-\delta)8A_k^2C} \left( \left( \int b_j^{\frac{1}{3}} \right)^2 \int b_j^{\frac{4}{3}} + \frac{\delta\lambda}{(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^3 \int b_j \right)^2
 \end{aligned}$$

Calculating the square in the third line we get

$$\begin{aligned}
\Pi^* &= \frac{(1-\alpha)}{1-\delta} \left( \int b_j^2 \frac{\alpha}{A_e} \right) \\
&+ \frac{(1-\alpha)^2 (\alpha + \beta)^2}{(1-\delta) 4CA_k^2} \left( \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda(1-2\delta\lambda+\delta)}{(1-\lambda)(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta\lambda^2 \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2}{(1-\delta\lambda)(1-\lambda)} \right) \\
&- \frac{(1-\alpha)^2 (\alpha + \beta)^2}{(1-\delta) 8A_k^2 C} \left( \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{2\delta\lambda}{(1-\delta\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta^2\lambda^2}{2(1-\delta\lambda)^2} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right)
\end{aligned}$$

Finally, collecting terms this simplifies to

$$\begin{aligned}
\Pi^* &= \frac{(1-\alpha)}{1-\delta} \frac{\alpha}{A_e} \left( \int b_j^2 \right) + \frac{(1-\alpha)^2 (\alpha + \beta)^2}{(1-\delta) 4CA_k^2} \\
&\times \left( \frac{1}{2} \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda}{(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta\lambda^2(4-3\delta\lambda-\delta)}{4(1-\delta\lambda)^2(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right)
\end{aligned}$$

## E.2 Proof of Comparative statics with respect to steady state profits

### Proof of Proposition 3

The fact that  $\Pi^*$  is decreasing in  $A_e$  and  $A_k$ , and  $C$  is obvious by inspection. So is the fact that  $\Pi^*$  is increasing in  $\beta$ .

Concerning the effects of  $\lambda$  and  $\delta$  on  $\Pi^*$  the only place where there is a possible ambiguity is in  $\frac{\delta\lambda^2(4-3\delta\lambda-\delta)}{4(1-\delta\lambda)^2(1-\lambda)}$ . Let

$$G(\delta, \lambda) = \frac{\lambda^2\delta(4-\delta-3\lambda\delta)}{2(1-\delta\lambda)^2(1-\lambda)}$$

$$\frac{\partial G}{\partial \delta} = \frac{\lambda^2(2-\delta(1+\lambda))}{(1-\lambda)(1-\delta\lambda)^3} \geq 0$$

Since  $\delta$  and  $\lambda$  are in  $[0, 1]$ . Now,

$$\frac{\partial G}{\partial \lambda} = \frac{\delta\lambda P(\delta, \lambda)}{(1-\lambda)^2(1-\delta\lambda)^3},$$

where

$$P(\delta, \lambda) = 2\delta^2\lambda^2 + \delta\lambda^2 - 4\delta\lambda - \delta - 2\lambda + 4.$$

The sign of  $\frac{\partial G}{\partial \lambda}$  is the sign of  $P(\delta, \lambda)$ .

For fixed  $\delta \in (0, 1)$ ,  $P$  is a quadratic polynomial in  $\lambda$ :

$$P(\lambda) = (2\delta^2 + \delta)\lambda^2 - (4\delta + 2)\lambda + (4 - \delta),$$

with leading coefficient  $2\delta^2 + \delta > 0$ . Its discriminant is

$$\Delta = (4\delta + 2)^2 - 4(2\delta^2 + \delta)(4 - \delta) = 4(\delta - 1)^2(2\delta + 1) > 0, \quad (0 < \delta < 1),$$

so there are two real roots. They can be written as

$$\lambda_{\pm} = \frac{1}{\delta} \pm \frac{1 - \delta}{\delta\sqrt{2\delta + 1}}.$$

We now show that both roots exceed 1.

