On the Origin of Shared Beliefs (and Corporate Culture)

Preliminary

Eric Van den Steen*

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Abstract

Since organizational homogeneity may reduce or eliminate agency problems, understanding its sources is important for organization design and for the trade-off between firms and markets.

This paper shows that organizational homogeneity will develop because, first, people prefer to hire others with similar beliefs since such others will make the 'right' decisions, and, second, these employees subsequently develop even more homogenous beliefs through shared experiences. The degree of homogeneity will be higher for firms with a longer history, for firms in which employees make more important decisions, and for firms with recent high performance but some big failures in the past. The homogeneity will be highest among the most important employees of the firm, and when the manager has strong convictions. From an outside perspective, firms will often be too homogenous, especially older firms that are faced with many alternatives and that have a manager with a strong prior.

I then relate this to the notion of corporate culture as shared assumptions and beliefs. The model confirms a pattern of 'facts' that has been informally suggested by the management literature. Similar organizations may develop very different cultures or beliefs, which can persist even when all the original members are gone and even when the culture is almost surely suboptimal. The organization's beliefs are heavily influenced by the founder's beliefs and by early experiences, and are more likely to change under an outsider-successor to the CEO than under an insider. The paper also studies the impact of the rate of learning and questions the received interpretation of the correlation between culture and performance.

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1 Introduction

From an agency perspective, one of the most fascinating observations about organizations is how they tend to be more homogenous, in terms of values and beliefs, than society at large. Since agency theory is essentially about how to deal with heterogenous objectives, such homogeneity may eliminate important agency problems from the start.[1] In particular, it may simplify delegation, reduce monitoring, improve communication, facilitate coordination, but reduce the incentives to collect information (Van den Steen 2004). Understanding the sources of homogeneity is thus important not only for the design of organizations and incentive systems, but also for the trade-off between markets and organizations.

This paper does essentially two things, which correspond to the two parts of the paper. The first, and most important, part shows that there are two important mechanisms that will cause homogeneity of beliefs in organizations. The first is sorting in the hiring process. In particular, a manager will prefer to hire employees who have beliefs that are similar to her own, since such employees make the 'right' decisions from her perspective. The second mechanism is that once employees are hired, their beliefs will become even more homogenous through learning from common experiences. After deriving these basic results, I study the comparative statics of homogeneity caused by these mechanisms. The key findings are that homogeneity will be most pronounced in older organizations that have recently been very successful but often also survived serious failures, in organization with a manager who has strong priors, and in organizations where employees make important decisions. Within one firm, the most important employees will be most similar. I also show that organizations are often too homogenous.

It is important to note that this part of the paper also suggests a non-traditional perspective on agency problems. In particular, agency theory has usually taken the objectives of agents as exogenously determined and fixed, and asked the question 'what is the right contract?' This paper shows that objectives, as determined by beliefs, are partially endogenous and thus suggests an alternative question to solve agency problems: 'who is the right agent?', i.e. which agent has the right beliefs, values, and priorities, for this particular task.

The second part of the paper compares some predictions of the model with observations in the management literature. In particular, the management literature often defines corporate culture as shared beliefs or assumptions (Donaldson and Lorsch 1983, Kotter and Heskett 1992, Schein 1985) and has suggested a pattern of 'facts' regarding such culture. This second part of the paper shows that the following observed 'facts', which relate to the content of beliefs rather than to their homogeneity, follow from this paper if we interpret culture as shared beliefs:

- The beliefs of the original leader and its early experiences are important determinants of an organization's culture.

[1] Agency problems at the managerial level, which are the focus of this paper, are typically about 'decisions', i.e. about the optimal course of action, rather than about (literal) 'effort'. As such, these agency problems are often driven by differing beliefs and values regarding alternative actions. While most models in agency theory are formulated in terms of differing utility functions, they usually allow an interpretation as reduced forms for differing beliefs.

- Organizations in identical circumstances may end up with very different cultures.
- Culture may persist, even though all the original members have left.
- Culture may persist, even though it is almost surely suboptimal.
- External succession of the CEO is more likely to lead to a change in culture than internal succession.

This may serve both as a formalization and potential formal explanation of these informally observed 'facts' and as a partial validation of the model. While many of these results, especially in the sorting model, follow straightforwardly from the setup, some other results, such as the influence of the manager on the organization's belief in the learning model and the ensuing succession effect, are more surprising. I also derive some new results that I have not encountered in the management literature. I show, in particular, that slow learning will lead to more diverse cultures across firms and will strengthen the influence of the CEO's original beliefs.

The paper's results may have implications in other areas. The stability of an organization's values and beliefs might help explain the persistent differences in performance of firms in the same industry (Mueller 1990, McGahan 1999). The results on succession and change of culture imply that high performing firms should select an insider successor to a retiring CEO while low performing firms should select an outsider (Parrino 1997). Finally, the result that successful organizations will develop homogenous beliefs raises doubts about the received interpretations of the correlation between culture and performance.

These results are developed in the context of a simple model that tries to capture the formation and learning process of a group of people faced with a new task. One may think of a start-up that get put together and then tries to organize itself. The group is faced with a set of alternative courses of action, or ways of doing things, among which it must choose. At the start, the performance of the alternatives are unknown, and the agents may openly disagree, i.e. I assume that agents may have differing priors, an assumption that I discuss in more detail later. In hiring the employees, the manager will take into account their beliefs since that will determine whether they will take the 'right' decisions from her perspective. Furthermore, by trying out different actions, the group will develop a relative consensus on the best way of doing things. It becomes 'the way we do things around here'. Due to analytical considerations, I study the sorting and learning models separately. The learning model can be considered a multi-armed bandit with instant revelation.

The Literature. Research on the origin of homogenous beliefs is, to my knowledge, new to the economic literature.

Congruity of objectives itself, on the other hand, has been implicit or explicit in a number of key papers in the agency literature (Crawford and Sobel 1982, Baker 1992, Crémer 1993, Aghion and Tirole 1997, Dessein 2002). Van den Steen (2004) interprets some of these in the context of differing beliefs and introduces new aspects, in particular the fact that homogenous beliefs facilitate coordination and that heterogenous beliefs create incentives to collect information, which may be an important factor in innovation and change.

The economic literature on corporate culture is in its early development. The papers most related to this one are Crémer (1993) and Lazear (1995). Crémer (1993) defines culture, following Schein (1985), as a stock of shared knowledge and argues that it improves the efficiency of information processing. The paper, which contains a very interesting model on the coordination effects of shared knowledge, focuses on the effects rather than the causes of shared knowledge. It essentially starts from the premise that culture is useful, apart from some unavoidable side-effects, and tries to explain why. Lazear (1995) also defines culture as 'shared beliefs, values and technology' and considers a 'genetic' evolutionary model of corporate culture, built on the assumption that culture is contagious. His work is complementary to the current paper in that it provides an alternative perspective how culture might evolve. The difference is clearly the level of abstraction, where Lazear takes the genetic nature of culture as a given. He also assumes that culture is useful.

An important alternative model of culture is that presented by Kreps (1990) and further clarified and interpreted by Hermalin (2001). Hermalin points out that there are in fact two notions of corporate culture in Kreps' paper: culture as a mechanism to coordinate in the presence of multiple equilibria and culture as a reputation for dealing in a specific way with unforseen contingencies. Culture as a coordination mechanism is a pure convention, like driving on the left, and thus very fragile.[2] Culture as reputation is valuable, argues Kreps, since it protects employees against abuses of authority in unforseen contingencies. Hermalin argues, however, that this latter notion is based on a fair amount of 'hand-waving.' The key difference with the current paper is that the Kreps-Hermalin model focuses on the effects rather than on the origin of culture, and again seems to start from the premise that culture is essentially good, apart from unavoidable side-effect. Aside from his important discussion of Kreps' model, Hermalin (2001) also summarizes and reinterprets other existing research, and adds to it by linking the topic with insights in other fields of economics, such as IO. Along such lines, Carrillo and Gromb (1999) model corporate culture as production technologies for which employees can make specific investments. The fact that employees choose their investments simultaneously combined with the possibility for the firm to change technology can lead to the coexistence of a strong culture (high investment) equilibrium and a weak culture (low investment) equilibrium. Rob and Zemsky (2002) present a theory in which firms differ in the stationary levels of cooperation among their employees, which they equate with corporate culture, in the sense of a 'stable, [...], pattern of behavior'. This notion of corporate culture is different from the one used in this paper, but is also very interesting. The model in this paper is further related to the work of Prescott and Visscher (1980) and could be extended to overlap with organization capital in their sense. Note, finally, that Greif (1994) considers 'cultural beliefs' an important part of a national culture.

Weber and Camerer (2003) present interesting experimental results that bear on the phenomenon culture. They let pairs of people ('firms') develop, through trial and error, a homemade language for solving problems, which they interpret as the firm's culture. They then merge groups and show that their performance declines after the merger. A key difference with the current theory is that culture in their sense has an obvious performance

[2]Including 'driving on the left' as a part of culture opens the possibility that culture might be changed by law.

advantage.

Apart from drawing attention to the important issue of homogeneity and the need to sometimes consider the agents' objectives as endogenous, this paper's contributions are to show that organizations have a natural tendency to develop homogeneity through sorting and shared experiences, to identify circumstances that will be conducive to homogeneity, to link it to the notion of corporate culture, to explain the pattern of 'facts' on corporate culture that have been informally suggested by the managerial literature, and to generate some new predictions in this context. Note also that this paper does not assume that homogeneity or culture on itself is good. It just says that homogeneity and culture will tend to develop naturally and that this has important implications. On the contrary, it shows that there will often be too much homogeneity.

The next section describes the model of the paper. Section 3 develops the basic homogeneity results and section 4 derives comparative statics. Section 5 discusses the relationship with performance. Section 6 considers the pattern of results related to corporate culture. Section 8 concisely discusses potential tests, while section 7 discusses the interaction between learning and sorting. Section 9, finally, concludes. The appendices contain a further discussion of culture and its definitions and a some lemmas on the sorting and learning models.