First, clearly

$$\lambda_+ = \frac{1}{\delta} + \frac{1 - \delta}{\delta\sqrt{2\delta + 1}} \geq 1.$$

For  $\lambda_-$ , observe

$$\lambda_- > 1 \iff \frac{1}{\delta} - \frac{1 - \delta}{\delta\sqrt{2\delta + 1}} > 1 \iff 1 - \frac{1 - \delta}{\sqrt{2\delta + 1}} > \delta.$$

Rearranging gives

$$1 - \delta > \frac{1 - \delta}{\sqrt{2\delta + 1}}.$$

which is true on our domain. Hence  $\lambda_- > 1$ . Therefore

$$\lambda_- > 1, \quad \lambda_+ > 1.$$

Since  $P(\delta, 0) = 4 - \delta > 0$ , and  $P(\delta, \lambda)$  is quadratic in  $\lambda$ , it follows that  $P(\delta, \lambda) > 0$  for all  $0 < \lambda < 1$  as we just showed both roots are bigger than one. Thus,

$$\frac{\partial G}{\partial \lambda} > 0.$$

Finally

$$\begin{aligned}
\Pi^* &= \frac{(1-\alpha)}{1-\delta} \frac{\alpha}{A_e} \left( \int b_j^2 \right) + \frac{(1-\alpha)^2 (\alpha+\beta)^2}{(1-\delta) 4CA_k^2} \\
&\quad \times \left( \frac{1}{2} \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda}{(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta\lambda^2 (4-3\delta\lambda-\delta)}{4(1-\delta\lambda)^2 (1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right) \\
\frac{\partial \Pi^*}{\partial \alpha} &= \frac{(1-2\alpha)}{1-\delta} \frac{1}{A_e} \left( \int b_j^2 \right) + \frac{2(1-\alpha)(\alpha+\beta)((1-\alpha)-(\alpha+\beta))}{(1-\delta) 4CA_k^2} \\
&\quad \times \left( \frac{1}{2} \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda}{(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta\lambda^2 (4-3\delta\lambda-\delta)}{4(1-\delta\lambda)^2 (1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right) \\
&= \frac{(1-2\alpha)}{1-\delta} \frac{1}{A_e} \left( \int b_j^2 \right) + \frac{2(1-\alpha)(\alpha+\beta)(1-2\alpha-\beta)}{(1-\delta) 4CA_k^2} \\
&\quad \times \left( \frac{1}{2} \left( \int b_j^{\frac{1}{3}} \right)^4 \left( \int b_j^{\frac{4}{3}} \right)^2 + \frac{\lambda}{(1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^5 \int b_j \int b_j^{\frac{4}{3}} \right. \\
&\quad \left. + \frac{\delta\lambda^2 (4-3\delta\lambda-\delta)}{4(1-\delta\lambda)^2 (1-\lambda)} \left( \int b_j^{\frac{1}{3}} \right)^6 \left( \int b_j \right)^2 \right)
\end{aligned}$$

and the result follows.

## F Examples for comparative statics different talent distributions

Assume that  $b^p$  is lognormally distributed, then the formula for the  $n^{th}$  moment of the lognormal random variable is given by

$$\int (b^p)^n = \exp \left( n\mu + \frac{1}{2} \sigma^2 n^2 \right). \quad (27)$$

where  $\mu$  refers to the mean and  $\sigma^2$  to the variance of the underlying normal distribution of the lognormal distribution and  $n$  is a real number.

Let us start with the baseline variable being  $b$ , which is an intermediate case not

covered in proposition 2 since  $p = 1$ . We first look at optimal meaning  $\bar{m}^*$  given by (14) as

$$\bar{m}^* = \frac{(1 - \alpha) \int b_j^{\frac{4}{3}} (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5}{C 4A_k^2 (1 - \lambda)} + \frac{(1 - \alpha) \delta \lambda \int b_j (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}{C (1 - \delta \lambda) 4A_k^2 (1 - \lambda)}$$

Note that  $\int b_j^{\frac{1}{3}} = \exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)$ ,  $\int b_j = \exp\left(\mu + \frac{1}{2}\sigma^2\right)$ , and  $\int b_j^{\frac{4}{3}} = \exp\left(\frac{4}{3}\mu + \frac{16}{18}\sigma^2\right)$ . Thus

$$\begin{aligned} \bar{m}^* &= \frac{(1 - \alpha) \exp\left(\frac{4}{3}\mu + \frac{16}{18}\sigma^2\right) (\alpha + \beta)^2 \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^5}{C 4A_k^2 (1 - \lambda)} \\ &\quad + \frac{(1 - \alpha) \delta \lambda \exp\left(\mu + \frac{1}{2}\sigma^2\right) (\alpha + \beta)^2 \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^6}{C (1 - \delta \lambda) 4A_k^2 (1 - \lambda)} \\ &= \frac{(1 - \alpha) \exp\left(3\mu + \frac{7}{6}\sigma^2\right) (\alpha + \beta)^2}{C 4A_k^2 (1 - \lambda)} + \frac{(1 - \alpha) \delta \lambda \exp\left(3\mu + \frac{5}{6}\sigma^2\right) (\alpha + \beta)^2}{C (1 - \delta \lambda) 4A_k^2 (1 - \lambda)} \end{aligned} \quad (28)$$

We now compare two talent distributions that can be ranked by SOSD. In particular, we examine how steady state meaning is affected by a change in variance without changing the mean. We use  $\sigma^2 + \Gamma$  which increases variance. But to keep the mean constant we use  $\mu - \frac{1}{2}\Gamma$ , so the mean  $\mu - \frac{1}{2}\Gamma + \frac{1}{2}\sigma^2 + \frac{1}{2}\Gamma$  is constant. This increase in dispersion affects steady state meaning as follows:

$$\begin{aligned} \bar{m}^*(\Gamma) &= \frac{(1 - \alpha) \exp\left(3\mu - \frac{3}{2}\Gamma + \frac{7}{6}\sigma^2 + \frac{7}{6}\Gamma\right) (\alpha + \beta)^2}{C 4A_k^2 (1 - \lambda)} \\ &\quad + \frac{(1 - \alpha) \delta \lambda \exp\left(3\mu - \frac{3}{2}\Gamma + \frac{5}{6}\sigma^2 + \frac{5}{6}\Gamma\right) (\alpha + \beta)^2}{C (1 - \delta \lambda) 4A_k^2 (1 - \lambda)} \\ &= \frac{(1 - \alpha) \exp\left(3\mu + \frac{7}{6}\sigma^2 - \frac{2}{6}\Gamma\right) (\alpha + \beta)^2}{C 4A_k^2 (1 - \lambda)} + \frac{(1 - \alpha) \delta \lambda \exp\left(3\mu + \frac{5}{6}\sigma^2 - \frac{4}{6}\Gamma\right) (\alpha + \beta)^2}{C (1 - \delta \lambda) 4A_k^2 (1 - \lambda)} \end{aligned} \quad (29)$$

and it is clear from (28) and (29) that

$$\bar{m}^*(\Gamma) - \bar{m}^* < 0$$

So an increase in the variance that keeps the mean constant decreases  $m^*$  when  $b_i$  is lognormally distributed.

Now we consider what happens to  $r^*$  in this case. Under the log-normal assumption

$$\begin{aligned}
r^* &= \frac{(1-\alpha) \int b_{j,t}^{\frac{4}{3}} (\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^2}{2CA_k} + \frac{(1-\alpha) \delta\lambda \int b_{j,t} (\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3}{2CA_k (1-\delta\lambda)} \quad (30) \\
&= \frac{(1-\alpha) \exp\left(\frac{4}{3}\mu + \frac{16}{18}\sigma^2\right) (\alpha + \beta) \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^2}{2CA_k} \\
&\quad + \frac{(1-\alpha) \delta\lambda \exp\left(\mu + \frac{1}{2}\sigma^2\right) (\alpha + \beta) \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^3}{2CA_k (1-\delta\lambda)} \\
&= \frac{(1-\alpha) \exp\left(\frac{6}{3}\mu + \frac{18}{18}\sigma^2\right) (\alpha + \beta)}{2CA_k} + \frac{(1-\alpha) \delta\lambda \exp\left(\frac{6}{3}\mu + \frac{12}{18}\sigma^2\right) (\alpha + \beta)}{2CA_k (1-\delta\lambda)}
\end{aligned}$$