2 The Model

The model tries to capture the situation of a new group that gets formed and that is faced with a new task. One could think of a new product development group which gets formed and then slowly finds its ways, as described in McCaskey (1997), or a start-up, as in Schein (1985).

In choosing the group's members, a rational manager will want to make sure that these members make the 'right' decisions, which typically means the decisions the manager would have made when faced with the same issues.[3] This leads the manager to select employees who hold beliefs that are similar to her own. Once formed, the group will try alternative ways of going about their work, starting with those that its manager considers most effective. Depending on the outcomes, the group will learn and may try other alternatives. Formally, the group is thus faced with a repeated choice among alternative ways of getting things done. Over time, the members of the group come to share beliefs about what works and what doesn't.

To study this formally, consider an organization with one manager, m, and J employees. After the formation process, which I will describe below, the organization is faced with an infinitely repeated δ-discounted game. In each period, each member of the organization has to choose an action from a set, A, of N actions, a_n, with payoffs ρ_{a_n}. Let $\hat{a}_i^t$ denote the action that agent i chooses in period t. Each employee j tries to maximize the present value of his own actions, $\sum_{t=1}^{\infty} \delta^{t-1} \rho_{\hat{a}_j^t}$. The manager tries to maximize the present value of the

[3]The earlier working paper Van den Steen (2002a) discussed in more generality when a manager will want to hire employees with similar beliefs. A shorter note that focuses completely on this issue is in preparation.

total organizational payoff, which is $\beta \sum_{j=1}^{J} \alpha_j \left(\sum_{t=1}^{\infty} \delta^{t-1} \rho_{\hat{a}_j^t} \right) + (1-\beta) \sum_{t=1}^{\infty} \delta^{t-1} \rho_{\hat{a}_m^t}$ with $\sum_{j=1}^{J} \alpha_j = 1$, where β parameterizes the importance of the employees' actions relative to those of the manager, and the α_j parameterize the importance of the employees' actions relative to each other. I assume that actions are non-contractible. As I will discuss in section 3.3, this assumption is not necessary but facilitates the analysis considerably.

Action a's payoff, ρ_a, is initially unknown but agents have their own subjective beliefs about ρ_a. In particular, agent i's prior belief is that ρ_a is distributed according to some distribution $G_{a,i}(\rho)$ with mean $r_{a,i}$. Only the means will play a role in the analysis, so I will simply refer to $r_{a,i}$ as 'beliefs', and completely disregard the $G_{a,i}$. It is commonly known that these $r_{a,i}$ may differ, which implies that I do not impose the common prior assumption.[4] The payoffs ρ_a and the priors $r_{a,i}$ are i.i.d. distributed according to some distribution F, with the joint distribution denoted $\mathcal{F}$. Note that these distributions are *not* priors, but empirical distributions that just happen to reflect the distribution in the population.

In terms of observability, I assume for most of the paper that the actions and outcomes of the manager are costlessly observed by all members of her firm, but by no one outside the firm. This latter assumption should not be controversial.[5] In fact, I only need that insiders observe more of the manager's actions and outcomes than outsiders, but the more extreme assumption facilitates the analysis. I will sometimes deviate slightly from this basic assumption and assume that the manager must invest in order for her actions and outcomes to be observed by the employees in her firm. Except for proposition 13, the actions of the employees will never be observed by anyone, an assumption which I must make for tractability reasons.

Consider now the hiring process. At the start of the game, the manager faces one candidate for each of the J positions, randomly drawn from the population. Candidates are position specific. At a cost c, the manager can learn the beliefs of a specific candidate and, if necessary, replace him with a new candidate, again randomly drawn. When the manager is satisfied with a candidate, she hires this employee. This process repeats for each of the J

[4]Differing beliefs do not contradict the economic paradigm: while rational agents should use Bayes' rule to update their prior with new information, nothing is said about those priors themselves, which are primitives of the model. In particular, absent any relevant information agents have no rational basis to agree on a prior. Harsanyi (1968), for example, observed that 'by the very nature of subjective probabilities, even if two individuals have exactly the same information and are at exactly the same high level of intelligence, they may very well assign different subjective probabilities to the very same events'. For a further discussion, see Morris (1995), Yildiz (2000), or Van den Steen (2002b). Note that it is commonly known in this model that agents have no private information beyond what they observe about the actions of their organization. An agent will not be able to infer anything from the fact that other agents in his organization hold beliefs that are different from his own.

[5]Competitors of Caterpillar, Walmart, or McKinsey, for example, have tried for years to understand these firms' recipes for success, with little success. There are multiple reasons why it is so difficult to figure out what other organizations are doing. One reason is that it is very difficult to describe and communicate something as complex as an organization's way of doing things. It is like trying to describe a person's face in all details. Such things are nearly impossible without direct observation and active participation, or years of coaching and detailed stories. Another reason is that firms have incentives to keep their successful practices secret. Note that I do *not* assume that no actions or outcomes can be observed. But I abstract from the dimensions that are easy to observe.

positions, in random order.

Since the interaction between the hiring and the learning process is very complex,[6] I will consider them separately. They correspond to extreme assumptions on the parameters of the model in the following way.

In the first case, which I will refer to as the **sorting case**, I assume that the first period lasts forever, i.e. the discount rate is zero.

Assumption 1 $\delta = 0$

In this case, there is essentially only one period, so that the learning process will not play any role in hiring decisions or action choices.

In the second case, which I will refer to as the **learning case**, I assume that learning a candidate's beliefs is prohibitively expensive.

Assumption 2 $c = \infty$

Under this assumption, the manager will immediately accept all candidates, so that the employees are essentially randomly drawn from the population.

3 Shared Beliefs

This section establishes that, through sorting and learning, organizations will be more homogenous than society at large. Before getting to that point, though, I need to be more precise on the meaning and measurement of belief homogeneity, since it plays such a central role in the analysis.

3.1 Measuring homogeneity

While homogeneity of beliefs is a straightforward idea, there are multiple ways to formally define and measure it. In fact, nearly any specific agency model will typically lead to a slightly different measure of homogeneity. Nevertheless, both simple intuition and the analysis in Van den Steen (2004) suggest that two measure will be of particular importance.

Probably the most attractive measure of homogeneity is the likelihood that two randomly selected members of the organization agree on which action has the highest payoff. To define this measure formally, consider the start of period t. Let $\tilde{a}_i^t$ denote the action that has the highest payoff according to agent i and let $\mathcal{F}_e$ denote the joint distribution of employee beliefs. This measure of homogeneity is then defined as

$$H_1^t = E_{\mathcal{F}_e}\left[\frac{\sum_{i=1}^{J}\sum_{j=1}^{i-1} I_{\tilde{a}_i^t=\tilde{a}_j^t}}{J(J-1)/2}\right]$$

[6] Not even with the priors and values i.i.d. standard normal, will the posteriors be either independent or identical or even symmetric. Instead, they are always completely jointly distributed with a density that escapes analytical expression. This makes it impossible to determine the benefit of hiring someone with more similar beliefs when there is also learning. It will also explain some other compromises in the learning model.

where I is the indicator function. A nice aspect of this measure is that it is directly related to the probability that two randomly selected members will actually 'do the same thing' and thus to 'the way we do things around here.' Furthermore, Van den Steen (2004), shows how it is the key measure for the impact of homogeneity on, for example, monitoring and delegation.

A shortcoming of H_1^t is that it does not reflect 'how much' two agents agree or disagree. A measure that is very good in this respect is the average squared Euclidean distance (at the start of the period) between the means of the beliefs of two randomly selected members. Let $\hat{d}(\mathbf{r}_i^t, \mathbf{r}_j^t) = \sum_{n=1}^{N}(r_{a_n,i}^t - r_{a_n,j}^t)^2$, then

$$H_2^t = -E_{\mathcal{F}_e}\left[\frac{1}{J(J-1)}\sum_{i=1}^{J}\sum_{j=1}^{J}\hat{d}(\mathbf{r}_i^t, \mathbf{r}_j^t)\right]$$

Van den Steen (2004) shows that this measure can be derived from H_1^t, and that it plays an important role in the incentives to collect and communicate information.

The use of H_2^t typically raises the natural question why not to use the regular, i.e. *non-squared*, Euclidean distance. The reason to attach more importance to H_2 is that it arises more naturally from agency models. Nevertheless, since regular distance is such a 'natural' measure, I will also consider it. To that purpose, let $d_e(\mathbf{r}_i^t, \mathbf{r}_j^t) = \sqrt{\sum_{n=1}^{N}(r_{a_n,i}^t - r_{a_n,j}^t)^2}$, then

$$H_3^t = -E_{\mathcal{F}_e}\left[\frac{1}{J(J-1)}\sum_{i=1}^{J}\sum_{j=1}^{J}d_e(\mathbf{r}_i^t, \mathbf{r}_j^t)\right]$$

3.2 Organizational homogeneity

I now show that members of the same organization will hold more similar beliefs than society at large, because of sorting in the hiring process and learning through shared experiences. While this result on itself should be no surprise, it has real significance. In particular, it shows that a few simple facts (the observation that managers often believe that they know best and the fact that it is more difficult for an outsider than for an insider to observe a firm's actions and outcomes) lead to a powerful outcome in terms of agency theory, homogeneity.

Sorting Consider first the sorting model. For the formal result, consider three agents of which two, denoted 1 and 2, belong to one organization, say f, while the third agent, denoted 3, belongs to a different organization g. Let $\tilde{a}_i$ denote the action that has the highest payoff according to agent i. The following proposition shows that beliefs are more homogenous within firms than between firms, according to any of the three measures.

Proposition 1a *Consider A1. For any two agents 1 and 2 of some organization f, and any agent 3 of some other organization g, $P[\tilde{a}_1 = \tilde{a}_2] \geq P[\tilde{a}_1 = \tilde{a}_3]$, $E[\hat{d}(\mathbf{r}_1, \mathbf{r}_2)] \leq E[\hat{d}(\mathbf{r}_1, \mathbf{r}_3)]$, and $E[d_e(\mathbf{r}_1, \mathbf{r}_2)] \leq E[d_e(\mathbf{r}_1, \mathbf{r}_3)]$.*

Proof : Lemma 3 derives the optimal hiring strategy of the manager. From that result, note that all actions in $\hat{A}$ are equally likely for each employee. It follows that the probability that the actions

are identical equals $\frac{1}{\hat{n}}$. Note also that each action is ex ante equally likely to be selected to be in $\hat{A}$. It follows that $\frac{1}{\hat{n}} = P[\tilde{a}_1 = \tilde{a}_2] \geq P[\tilde{a}_1 = \tilde{a}_3] = \frac{1}{N}$. This proves the first part of the proposition. For the second part of the proposition, note that we can rewrite $-H_2$ as

$$E_{\mathcal{F}_e}\left[\sum_{n=1}^{N}(r_{a_n,i} - r_{a_n,j})^2 \mid \tilde{a}_i = \tilde{a}_j\right]$$
$$+ \quad \left(E_{\mathcal{F}_e}\left[\sum_{n=1}^{N}(r_{a_n,i} - r_{a_n,j})^2 \mid \tilde{a}_i \neq \tilde{a}_j\right] - E_{\mathcal{F}_e}\left[\sum_{n=1}^{N}(r_{a_n,i} - r_{a_n,j})^2 \mid \tilde{a}_i = \tilde{a}_j\right]\right) P[\tilde{a}_i \neq \tilde{a}_j]$$

Since, by the above argument, $P[\tilde{a}_i \neq \tilde{a}_j]$ is larger for employees of different firms, it suffices to show that

$$E_{\mathcal{F}_e}\left[\sum_{n=1}^{N}(r_{a_n,i} - r_{a_n,j})^2 \mid \tilde{a}_i \neq \tilde{a}_j\right] \geq E_{\mathcal{F}_e}\left[\sum_{n=1}^{N}(r_{a_n,i} - r_{a_n,j})^2 \mid \tilde{a}_i = \tilde{a}_j\right]$$

To prove this, consider the following operation. Fix a set of r_a for two agents, i and j. Rename actions such that $\tilde{a} = a_1$ for the first agent. Let a_n be the $\tilde{a}$ of the other agent. With $a_n = a_1$, we have the right hand side, while with $a_n \neq a_1$ we have the left hand side. All we have to show is that when going from $a_n \neq a_1$ to $a_n = a_1$, keeping all values and other actions fixed, the distance decreases. To that purpose, assume that $a_n \neq a_1$. Now switch the values of a_1 and a_n for the second agent. The claim is that this decreases the squared distance between the two. This is the same as saying that if $a > b$ and $c < d$ then $(a-c)^2 + (b-d)^2 \geq (a-d)^2 + (b-c)^2$, which indeed holds. The completes the proof of the second part.

The argument for H_3 is completely analogous. ■

The intuition for this result is that managers want to hire employees who make the 'right' decisions, i.e. employees whose optimal action is among the best actions according to the manager. Since employees are thus sorted to look a bit like the manager, they will also look a bit like each other. It is this effect that results in homogeneity.

Learning To obtain the result formally for the learning model, I consider again the above setting with 2 firms and 3 agents. The proposition says that also with learning, beliefs will be more homogenous according to any of the measures.

Proposition 1b *Consider A2. For any period t, any two agents 1 and 2 of some organization f, and any agent 3 of some other organization g, $P[\tilde{a}_1^t = \tilde{a}_2^t] \geq P[\tilde{a}_1^t = \tilde{a}_3^t]$, $E[\hat{d}(\mathbf{r}_1^t, \mathbf{r}_2^t)] \leq E[\hat{d}(\mathbf{r}_1^t, \mathbf{r}_3^t)]$, and $E[d_e(\mathbf{r}_1^t, \mathbf{r}_2^t)] \leq E[d_e(\mathbf{r}_1^t, \mathbf{r}_3^t)]$.*

Proof : For the first part of the proposition, fix a set of payoffs $(\rho_a)_{a\in A}$. Fix an action, say $\check{a}$, and let the sample point ω denote a realization of $(\rho_a)_{a\in A}$ and $(r_{a,i})_{a\in A}$ for all relevant agents i in the model. Let $X_{\check{a},1} = \{\omega : r_{\check{a},1}^t \geq r_{a,1}^t \; \forall a \in A\}$ denote the event that member 1 considers $\check{a}$ to be the best action. It is sufficient to show that $P[X_{\check{a},1} \cap X_{\check{a},2}] \geq P[X_{\check{a},1} \cap X_{\check{a},3}]$. Conditional on $(\rho_a)_{a\in A}$, $X_{\check{a},1}$ and $X_{\check{a},3}$ are independent. Moreover, by symmetry $P[X_{\check{a},1}] = P[X_{\check{a},2}] = P[X_{\check{a},3}]$, so that it is sufficient to show that $P[X_{\check{a},1} \cap X_{\check{a},2}] \geq P[X_{\check{a},1}]^2$ or $P[X_{\check{a},1} \mid X_{\check{a},2}] \geq P[X_{\check{a},1}]$, where 1 and 2 are in the same firm, or that $P[X_{\check{a},1} \mid X_{\check{a},2}] \geq P[X_{\check{a},1} \mid \overline{X_{\check{a},2}}]$ or $P[r_{\check{a},1}^t \geq r_{a,1}^t \; \forall a \in A \mid r_{\check{a},2}^t \geq r_{a,2}^t \; \forall a \in A] \geq P[r_{\check{a},1}^t \geq r_{a,1}^t \; \forall a \in A \mid \exists a \in A : r_{\check{a},2}^t < r_{a,2}^t]$ which is straightforward.

For the second part of the proposition, note that for any agents i and j $E[d(\mathbf{r}_i^t, \mathbf{r}_j^t)] = E\left[\sum_{a\in A}(r_{a,i}^t - r_{a,j}^t)^2\right] = E\left[\sum_{a\in B_i^t\cap B_j^t} 0 + \sum_{a\in A\setminus(B_i^t\cap B_j^t)}(r_{a,i}^t - r_{a,j}^t)^2\right]$. Since $\{a \in B_1^t \cap B_3^t\} \subset \{a \in B_1^t\} = \{a \in B_1^t \cap B_2^t\}$ (using $B_1^t \cap B_2^t = B_1^t$ when 1 and 2 are part of the same organization), the second part follows. The argument for the third part is analogous. ■

In this case, beliefs converge since they get updated with the same information. This also leads agents to agree more often on the optimal action. Those results formally establishes that joint experience will lead to shared beliefs.

3.3 Discussion

The role of non-contractibility The model of section 2 assumed that actions were not contractible. How does that assumption affect the results? Consider first the sorting model. Van den Steen (2002a) shows that we will have sorting *even when actions are contractible*, as long as employees care about the outcome of their actions. The reason is that managers will have to compensate employees with differing beliefs for the fact that they have to undertake actions that are 'suboptimal' from their perspective. Moreover, if the employee cares more about the outcome of his action than the manager, then the optimal contract will specify that the employee undertakes the action that the employee considers best. In this case, contractibility is completely irrelevant. Sorting only goes away when actions are contractible *and* employees don't care about their outcomes at all. While employees will typically care less about the actions' outcomes when actions are contractible, e.g. because the labor market realizes that the action choice does not reflect the employee's abilities, the effect will never completely disappear. It follows that sorting will nearly always happen, even when actions are contractible. In the learning model, on the other hand, contractibility will have no effect on the evolution of beliefs and thus on the homogeneity. Section 4.2 will discuss the effect of non-contractibility in the context of comparative statics.

There is, however, a very direct effect of contractibility on homogeneity. In particular, when actions are contractible they will all reflect more often the beliefs of the manager. This leads to a direct homogeneity of behavior.

The role of differing priors As mentioned earlier, the assumption of differing priors is not fundamental for the results, but is important to keep the model focused and transparent. Much as Aumann (1987) argued that the common prior assumption allows us to 'zero in on purely informational issues', the use of differing priors in this paper allows us to zero in on the effect of open disagreement. In both cases, the assumption is a simplification of the world for the benefit of transparency and tractability. Since disagreement is at the core of the argument here, the use of differing priors seems to be the most appropriate approach from an analytical perspective.

To give some more perspective on this issue, consider the model of this paper, but now with a common prior and differing information. Note first that if beliefs are perfectly observable within a firm, or communication is costless, then we will get instantaneous homogeneity of beliefs within the firm. Sorting and learning are not necessary any more to get homo-

geneity. It is still possible to have disagreement across firms when it is more difficult to observe beliefs across firms, or agents gain from communicating with colleagues but not with competitors. This is a strong homogeneity result. While this is probably part of what really happens, casual observation suggests that this misses some of the most interesting issues: any differences between firms would disappear when people can move between firms, and culture clash would be non-existent.

As soon as there is a non-negligible cost to observing beliefs or to communication, however, the results of this paper appear, including all the comparative statics. When disagreement is driven by information, however, the analysis becomes very complex. For one thing, agents constantly update their beliefs based on what they see others do. After a manager has learned an employee's beliefs, the decision whether or not to hire the employee gives information to all employees of the firm. Moreover, the manager may want to learn the employee's beliefs, just to get more information. Apart from all these updating issues, we also have to worry about signaling. For example, a manager might be reluctant to experiment since that may signal bad information about her earlier actions. While all these issues are interesting and important on themselves, they cloud very much the main focus of the analysis: how homogeneity gets generated through sorting and learning. I therefore formulated the model completely with differing priors and postponed information effects to later analyses.