Introducing the increase in dispersion we get

$$\begin{aligned}
r^*(\Gamma) &= \frac{(1-\alpha) \exp\left(\frac{6}{3}\left(\mu - \frac{1}{2}\Gamma\right) + \frac{18}{18}(\sigma^2 + \Gamma)\right) (\alpha + \beta)}{2CA_k} \quad (31) \\
&\quad + \frac{(1-\alpha) \delta\lambda \exp\left(\frac{6}{3}\left(\mu - \frac{1}{2}\Gamma\right) + \frac{12}{18}(\sigma^2 + \Gamma)\right) (\alpha + \beta)}{2CA_k (1-\delta\lambda)} \\
&= \frac{(1-\alpha) \exp\left(\frac{6}{3}\mu + \frac{18}{18}\sigma^2\right) (\alpha + \beta)}{2CA_k} + \frac{(1-\alpha) \delta\lambda \exp\left(\frac{6}{3}\mu + \frac{12}{18}\sigma^2 - \frac{6}{18}\Gamma\right) (\alpha + \beta)}{2CA_k (1-\delta\lambda)}
\end{aligned}$$

and it is clear from (30) and (31) that

$$r^*(\Gamma) - r^* < 0$$

So an increase in the variance that keeps the mean constant decreases  $r^*$  when  $b_i$  is lognormally distributed.

We now study  $k^*$  given by (16) which under the assumption of our distribution becomes

$$\begin{aligned}
k^* &= \frac{(1-\alpha)^{\frac{1}{2}} (\alpha + \beta)^{\frac{3}{2}}}{2A_k} \exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right) \left(\exp\left(\frac{2}{3}\mu + \frac{4}{18}\sigma^2\right)\right) \quad (32) \\
&\quad \left(\frac{\exp\left(\frac{4}{3}\mu + \frac{16}{18}\sigma^2\right) \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^2}{2CA_k} + \frac{\delta\lambda \exp\left(\mu + \frac{1}{2}\sigma^2\right) \left(\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right)\right)^3}{2CA_k (1-\delta\lambda)}\right)^{\frac{1}{2}} \\
&= \frac{(1-\alpha)^{\frac{1}{2}} (\alpha + \beta)^{\frac{3}{2}}}{2A_k} \exp\left(\mu + \frac{5}{18}\sigma^2\right) \left(\frac{\exp(2\mu + \sigma^2)}{2CA_k} + \frac{\delta\lambda \exp\left(2\mu + \frac{12}{18}\sigma^2\right)}{2CA_k (1-\delta\lambda)}\right)^{\frac{1}{2}}
\end{aligned}$$

Introducing the increase in dispersion we get

$$\begin{aligned}
k^*(\Gamma) &= \frac{(1-\alpha)^{\frac{1}{2}}(\alpha+\beta)^{\frac{3}{2}}}{2A_k} \exp\left(\left(\mu - \frac{1}{2}\Gamma\right) + \frac{5}{18}(\sigma^2 + \Gamma)\right) \\
&\quad \left(\frac{\exp\left(2\left(\mu - \frac{1}{2}\Gamma\right) + (\sigma^2 + \Gamma)\right)}{2CA_k} + \frac{\delta\lambda \exp\left(2\left(\mu - \frac{1}{2}\Gamma\right) + \frac{12}{18}(\sigma^2 + \Gamma)\right)}{2CA_k(1-\delta\lambda)}\right)^{\frac{1}{2}} \\
&= \frac{(1-\alpha)^{\frac{1}{2}}(\alpha+\beta)^{\frac{3}{2}}}{2A_k} \exp\left(\mu + \frac{5}{18}\sigma^2 - \frac{4}{18}\Gamma\right) \left(\frac{\exp(2\mu + \sigma^2)}{2CA_k} + \frac{\delta\lambda \exp\left(2\mu + \frac{12}{18}\sigma^2 - \frac{6}{18}\Gamma\right)}{2CA_k(1-\delta\lambda)}\right)^{\frac{1}{2}}
\end{aligned} \tag{33}$$