Note also that we could reformulate the model in terms of differing utilities or values, or in terms of differing personal traits. While the learning results would disappear, the sorting results would remain as long as the manager is affected by the values or behavior of the employees. A manager who cares deeply about ethical conduct or social responsibility will prefer to hire people with the same values, since she will want her firm to act in a manner consistent with these values. A manager who prefer informal interactions will tend to hire people who have the same informal attitude.

4 Comparative Statics

Given its potential importance in mediating agency conflicts, understanding the factors that may stimulate such homogeneity is important for the design of organizations and incentives, among other things. The following sections study these factors.

4.1 Evolution over time

Since shared experience drives homogeneity, it is reasonable to conjecture that organizations with more experience will be more homogenous. The following proposition proves that this is true in the learning model. To be more precise, it says that the probability of agreement between two agents in the same organization increases monotonically over time while the distance between their beliefs, as measured by H_2 or H_3, decreases monotonically over time.

Proposition 2 *For any period t and any members 1 and 2 of the same organization, $E[\hat{d}(\mathbf{r}_1^t, \mathbf{r}_2^t)] \geq E[\hat{d}(\mathbf{r}_1^{t+1}, \mathbf{r}_2^{t+1})]$, $E[d_e(\mathbf{r}_1^t, \mathbf{r}_2^t)] \geq E[d_e(\mathbf{r}_1^{t+1}, \mathbf{r}_2^{t+1})]$, and $P[\tilde{a}_1^t = \tilde{a}_2^t] \leq P[\tilde{a}_1^{t+1} = \tilde{a}_2^{t+1}]$.*

Proof : For the first two parts of the proposition it is sufficient, by the proof of proposition 1b, that the number of action tried by organization f increases over time. This is of course the case.

Consider then the last part of the proposition, that the probability of agreement increases over time. Condition on $(\rho_a)_{a\in A}$, on B^t (the revealed set at the beginning of the period), and on $\{r_{a,m}\}_{a\in A}$ (the set of priors of the principal). Let the current best known action in period t be $\hat{a}$, with performance $\rho_{\hat{a}}$. Let $k = \#(A \setminus B^t)$ denote the number of unknown actions.

We need to prove that the probability of two randomly selected agents agreeing increases when the set of known actions goes from B^t to $B^t \cup \check{a}$, or the number of unknown actions goes down from k to $k-1$. Since the proposition is trivial when $k = 1$, I will assume $k \geq 2$.

The probability that two agents agree on $\hat{a} = \text{argmax}_{a\in B^t}\,\rho_a$ as the best action is $F(\rho_{\hat{a}})^{2k}$. The probability that they agree on some particular unknown action is (by independence of their beliefs) the product of the probabilities that one member thinks that action is best. That latter probability is $\int_{\rho_{\hat{a}}}^{\infty} F(u)^{k-1} f(u)\,du = \frac{1}{k}\left[1 - F(\rho_{\hat{a}})^k\right]$. The overall probability of agreement, given $\rho_{\hat{a}}$, is thus $F(\rho_{\hat{a}})^{2k} + \frac{1}{k}\left[1 - F(\rho_{\hat{a}})^k\right]^2$ or, with $F = F(\rho_{\hat{a}})$, $P(k, F) = F^{2k} + \frac{1}{k}\left[1 - F^k\right]^2$.

Consider now what happens when a new action $\check{a}$ gets tried. If $\rho_{\check{a}} < \rho_{\hat{a}}$, then it just is as if one action got removed from $A \setminus B^t$. The probability of agreement is then $P((k-1), F) = F^{2(k-1)} + \frac{1}{(k-1)}\left[1 - F^{(k-1)}\right]^2$. If, however, $\rho_{\check{a}} > \rho_{\hat{a}}$, then $\check{a}$ becomes the new best known action. Denote $\check{F} = F(\rho_{\check{a}})$, then the probability of agreement becomes $P((k-1), \check{F}) = \check{F}^{2(k-1)} + \frac{1}{(k-1)}\left[1 - \check{F}^{(k-1)}\right]^2$ with $\check{F} \geq F$.

Combining these equations implies that we need to show that $\Delta P = \check{F}^{2(k-1)} + \frac{1}{(k-1)}\left[1 - \check{F}^{(k-1)}\right]^2 - \left(F^{2k} + \frac{1}{k}\left[1 - F^k\right]^2\right) \geq 0$ for $k \geq 2$, $F, \check{F} \in [\,0, 1\,]$ and $\check{F} \geq F$. A long and tedious analysis shows that this holds.[7] ■

Note that this result assumes that the environment is static and that there is no turnover. Especially with change, we will have to be more careful on how to formulate the result although the basic ideas remain valid. The aspects change and turnover are briefly touched upon in section 6.6.

In the sorting model as specified in this paper, the homogeneity will not increase over time. Note, however, that this derives completely from the assumption that all sorting is instantaneous and takes place at the beginning of the game. In a more realistic model, sorting would take place over time, through turnover, if only because it takes time to learn a person's beliefs. In that case, homogeneity would also increase over time in the sorting model.

4.2 Importance of employee decisions

Managers have more interest in making sure their employees hold the 'right' beliefs when these employees make more important decisions. As a consequence, if managers can affect it, belief homogeneity will be higher in firms where employees are more involved in decision making, as captured by β.[8]

[7] A formal proof is available from the author.

[8] Once agency problems are introduced in the model, employee involvement becomes an even bigger factor since homogeneity is an important determinant of delegation, monitoring, communication, and coordination

Sorting This effect is very clear in the sorting model since the motivation for sorting is exactly the fact that employees are involved in decision making. The following proposition captures that fact, showing that H_1, H_2, and H_3 increase when β is higher.

Proposition 3a *Consider A1. For any two employees 1 and 2,* $P[\tilde{a}_1 = \tilde{a}_2]$ *increases while* $E[\hat{d}(\mathbf{r}_1, \mathbf{r}_2)]$ *and* $E[d_e(\mathbf{r}_1, \mathbf{r}_2)]$ *decrease in* β*.*

Proof : This follows from lemmas 4 and 5. ■

Firms in which employees make more important decisions will thus spend more resources on recruiting for fit.

Learning Something very similar happens in the learning model when the manager can affect the learning process. While the basic model of section 2 assumes that employees always observe all actions and outcomes of the manager at no cost, reality is different. Making sure that employees observe the actions and outcomes requires investments. Such investments come in different forms: involving employees in decision making, socializing new employees with stories about the organization's great successes and failures, or creating explicit policies about best practice and 'the way we do things around here', in order to force employees to learn about the benefits of certain practices. Since such investments are costly, they will only be made when employees make important decisions.[9] It follows that also in this case, homogeneity will increase as employees play a more important role in decision making.

The formal study of this mechanism poses some analytical issues, since the posterior beliefs are not independent any more. I will therefore focus the analysis on a relatively simple case.

Consider, in particular, the following model where the manager invests in employee learning. Assume that, at the end of period 1, the manager can, with probability $p \downarrow 0$, involve employees at a cost $c > 0$ to the organization. With employees involved, they learn the first period action and return. The following propositions says that the homogeneity will increase in the importance of employee decisions.

Proposition 3b *The probability of investment,* H_1*,* H_2*, and* H_3 *all increase in* β*.*

Proof : I drop the superscript references to the period (all r's are prior beliefs). Let, wlog., the manager's action in the first period be a_1 and let the return be denoted R.

Let $\hat{V}$ denote the expected per-period payoff from the manager's actions, taking the manager's perspective at the start of period 2. Let V^0 denote the total expected per-period payoff of the organization, from the manager's perspective at the start of period 2, when the manager does not invest. Without investment, employee actions are essentially random from the manager's perspective. Therefore $V^0 = (1-\beta)\hat{V} + \beta\frac{R+\sum_{i=2}^{N} r_{a_i,m}}{N}$.

problem (Van den Steen 2004).

[9] These investments would also have value if the employees had to expend private effort that is complementary, in their payoff, to the probability of success of the course of action. I will not consider that case here.

Let $P(R)$ denote the ex-ante probability that the employee will undertake a_1 when the manager invests in employee learning and the return on the first action is R. Since $P(R)$ is the probability that R is the highest return for the employee, $P(R) = F(R)^{N-1}$

Let V^1 denote the expected per-period payoff from the manager's perspective at the start of period 2, when the manager does invest. $V^1 = (1-\beta)\hat{V} + \beta R P(R) + \beta \sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1}(1-P(R))$ so that $V^1 - V^0 = \beta\left(R - \sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1}\right)\left(P(R) - \frac{1}{N}\right)$ so that the manager will invest iff

$$\left(R - \sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1}\right)\left(F(R)^{N-1} - \frac{1}{N}\right) \geq \frac{c}{\beta} \tag{1}$$

Let now $\hat{R}$ be defined by $F(\hat{R}) = \left(\frac{1}{N}\right)^{\frac{1}{N-1}}$. If $R \geq \hat{R}$, the manager will invest iff $R - \frac{c}{\beta\left(F(R)^{N-1} - \frac{1}{N}\right)} \geq \sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1}$ so that the probability of investment increases in β and R. If $R < \hat{R}$ then we can rewrite the condition for investment as $\left(\sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1} - R\right)\left(\frac{1}{N} - F(R)^{N-1}\right) \geq \frac{c}{\beta}$ so the manager will invest iff $\sum_{i=2}^{N} \frac{r_{a_i,m}}{N-1} \geq R + \frac{c}{\beta\left(\frac{1}{N} - F(R)^{N-1}\right)}$ so that the probability of investment increases when β increases or R decreases.