and it is clear from (32) and (33) that

$$k^*(\Gamma) - k^* < 0.$$

So an increase in the variance that keeps the mean constant decreases  $k^{**}$  when  $b_i$  is lognormally distributed.

Introducing the lognormal assumption into steady state utility given by (17) we get

$$\begin{aligned}
u^* &= b_{i,t}^{\frac{4}{3}} \left( \left( \frac{3(\alpha+\beta)^2}{8A_k} \left( \int b_j^{\frac{1}{3}} \right)^2 \right) r^* + \lambda \bar{m}^* \right) + \frac{b_{i,t}^2}{2} \frac{\alpha^2}{A_e} \\
&= b_{i,t}^{\frac{4}{3}} \left( \left( \frac{3(\alpha+\beta)^2}{8A_k} \left( \exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right) \right)^2 \right) r^* + \lambda \bar{m}^* \right) + \frac{b_{i,t}^2}{2} \frac{\alpha^2}{A_e}
\end{aligned}$$

and with the increase in dispersion

$$\begin{aligned}
u^*(\Gamma) &= b_{i,t}^{\frac{4}{3}} \left( \left( \frac{3(\alpha+\beta)^2}{8A_k} \left( \exp\left(\frac{1}{3}\left(\mu - \frac{1}{2}\Gamma\right) + \frac{1}{18}(\sigma^2 + \Gamma)\right) \right)^2 \right) r^*(\Gamma) + \lambda \bar{m}^*(\Gamma) \right) + \frac{b_{i,t}^2}{2} \frac{\alpha^2}{A_e} \\
&= b_{i,t}^{\frac{4}{3}} \left( \left( \frac{3(\alpha+\beta)^2}{8A_k} \left( \exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2 - \frac{2}{18}\Gamma\right) \right)^2 \right) r^*(\Gamma) + \lambda \bar{m}^*(\Gamma) \right) + \frac{b_{i,t}^2}{2} \frac{\alpha^2}{A_e}
\end{aligned}$$

Since  $\bar{m}^*(\Gamma) - \bar{m}^* < 0$ ,  $r^*(\Gamma) - r^* < 0$ , and  $\exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2 - \frac{2}{18}\Gamma\right) - \exp\left(\frac{1}{3}\mu + \frac{1}{18}\sigma^2\right) < 0$ , we have that  $u^*(\Gamma) - u^* < 0$ .

Finally, we study steady state profits given by (18) when  $b_i$  is lognormally distributed by introducing the corresponding expressions of (27) and simplifying we get

$$\begin{aligned}
\Pi^* &= \frac{1}{1-\delta} (1-\alpha) \left( \exp(2\mu + 2\sigma^2) \frac{\alpha}{A_e} \right) \\
&+ \frac{1}{1-\delta} (1-\alpha)^2 \frac{(\alpha + \beta)^2}{4CA_k^2} * \\
&\left( \frac{1}{2} \exp(4\mu + 2\sigma^2) + \frac{\lambda}{1-\lambda} \exp\left(4\mu + \frac{30}{18}\sigma^2\right) + \frac{\lambda^2\delta(2-\delta-\delta\lambda)}{2(1-\lambda)(1-\delta\lambda)^2} \left( \exp\left(4\mu + \frac{4}{3}\sigma^2\right) \right) \right)
\end{aligned} \tag{34}$$

while with the increase in dispersion we get

$$\begin{aligned}
\Pi^*(\Gamma) &= \frac{(1-\alpha)}{1-\delta} \left( \exp(2\mu + 2\sigma^2 + \Gamma) \frac{\alpha}{A_e} \right) \\
&+ \frac{(1-\alpha)^2 (\alpha + \beta)^2}{1-\delta} \frac{1}{4CA_k^2} * \\
&\left( \frac{1}{2} \exp(4\mu + 2\sigma^2) + \frac{\lambda}{1-\lambda} \exp\left(4\mu + \frac{30}{18}\sigma^2 - \frac{6}{18}\Gamma\right) \right. \\
&\left. + \frac{\lambda^2\delta(2-\delta-\delta\lambda)}{2(1-\lambda)(1-\delta\lambda)^2} \left( \exp\left(4\mu + \frac{4}{3}\sigma^2 - \frac{2}{3}\Gamma\right) \right) \right)
\end{aligned} \tag{35}$$

Comparing  $\Pi^*(\Gamma)$  to  $\Pi^*$  we can see that the first line in (35) is bigger than the first line in (34) but the opposite hold for the third line in (35) versus the third line in (34) (which are both multiplied by the same second line). If  $A_e$  is much smaller than  $A_k$  we can get that

$$\Pi^*(\Gamma) - \Pi^* > 0$$

but the opposite holds otherwise. This clearly illustrates that the cases not covered by proposition 2 have to be studied in detail and a SOSD shift (which is a reduction in dispersion keeping the mean constant) might increase or decrease the studied steady state outcome.

To illustrate the case of a convex baseline distribution function which is covered in proposition 2 assume that  $b_j^{\frac{1}{3}}$  is lognormally distributed (hence  $p = \frac{1}{3}$ ) and let's calculate how an increase in dispersion affects  $\bar{m}^*$  given by

$$\bar{m}^* = \frac{(1-\alpha) \int b_j^{\frac{4}{3}} (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^5}{C4A_k^2(1-\lambda)} + \frac{(1-\alpha) \delta\lambda \int b_j (\alpha + \beta)^2 \left( \int b_j^{\frac{1}{3}} \right)^6}{C(1-\delta\lambda)4A_k^2(1-\lambda)}$$

Note then that  $\int b_j^{\frac{1}{3}} = \exp\left(\mu + \frac{1}{2}\sigma^2\right)$ ,  $\int b_j = \exp\left(3\mu + \frac{9}{2}\sigma^2\right)$ , and  $\int b_j^{\frac{4}{3}} = \exp\left(4\mu + \frac{16}{2}\sigma^2\right)$ .

So

$$\begin{aligned}
\bar{m}^* &= \frac{(1-\alpha) \exp\left(4\mu + \frac{16}{2}\sigma^2\right) (\alpha + \beta)^2 \left(\exp\left(\mu + \frac{1}{2}\sigma^2\right)\right)^5}{C4A_k^2(1-\lambda)} \\
&+ \frac{(1-\alpha) \delta\lambda \exp\left(3\mu + \frac{9}{2}\sigma^2\right) (\alpha + \beta)^2 \left(\exp\left(\mu + \frac{1}{2}\sigma^2\right)\right)^6}{C(1-\delta\lambda)4A_k^2(1-\lambda)} \\
&\frac{(1-\alpha) \exp\left(9\mu + \frac{21}{2}\sigma^2\right) (\alpha + \beta)^2}{C4A_k^2(1-\lambda)} + \frac{(1-\alpha) \delta\lambda \exp\left(9\mu + \frac{15}{2}\sigma^2\right) (\alpha + \beta)^2}{C(1-\delta\lambda)4A_k^2(1-\lambda)}
\end{aligned} \tag{36}$$