All that is left to prove is that the levels of homogeneity increase as the manager makes the investment. Given that we assumed $p \downarrow 0$, the level of homogeneity when the manager does not invest is that of employees without any information. When the manager invests, $H_1 = P(R)^2 + (N-1)\left(\frac{1-P(R)}{N-1}\right)^2 = \frac{(N-1)P(R)^2 + (1-P(R))^2}{N-1}$ which reaches it minimum at $P(R) = \frac{1}{N}$ which is the prior H_1. For H_2 and H_3, this follows immediately from the proof of proposition 1b. ■

Appendix A discusses some further issues related to the role of employee involvement in the learning model. It discusses in particular:

- why it is more difficult for competing firms than for employees to learn from a focal firm's experience,
- how employees' role in decision making increases the incentives for the manager to experiment, which then leads to further homogeneity, and
- how all agents will reach a perfect consensus on the optimal course of action if the actions and outcomes of *all* employees are observed.

Importance of individual employees The above analysis shows that beliefs will be more homogenous in firms where employees make more important decisions. Something analogous is true *within* a firm: homogeneity will be stronger among more important employees. This is easy to see in the sorting model. The following proposition says that H_1, H_2, and H_3 will be higher among employees who make more important decisions.

Proposition 4 *Consider A1. Consider employees i, j, k, l of one and the same firm. If $\alpha_i > \alpha_k$ and $\alpha_j > \alpha_l$, then $P[\tilde{a}_i = \tilde{a}_j] \geq P[\tilde{a}_k = \tilde{a}_l]$, $E[\hat{d}(\mathbf{r}_i, \mathbf{r}_j)] \leq E[\hat{d}(\mathbf{r}_k, \mathbf{r}_l)]$, and $E[d_e(\mathbf{r}_i, \mathbf{r}_j)] \leq E[d_e(\mathbf{r}_k, \mathbf{r}_l)]$.*

Proof : The proof is completely analogous to the proof of proposition 3a. ■

The same will be true in the case of learning when the investments in learning are employee-specific. This result is important from a practical and from an empirical perspective. It says that those people within a firm who make important non-contractible decisions will be most enculturated.

Non-contractibility Since the investment in socialization is driven by a desire to affect the employees' choice of action, we should see more homogeneity in organizations where the employees' actions are less contractible. We can get more or less to this result by interpreting β as the combination of non-contractibility and employee involvement, i.e. as the share of the firm's outcome that depends on non-contractible decisions by employees. The above comparative static then suggests that there will be more homogeneity in firms in which the employees' decisions are less contractible. A formal analysis is more complicated since the above interpretation only holds when the impact of the actions on the employee's utility is negligible relative to their impact on the firm's profits.

4.3 Past successes and failures

When managers can actively invest in homogeneity, either through sorting or through investments in employee learning, the firm's performance history becomes another important determinant of homogeneity. In particular, as the best action gets better and the worst actions get worse, the manager has more to gain from making sure that the employees take the best course of action and avoid the worst ones. One would therefore expect that both current high performance and past big failures will strengthen homogeneity.

Sorting Consider first the case of sorting. The following result essentially says that homogeneity will increase when, in the eyes of the manager, the best actions get relatively better and the worst actions get relatively worse.

Proposition 5a *Let the actions be ordered such that* $r_{a_n,m} \geq r_{a_{n+1},m}$ *and let* x *be a parameter such that* $\frac{dr_{a_n,m}}{dx} > \frac{dr_{a_{n+1},m}}{dx}, \forall n < N$*, then* H_1*,* H_2*, and* H_3 *increase in* x*.*

Proof : By lemma 5, it is sufficient to show that $\hat{n}$ decreases in x. To that purpose, remember from lemma 3 that we add the next action if

$$\frac{\sum_{m=1}^{n} r_{a,m}}{n} \leq r_{a_{n+1}} + \frac{c}{\beta_1}\frac{N}{n}$$

This inequality clearly gets tighter in x. The result follows. ■

We have to be a bit careful with interpreting this result, however. In the original model, these beliefs are just priors and thus not related to past experiences. Taking that literally, the result says that homogeneity will be higher under manager with more extreme prior beliefs (in both directions).

However, although it becomes extremely complex to analyze, we can imagine an extended model with simultaneous hiring and learning. In that case, these extreme managerial beliefs will often reflect past successes and failures. It will then be the firms with the best performance and the worst past failures that develop the most homogenous beliefs.

Learning When the manager needs to invest to make employees learn the firm's experience, similar effects will happen. In particular, using the same model as in section 4.2, we get that the probability of investment and all measures of homogeneity increase as the first-period performance is more extreme.

Proposition 5b *For any realization of the manager's priors, there exists a* $\hat{R}$*, such that the probability of investment,* H_1*,* H_2*, and* H_3*, all increase in* R *for* $R > \hat{R}$ *and decrease in* R *for* $R < \hat{R}$*.*

Proof : This follows from the proof of proposition 3b ■

The intuition is similar as before: if the first payoff was really high and employees learn about the action and payoff, then that increases the probability that they undertake that action, which is exactly what the manager wants. When the first payoff was really low, then the manager gains again from employees knowing about it since they can then avoid it.

For later purposes, note that the *future* performance of the firm depends much more on past successes than on past failures, since successes get repeated but failures get avoided. This will lead to a correlation between homogeneity and performance.

There is actually a second effect, which I denote the 'extreme value effect', that causes homogeneity as measured by H_1 to increase in performance in a learning model. To see what is happening, consider the original model of section 2 under A2 and assume that $t > N$, so that all experimentation is over. The manager undertakes henceforth the best action of those she tried. Denote the return to that action as ρ_{a^*}. Let the number of actions that have not been tried be J. In this case, $H_1 = F(\rho_{a^*})^2 J + J\left(\frac{1-F(\rho_{a^*})^J}{J}\right)^2$ so that H_1 increases in ρ_{a^*} for $\rho_{a^*} > \hat{\rho} = F^{-1}\left[\left(\frac{1}{J+1}\right)^{\frac{1}{J}}\right]$. Intuitively, if employees learn about the payoffs of the firm's actions and the firm happens to have discovered an exceptionally good action, then employees are quite likely to agree that that particular action is optimal. So exceptional performance leads to agreement and homogeneity. This 'extreme value effect' is independent of the earlier effect of investment in learning. To see this, note that the proof of proposition 3b shows that the likelihood of investment increased in R for $R > \hat{R}$ and that such investment increased homogeneity *independent* of the particular value of R.

4.4 Convictions of the manager

The sorting model also implies that there will be more homogeneity when the manager or founder has stronger convictions about the right course of action. To state this formally, let the actions be ordered according to the manager's beliefs, such that $r_{a_1,m} \geq r_{a_n,m}, \forall n$. The following proposition says that the homogeneity increases in the strength of the manager's belief in her optimal action.

Proposition 6 *Under A1, H_1, H_2, and H_3 increase in $r_{a_1,m}$.*

Proof : This follows immediately from proposition 5a. ■

A variation on this theme will appear in the second part of the paper, when we talk about the influence of the manager on the *content* of the beliefs.

4.5 Summary

The following table summarizes these comparative statics. The main conclusion is actually that the two mechanisms are quite similar. On the one hand, this implies that the conditions under which homogeneity will be more prominent should be relatively robust to which process is driving it. It follows that distinguishing the two processes has limited use. On the other hand, however, it also makes such distinction more difficult.

Comparative static	Sorting	Learning
Increase over time	Possible (but only through turnover)	Yes
Increase in β	Yes	Possible (if explicit investment in communication)
Increase in α_i	Yes	Possible (if *individualized* investment in communication)
Increase in success	Possible (if sorting and learning combined)	Yes (if investment in communication)
Increase in failure	Possible (if sorting and learning combined)	Yes (if investment in communication)
Convictions of the founder	Yes	No

Note, though, that it is in principle possible to distinguish the two mechanisms. Take, for example, the evolution over time. In case of sorting, the evolution is a consequence of turnover, while that is not the case for learning. This suggests that controlling for turnover should remove the time-dependence of homogeneity in the case of sorting, but not in the case of learning. Other ways one could distinguish the mechanisms is by looking at investments in hiring for fit and in communication of past experiences, or by measuring changes in individuals' beliefs over time. The effect of the conviction of the founder or early leader is also a distinguishing factor, but is more difficult to evaluate empirically.

Overall, this section has showed that organizations have a natural tendency to develop homogeneity and identified some key factors that play a role in this process. The next section links this natural homogeneity to the concept of corporate culture and to firm performance.

5 Homogeneity, culture, and performance

5.1 The question of culture and performance

An important question is obviously how belief homogeneity affects firm performance. This is reflected in the importance that the management literature attaches to beliefs and belief homogeneity. Thomas Watson Jr., the legendary manager of IBM, already famously stated that 'I firmly believe that any organization, in order to survive and achieve success, must have a sound set of beliefs on which it premises all its policies and actions' (Watson 1963). More important, seminal authors on corporate culture, such as Burns and Stalker (1961), Schwartz and Davis (1981), Peters and Waterman (1982), Donaldson and Lorsch (1983), and especially Schein (1985) and Kotter and Heskett (1992), have defined shared beliefs as an essential part of corporate culture, as discussed in appendix B. It thus makes sense to try to connect the model and results of this paper to the management literature on corporate culture.

Historically, the interest in corporate culture has been largely driven by its suggested impact on corporate performance. In particular, works such as Deal and Kennedy (1982), Peters and Waterman (1982), or Collins and Porras (1994) have popularized the notion that culture is a driver of performance. Most economic analyses of culture have essentially focused on explaining the benefits of culture (Kreps 1990, Crémer 1993), although they do explicitly admit to potential negative side-effects.

It is unclear, however, whether this popular notion is really correct. The case studies in these management books (and our casual observations) are subject to important selection biases. More systematic studies are rare and the three systematic studies that are often mentioned in the literature (Kotter and Heskett 1992, Burt, Gabbay, Holt, and Moran 1994, Sørensen 2002) use the same fairly rudimentary data set.[10]

So this opens the question: is homogeneity (or corporate culture) good or bad for performance? The costs and benefits of homogeneity are studied explicitly in Van den Steen (2004). That analysis shows that homogeneity will facilitate delegation, reduce monitoring, improve communication, stimulate coordination, but that it reduces incentives to collect information. There are some other costs of homogeneity, not considered in that paper, such as less variety of information, less creativity, and less responsiveness to change. The end conclusion is essentially that homogeneity can be good or bad, depending on the circumstances. An informal reading of the results suggests that homogeneity will be good for getting things done efficiently, but bad for creativity and responsiveness.

Since the answer to whether homogeneity is good or bad depends on the context, this section takes a different approach. It essentially draws two conclusions with respect to the relationship between homogeneity and performance.

1. There will often be too much homogeneity from the perspective of an outsider.

2. There will be an important spurious correlation between homogeneity and performance.

[10] See also Lazear (1995) for a criticism of Kotter and Heskett (1992).

5.2 Too much homogeneity?

One of the key implications of the model in this paper is that organizations have an innate tendency to develop homogeneity, independent of whether such homogeneity will be good. This suggests that in general, organizations might become too homogenous for their own good. This is most easy to see with the sorting model. Consider a model with two actions, with two employees, and with $\beta = 1/2$ and $\alpha_1 = \alpha_2 = 1/2$. Let us further use H_1 as the measure of homogeneity, and assume that the organization gets an exogenous benefit from homogeneity of $X = \gamma H_1$. The following proposition says that there will be too much homogeneity when homogeneity is not beneficial, but potentially too little when it is very beneficial. Moreover, the boundary increases in the number of actions, so that with many alternatives, there is nearly always too much homogeneity.

Proposition 7

- *When $X < \frac{N(N+1)}{N-1}c$ then the expected level of H_1 is strictly too large.*
- *When $X > \frac{N(N+1)}{N-1}c$ then the expected level of H_1 is weakly too small.*

Proof : Let the actions be rank-ordered such that $r_{a_k,m} \geq r_{a_{k+1},m}$ and say that a candidate is of type k when he or she would choose action a_k.
With N actions, the manager's objectively optimal action is as follows.

- If $X > \frac{N(N+1)}{N-1}c$ then she should hire the first available candidate in the first position, but still invest in learning her beliefs, and after that hire only candidates who agree with this first candidate on the optimal action. It follows that the optimal level of H_1 is 1.
- If $X < \frac{N(N+1)}{N-1}c$ then she should hire the first available candidate for any position in any period, without learning his beliefs. It follows that the optimal level of H_1 equals $1/N$, i.e. the level of homogeneity with completely random hiring.

The second part will always be true when $r_{a_1,m} - 2Nc > r_{a_2,m}$ (when actions are ordered according to the manager's beliefs), which happens with strictly positive probability.
For the first part of the proposition, it is sufficient to show that, under these assumptions,

1. when hiring the second employee, the manager always accepts a candidate who has the same type as the first employee
2. with strictly positive probability, the manager's beliefs are such that she only accepts candidates of one type.

For the first part, let the first employee be of type k. Assume, by contradiction, that the manager rejects a candidate of the same type. Then there must be a set of types $J = \{1, ..., J\}$, which does not include k, such that

$$\frac{\sum_{j=1}^{J} r_{a_j,m}}{J} - \frac{N}{J}c \geq r_{a_k,m} + X$$

but then the manager would have been better off to reject k in the first period and just to select a type from J in each period since that would have given a payoff

$$2\frac{\sum_{j=1}^{J} r_{a_j,m}}{J} - 2\frac{N}{J}c + \frac{X}{J} \geq \frac{\sum_{j=1}^{J} r_{a_j,m}}{J} - \frac{N}{J}c + \frac{X}{J} + r_{a_k,m} + X \geq r_{a_k,m} + \frac{\sum_{j=1}^{J} r_{a_j,m}}{J} - \frac{N}{J}c$$

which contradicts the fact that it was optimal for the manager to accept k to start with. The proposition follows. ■

The intuition why there is too much homogeneity when the organization gets very little benefits from homogeneity, can be seen easily when homogeneity has no benefit whatsoever, i.e. $X = 0$. In that case, from an outsider's perspective, the manager should not sort when hiring people since sorting is costly and adds no objective benefit. The organization, however, has an innate tendency to create homogeneity, so there will be too much of it. The reason why the organization can be too heterogenous when X is large goes as follows. Assume that the firm has already hired a bunch of employees who all choose the action that is the second best according to the manager, a_2. The next applicant, however, prefers the action that the manager thinks is best, a_1. Now the manager has two sorting incentives that go in opposite directions: from the perspective of homogeneity, the manager should reject this candidate and try to hire an employee who prefers a_2; from the perspective of trying to hire the person who makes the best decisions, however, the manager will have a tendency to hire this candidate. This may lead to less homogeneity than optimal.

As the number of actions $N \to \infty$, there will be too much homogeneity for sure. Moreover, with learning, even objectively optimal hiring will lead to too little homogeneity early on, but too much homogeneity in old organizations. A final factor is that a manager with a strong prior will increase this excess homogeneity. Overall, older organizations with a manager with a strong prior and that are faced with many potential courses of action will tend to be too homogenous.

5.3 Spurious correlations between homogeneity and performance

Another important outcome is that there will be a spurious correlation between homogeneity and performance for at least two reasons.

Investment-driven correlation Section 4.3 implies a correlation between homogeneity and performance, but it is performance that causes homogeneity, and not the other way around.[11] The simulation result in figure 1 suggests that this correlation may be quite strong. It depicts the results of a simulation where a manager takes actions until she settles on some a^*. At that point the manager decides whether to convey all her experience to the members of the organization, who take this 'information' then as given, without any further inferences.

With such a strong correlation, it is understandable that many people get struck by the strong cultures of extreme performers. They are led to conclude that culture must be one of the keys to their success and then try to develop theories to explain this obvious 'fact'.

This result thus questions the inferences that can be drawn from simple regression analyses, such as these by Kotter and Heskett (1992), and the 'received wisdom' on the relationship

[11] Note that section 4.3 implied that homogeneity would be stronger with more extreme past experiences, both in positive and in negative direction. However, only the positive ones will be repeated in the future. It follows that when correlating current homogeneity with current or future performance, this correlation turns completely positive.

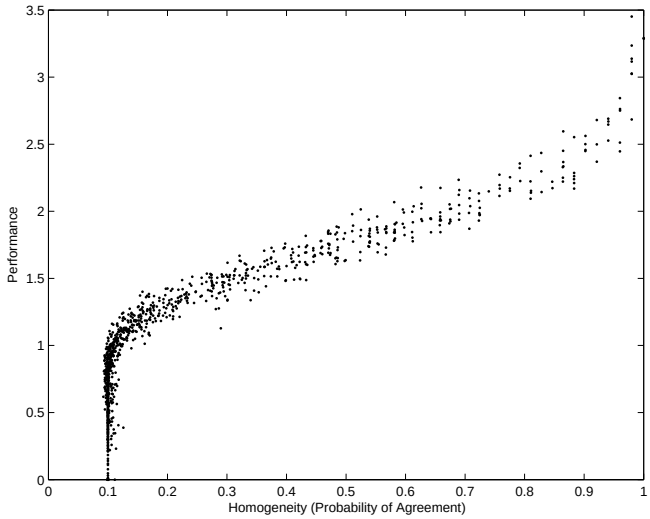

Figure 1: Performance in function of homogeneity (measured as probability of agreement on optimal action). The simulation consisted of 100 organizations with 500 members each, choosing among 10 arms.

between culture and performance.

Selection bias Another important consideration in this context is selection bias. In the sorting model, for example, the cross-sectional variance of actual performance will be higher among firms with more homogeneity. The reason is that with homogenous beliefs all employees will follow the same course of action. As a consequence, the firm essentially bets on that one action. Firms with more heterogenous beliefs are more diversified in their actions and have therefore more average performance.

In such situation, if either the worst performing firms go bankrupt or the attention is focused on the more successful firm, as it often is, then the impression will arise that homogeneity is positively correlated with performance. It seems that this effect might have played in some popular studies on culture, such as Peters and Waterman (1982) or Collins and Porras (1994).[12]

6 Matching Some Facts on Corporate Culture

The literature that defines culture as shared beliefs also suggests a pattern of 'facts', mainly based on case studies (Donaldson and Lorsch 1983, Schein 1985, Kotter and Heskett 1992). These 'facts' are more or less as follows. Organizations in similar circumstances may develop very different cultures. These cultures may persist even in the view of complete turnover

[12]While the risk of selection bias is obvious in Peters and Waterman (1982), Collins and Porras (1994) claim to have eliminated it by using a matched sample. It should be clear, however, that comparing the best firm with matched average firms will not solve the selection bias when the cause of the bias is an increase in variance.

and even when there are clear signs that a different culture may be more effective. An organization's culture is often determined by the beliefs of the original leader and by early experiences, and external succession of the CEO is more likely to lead to a change in culture than internal succession.

The purpose of this section is twofold. First of all, I want to verify that this pattern of 'facts' does indeed hold in the current model, when we interpret culture as shared beliefs. This serves both as a formalization and potential formal explanation of these informally observed 'facts' and as a partial validation of the model. Second, I derive two new implications for corporate culture which both relate to the speed of learning. In particular, I show that slow feedback from the environment will increase the heterogeneity of cultures across firms and will also increase the influence of the CEO's original beliefs.

In this section, I will slightly simplify the models to simplify the analysis and the arguments. In particular, for the sorting model (A1), I will assume that $c = 0$, so that we get perfect sorting and that the manager and all employees agree on the optimal course of action. For the learning model, I will focus on the limit situation where only the manager's actions matter, i.e., the limit for $\beta \to 0$. The results seem to extend, in an appropriate sense, to more general models.

Ideally, I would like to identify the firm's culture, denoted $\mathbf{a}$, with the course of action on which most employees agree that it is the optimal action. For the case of sorting, I will show in the next section that that is $\mathbf{a} = \tilde{a}_m$. The case of learning, however, is more complex. The fact that the posterior beliefs are not independent makes it very difficult to work with this notion of culture in the formal analysis. Lemma 2 in appendix C, however, implies that a^*, the eventual course of action of the manager,[13] is also the one that is most likely to be considered optimal by other employees. In the case of learning, I will therefore define $\mathbf{a} = a^*$.