Change  $\sigma^2 + \Gamma$  which increases variance but keep mean constant by decreasing  $\mu - \frac{1}{2}\Gamma$ , so  $(\mu - \frac{1}{2}\Gamma + \frac{1}{2}\sigma^2 + \frac{1}{2}\Gamma)$  is constant

$$\begin{aligned}
\bar{m}^*(\Gamma) &= \frac{(1-\alpha) \exp\left(9\left(\mu - \frac{1}{2}\Gamma\right) + \frac{21}{2}(\sigma^2 + \Gamma)\right) (\alpha + \beta)^2}{C4A_k^2(1-\lambda)} \\
&+ \frac{(1-\alpha) \delta\lambda \exp\left(9\left(\mu - \frac{1}{2}\Gamma\right) + \frac{15}{2}(\sigma^2 + \Gamma)\right) (\alpha + \beta)^2}{C(1-\delta\lambda)4A_k^2(1-\lambda)} \\
&= \frac{(1-\alpha) \exp\left(9\mu + \frac{21}{2}\sigma^2 + \frac{12}{2}\Gamma\right) (\alpha + \beta)^2}{C4A_k^2(1-\lambda)} + \frac{(1-\alpha) \delta\lambda \exp\left(9\mu + \frac{15}{2}\sigma^2 + \frac{6}{2}\Gamma\right) (\alpha + \beta)^2}{C(1-\delta\lambda)4A_k^2(1-\lambda)}
\end{aligned} \tag{37}$$

and it is clear from (36) and (37) that

$$\bar{m}^*(\Gamma) - \bar{m}^* > 0$$

So when  $b^{\frac{1}{3}}$  is lognormally distributed we get the result from proposition 2 that an increase in the variance that keeps the mean constant indeed increases  $m^*$ . This means that a SOSD shift would reduce  $m^*$ .

## G The roots of the quadratic equation

Anton et al. (1998) analyze the quadratic case where the function  $F(\bar{m}_{t-1}, \bar{m}_t, z)$  can be written as

$$F(\bar{m}_{t-1}, \bar{m}_t, a, b, c, d, e, f) = \frac{1}{2}a\bar{m}_{t-1}^2 + \frac{1}{2}b\bar{m}_t^2 + c\bar{m}_{t-1}\bar{m}_t + d\bar{m}_{t-1} + e\bar{m}_t + f$$

In this case the roots of the characteristic equation determine the approach to the steady state. These roots which we denote by  $\mu_i$  are where  $\delta$  refers to the discount

factor

$$\begin{aligned}\mu_1 &= \frac{1}{2} \left( -\frac{b + \delta a}{\delta c} + \sqrt{\left( \frac{b + \delta a}{\delta c} \right)^2 - \frac{4}{\delta}} \right) \\ \mu_2 &= \frac{1}{2} \left( -\frac{b + \delta a}{\delta c} - \sqrt{\left( \frac{b + \delta a}{\delta c} \right)^2 - \frac{4}{\delta}} \right)\end{aligned}$$

In our case

$$\begin{aligned}a &= -C \frac{4A_k^2 \lambda^2}{\left( (\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3 \right)^2} \\ b &= -C \frac{4A_k^2}{\left( (\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3 \right)^2} \\ c &= C \frac{4A_k^2 \lambda}{\left( (\alpha + \beta) \left( \int b_{j,t}^{\frac{1}{3}} \right)^3 \right)^2}\end{aligned}$$

and therefore the roots are

$$\begin{aligned}\mu_1 &= \frac{1}{2} \left( \frac{1 + \delta \lambda^2}{\delta \lambda} + \sqrt{\left( \frac{1 + \delta \lambda^2}{\delta \lambda} \right)^2 - \frac{4}{\delta}} \right) \\ \mu_2 &= \frac{1}{2} \left( \frac{1 + \delta \lambda^2}{\delta \lambda} - \sqrt{\left( \frac{1 + \delta \lambda^2}{\delta \lambda} \right)^2 - \frac{4}{\delta}} \right)\end{aligned}$$

and since  $\frac{\partial^2 F}{\partial \bar{m}_t \partial \bar{m}_{t-1}} = C \frac{4A_k^2 \lambda}{(\alpha + \beta)^2 \left( \int b_{j,t}^{\frac{1}{3}} \right)^6} > 0$ , we have that the solution is determined by  $\mu_2$ . Therefore,

$$\bar{m}_t = \bar{m}^* + \mu_2^t (\bar{m}_0 - \bar{m}^*)$$