6.1 Managerial beliefs as a determinant of culture

The management literature suggests that an organization's beliefs and practices are influenced by the beliefs of founders and early managers (Donaldson and Lorsch 1983, Schein 1985, Kotter and Heskett 1992, Baron et al. 1999).

This is nearly trivially true in the sorting model, since the manager hires people in her own image. The following proposition notes that in the sorting model the culture coincides with the course of action that the manager believes is optimal, while an action is more likely to become a firm's culture in the learning model when the manager is originally more positive about it.

Proposition 8 *Under A1,* $\mathbf{a} = \tilde{a}_m$. *Under A2, the probability that* $\mathbf{a} = \check{a}$, *for any action* $\check{a}$, *increases in* $r_{\check{a},m}$.

Proof : The first part follows from lemma 3 and the fact that $c = 0$.

By definition of $\mathbf{a}$ under A2, it is sufficient to prove for the second part that for any action $\check{a}$, the probability that $a^* = \check{a}$ increases in $r_{\check{a},m}$. The probability that $\check{a}$ gets tried increases in $r_{\check{a},m}$ since

[13] As appendix C discusses, the manager will almost surely after some time settle on one action, and play that action forever after.

it equals the probability that there is no action $\tilde{a}$ that (1) has a prior $r_{\tilde{a},m} \geq r_{\check{a},m}$ *and* (2) has a true value $\rho_{\tilde{a}}$ such that $r_{\check{a},m} \leq \rho_{\tilde{a}} - \frac{\delta}{(1-\delta)} \int_{\rho_{\tilde{a}}}^{\infty} (u - \rho_{\tilde{a}}) g(r_{\check{a},m}, u)\, du$. Conditional on getting tried at least once, all actions are ex ante equally likely to become the eventual action a^*. This implies the proposition. ■

It is also trivial but intriguing that (ex-post) the most influential managers are those under whose early actions the firm was very successful. This corresponds well with the observation that in many, if not most, case studies of firms with a strong culture, the firm had an early leader who had strong beliefs *and* was successful.

To make sure that, in the learning model, this result is not an artifact caused by my definition of 'culture as the eventual action', I also ran a simulation with 'culture as the action on which most employees agree'. Figure 2 shows the results and confirms that this effect is real and significant. The simulation considered the learning process in 10,000 firms that were each faced with 15 actions. On the horizontal axis are the actions of the manager, ranked according to the manager's original beliefs in each. The vertical axis represents how often two randomly selected (non-manager) employees agreed on that action being optimal, once the manager stops trying new actions. The result is quite remarkable: although ex ante these actions are identical except for the manager's prior, the action most preferred by the manager is 5 times more likely to be agreed upon as the optimal action than the action least preferred by the manager. This clearly demonstrates how the order of learning, which

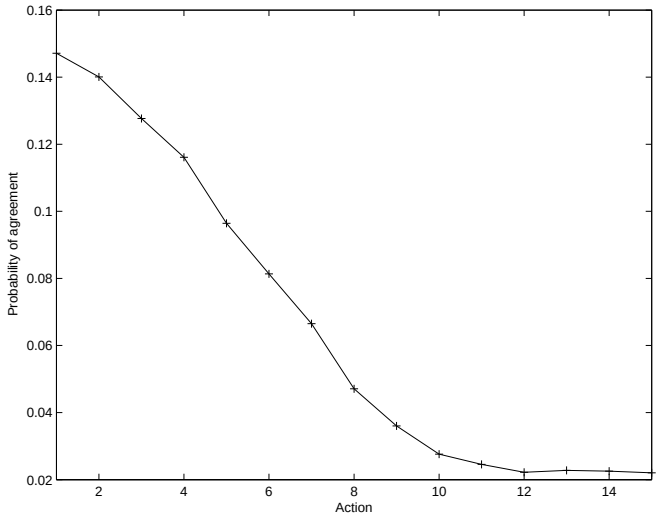

Figure 2: The manager's role in determining the organization's culture. On the horizontal axis are the different actions, ranked according to the belief of the manager, with the best action according to the manager being in the leftmost position. The graph indicates the probability that two randomly selected employees, conditional on agreeing, agree on that action being the optimal one. The simulation was run for 10,000 firms, each facing 15 actions and having 100 employees. The agreement was measured in period 15, when all learning was over.

is determined by the manager's prior beliefs, may be an important 'historical' determinant

of an organization's behavior.

An alternative perspective of a manager's influence on culture is presented in Van den Steen (2002c). In that model, a manager's strong beliefs or vision cause sorting in the labor market, which leads to homogeneity in the firm's beliefs.

6.2 Diversity of culture

The fact that a firm's culture will depend on its manager's original beliefs suggests that otherwise similar organizations may develop very different cultures. I obtain an even stronger result in this model: as the number of alternative actions increases, the probability that two organizations share the same culture converges to 0. This is true both for the sorting and for the learning model. To see this formally, let $\mathbf{a}_f$ denote organization f's culture.

Proposition 9 *Consider either A1 or A2. As* $N \to \infty$, $P[\mathbf{a}_f = \mathbf{a}_g] \to 0$.

Proof : In the case of learning, it is sufficient by lemma 2 to show that as $N \to \infty$, $P[a_f^* = a_g^*] \to 0$. To see that that is true, note that $P[a_f^* = a_g^*] = \sum_{n=1}^{N} P[a_f^* = a_n] P[a_g^* = a_n \mid a_f^* = a_n]$ $= \frac{1}{N} \sum_{n=1}^{N} P[a_g^* = a_n \mid a_f^* = a_n] \leq \frac{1}{N} \sum_{n=1}^{N} P[\hat{a}_N \in B] = P[\hat{a}_N \in B]$ with $\hat{a}_N = \text{argmax}_{a \in A} \rho_a$ and B the set of eventually tried actions. For the last step, note that for a fixed a_n

$$\begin{aligned} P[a_g^* = a_n \mid a_f^* = a_n] &= \sum_{B_f} P[a_g^* = a_n \mid a_f^* = a_n \& B_f] P[B_f] \\ &\leq \sum_{B_f} P[a_g^* = a_n \mid \rho_{a_n} \geq \rho_a \forall a \in A \& \rho_{a_n} \geq h(r_{a,m}) \forall a \in \overline{B}_f \& B_f] P[B_f] \\ &\leq \sum_{B_f} P[\hat{a}_N \in B_g \mid \rho_{\hat{a}_N} \geq h(r_{a,m}) \forall a \in \overline{B}_f \& B_f] P[B_f] \\ &\leq \sum_{B_f} P[\hat{a}_N \in B_g \mid B_f] P[B_f] = P[\hat{a}_N \in B_g] \end{aligned}$$

where the last inequality comes from the fact that the conditioning event says that the ρ_{a_k} may be large, which clearly reduces the probability that $\hat{a}_N \in B_g$. Finally, $\frac{1}{N} \sum_{n=1}^{N} P[\hat{a}_N \in B] = P[\hat{a}_N \in B]$ which goes to zero according to proposition 10.

In the case of sorting, $P[\mathbf{a}_f = \mathbf{a}_g] = \frac{1}{N}$ which clearly goes to zero when N goes to infinity. ■

6.3 Suboptimal cultures

The fact that firms in identical circumstances may develop very different cultures, suggests further that the eventual culture might be suboptimal. I derive again a strong version of this idea: when the number of potential actions increases, the probability that the firm's culture is optimal goes to zero. This holds again for both the sorting and the learning model. To see this formally, let $\hat{a}_N = \text{argmax}_{a \in A} \rho_a$ when A has N elements.

Proposition 10 *Consider either A1 or A2. As* $N \to \infty$, $P[\mathbf{a} = \hat{a}_N] \to 0$.

Proof : For the sorting model, this is trivial since $P[\tilde{a}_m = \hat{a}_N] = \frac{1}{N}$ which clearly goes to zero as $N \to \infty$.
Consider then the learning model. It is sufficient to show that $P[a^* = \hat{a}_N] \to 0$. Fix a given set of potential returns $\{\rho_{a_n}\}_{n=1}^{\infty}$ with only the set $A_N = \{a_n\}_{n=1}^{N}$ available to the firm. Let $\hat{a}_N = \text{argmax}_{a \in A_N} \rho_a$, which is unique for all N with probability one (which I assume henceforth). Since $P[\hat{a}_N = a^*] \leq P[\hat{a}_N \in B]$ (where B is the set of eventually tried actions), it suffices to show that $P[\hat{a}_N \in B] \to 0$ as $N \to \infty$. The probability that $\hat{a}_N$ gets tried equals the probability that there is no action $\tilde{a}$ that (1) has a prior $r_{\tilde{a},m} \geq r_{\hat{a}_N,m}$ *and* (2) has a true value $\rho_{\tilde{a}}$ such that $r_{\hat{a}_N,m} \leq \rho_{\tilde{a}} - \frac{\delta}{(1-\delta)} \int_{\rho_{\tilde{a}}}^{\infty} (u - \rho_{\tilde{a}}) g(r_{\hat{a}_N,m}, u)\, du$. We can write the latter condition as $\rho_{\tilde{a}} \geq h(r_{\hat{a}_N,m})$ for some increasing function h. Given some $r_{\hat{a}_N,m}$, the probability that $\tilde{a}$ satisfies conditions 1 and 2 is $P[r_{\tilde{a},m} \geq r_{\hat{a}_N,m} \;\&\; \rho_{\tilde{a}} \geq h(r_{\hat{a}_N,m})] = (1 - F(r_{\hat{a}_N,m})) I_{\rho_{\tilde{a}} \geq h(r_{\hat{a}_N,m})}$ so that, still for given $r_{\hat{a}_N,m}$, the probability that no action satisfies them is $\Pi_{a \in A_N \setminus \hat{a}_N} \left[1 - (1 - F(r_{\hat{a}_N,m})) I_{\rho_a \geq h(r_{\hat{a}_N,m})}\right]$. Since $r_{\hat{a}_N,m}$ is drawn from F, we get $P[\hat{a}_N \in B] = \int \Pi_{a \in A_N \setminus \hat{a}_N} \left[1 - (1 - F(u)) I_{\rho_a \geq h(u)}\right] f(u)\, du$. When we go from N to $N+1$ actions, the integrand gets multiplied with an extra factor, being either $\left[1 - (1 - F(u)) I_{\rho_{\hat{a}_N} \geq h(u)}\right]$ or $\left[1 - (1 - F(u)) I_{\rho_{a_{N+1}} \geq h(u)}\right]$. Either way, with probability one (over the realizations of returns $\{\rho_{a_n}\}_{n=1}^{\infty}$), the integrand converges to zero for any u, so that $P[a^* = \hat{a}_N] \to 0$. That proves the proposition. ■

Note that the organization's manager will be aware of the fact that her firm's culture is almost surely suboptimal.

Dysfunctional cultures It has often been noted that culture can also be dysfunctional, in the sense of actually decreasing the organization's performance. While the above is one way to interpret this observation, there is a more important sense in which cultures in this model can be dysfunctional. While I implicitly treated the payoffs as if they were also the firm's profits, there is nothing in the model that requires this to be the case. If the agents' payoffs differ from these of the firm, we can get very dysfunctional cultures that may eventually destroy the organization. Enron managers, for example, learned that the easy way to success was deceiving shareholders and regulators, and developed a culture that allowed such behavior, which eventually destroyed the firm. NASA engineers learned that things went smoother if they minimized potential problems and just hoped for the best. A culture developed that allowed such behavior to flourish, with disastrous consequences.

6.4 Persistence of culture and managerial succession

One of the most remarkable things about corporate culture is its persistence. Even when all original members of the firms are long gone, the shared beliefs are still very similar to those of these original members. It feels as if the organization has some kind of independent personality that remains constant over time.

Both models in this paper predict such persistence. In particular, the models predict persistence when the manager is succeeded by one of her own employees but less so when the manager is succeeded by an outsider. These conclusions resonate well with the case studies of management theorists such as Donaldson and Lorsch (1983) or Kotter and Heskett (1992)

who have stressed the persistence of culture and the need to bring in new managers as a key step towards changing a firm's culture. To study this formally, I need to extend the model to allow for succession.

Sorting Consider first the sorting model. In this case, I will assume that after the hiring is completed, the manager gets succeeded either by one of her current employees or by an employee from a different firm. After the succession, the new manager is allowed to costlessly fire any employee and then hire new employees in the same way as the original manager could hire. In particular, after having fired those employees who she wants to replace, she draws at random a candidate for every position she wants to fill. At cost c, she can learn the beliefs of this candidate. She then decides whether to hire this person or to make a new candidate draw. This process gets repeated for all position the new manager wants to fill. Let $\mathbf{a}_1$ denote the culture under the first manager and $\mathbf{a}_2$ the culture under the second manager. The following proposition says that the culture is perfectly persistent with the insider-successor, but not at all with the outsider.

Proposition 11a $P[\mathbf{a}_1 = \mathbf{a}_2] = 1$ *when the successor is a current employee of the firm, but* $P[\mathbf{a}_1 = \mathbf{a}_2] = \frac{1}{N}$ *when the successor is an outsider.*

Proof : Assume that employee 1 becomes the new manager. Then we have that $\mathbf{a}_1 = \tilde{a}_m = \tilde{a}_1 = \mathbf{a}_2$, which proves the first part of the proposition. The second just follows from the fact that the probability that an employee of a different firm shares the same belief on the optimal action as the original manager of the focal firm is $\frac{1}{N}$. ■

The intuition is that a manager selects her successor in her own image. After a few generations, the new manager will still be selected in the image of the original manager. The culture may thus persist over many generations of managers and employees.

Learning For the learning model, assume that at the end of each period, there is a probability p that the manager will be replaced by a new one. Assume that a manager only cares about the organization's performance under her own management, and that therefore the probability p is just a factor in the manager's discount factor δ. I will compare the case that the successor is one of the firm's current members, i.e. an insider-successor, to the case in which the successor is a member of another organization, i.e. an outsider-successor. Insiders know the organization's history in terms of actions and outcomes. Outsiders have no information about this organization's prior actions and outcomes but do have an equal amount of experience as a member of another randomly drawn firm.

Since I want to compare eventual actions, I will assume that the period $t \geq N$. Let a_m^*, a_i^*, a_o^* denote the eventual action under respectively the original manager, the insider-successor and the outsider-successor.

The following proposition says that the culture is more likely to remain the same under an insider-successor and determines the limit probabilities as the number of alternatives goes to infinity.

Proposition 11b *The probability* $P[a_i^* = a_m^*] \geq P[a_o^* = a_m^*]$ *Moreover, in the limit as* $N \to \infty$, $P[a_i^* = a_m^*] \to x \geq 1/2$ *while* $P[a_o^* = a_m^*] \to 0$.

Proof : Denote by a_2^*, the eventual action of the manager of the outsider-successor's original organization. For the first part of the proposition, fix a set of identical prior beliefs for the insider and outsider successor and a set of ρ_a's. Note that, if they started from scratch, they would arrive at the same eventual action, say a^*. Consider now first the case that $a^* = a_m^*$. While the outsider may settle on either a_m^* or a_2^*, the insider will always settle on a_m^* in the original game. Consider next the case that $a^* \neq a_m^*$. The insider will eventually settle on either a_m^* or on a^*. If $a_2^* \neq a_m^*$, then the outsider will never settle on a_m^*. If $a_2^* = a_m^*$, then the likelihood that the outsider settles on a_m^* is identical to the likelihood that the insider settles on a_m^*. Overall, it follows that the insider is always at least as likely to settle on a_m^* as the outsider.

For the limit results, consider first the case of the insider successor, denoted I. Note that $\forall a \in A, P[\rho_{a_m^*} \geq \rho_a] \geq 1/2$. To see why, note that if $a \in B$, then $\rho_{a_m^*} \geq \rho_a$ for sure. If $a \notin B$, then ρ_a is distributed according to F, while $\rho_{a_m^*}$'s distribution first order stochastically dominates F. Consider then the modified problem that I's choice set is restricted to $A \setminus a_m^*$. Let a^* denote I's eventual action in this modified problem. In the unmodified problem I's eventual action a_i^* must then be either a_1^* or a^*. Note that I's eventual action can be a^* only if $\rho_{a_m^*} \leq \rho_{a^*}$. Furthermore, $P[\rho_{a_m^*} \geq \rho_{a^*}] \geq 0.5$ by the earlier argument. So it follows that the probability that $a_i^* = a_m^*$ must be weakly larger than $1/2$ in the limit.

Consider next the outsider-successor. Since there is no information transfer, it is like a succession in a completely different organization. An immediate extension of proposition 9 implies then that as $N \to \infty$, the probability of the eventual actions being identical goes to zero. ■

A change in culture is thus more likely under an outsider than under an insider successor. The effect here is essentially one of forced learning: during her tenure, the original manager implicitly chooses what her successor learns. When the successor takes over, he might try out a few changes, but if he doesn't quickly find an action that performs really well, he will fall back on the proven strategy of his predecessor. Combined with the earlier result, this implies that a manager's beliefs may determine an organization's culture even after the manager is gone.

Simulations suggest that this effect can be large, even in the learning model. Table 1 gives the results of 5 simulations with 50 organizations each, in which one manager runs the organization for N periods and then gets succeeded either by one of her organization's own members or by an outsider. The numbers in the table represent the percentage of cases in which the successor eventually chose the *same* action as the original manager. Clearly, a change in culture is much more likely under outsiders than under insiders. Such changes are generally not performance-neutral, as can be seen from the average performance difference column. The model does not predict, however, whether performance will go up or down.

This also suggests a prediction on CEO succession: a rationally acting board of an underperforming firm should select an outsider as successor to a retiring CEO, while the board of an excellent performer should select an insider (Parrino 1997).

6.5 Rate of learning

Apart from formalizing and formally explaining the informally observed pattern of 'facts', we can also derive new insights from the model. An interesting one is the effect of the rate of learning. A natural conjecture would be that in more fuzzy environments, cultures would

Simulation	Insider	Outsider	Avg. % Performance difference
1	68	10	24
2	66	12	19
3	72	14	20
4	64	18	14
5	78	10	20

Table 1: Percentage of cases in which the eventual action of the successor-CEO is identical to the eventual action of the original CEO, and the average percentage performance difference. The data represent 5 simulations of 50 organizations each. The number of actions was 100.

be more diverse and the influence of the manager's beliefs would be stronger.

The current model allows a comparative static that partially captures this. Consider in particular the following interpretation of the model. Assume that the manager can change actions at any point in (continuous) time, but she has to wait at least the duration of a period, denoted Δ, to learn an action's payoff. In any optimal strategy the manager will only change actions at the discrete time points $t\Delta$. Since the rate of learning is determined by the length of Δ, and the length of Δ is reflected in the discrete-time discount rate δ (for a given continuous-time discount rate), δ captures that rate of learning.

The intuition is now that in an environment where it takes longer to learn about an action's performance, cultures would be more diverse and the influence of the manager's original beliefs will be stronger. To see this formally, let a_f^* and a_g^* denote the eventual cultures of randomly selected organizations f and g respectively.

Proposition 12 *The probability $P[a_f^* = a_g^*]$ increases in the discount rate δ. The probability that an organization's eventual culture is the one originally preferred by the manager, $P[a^* = \tilde{a}_m^0]$, decreases in δ.*

Proof : For given $(\rho_a)_{a\in A}$ and $\{r_{a,m}\}_{a\in A}$, equation (2) says that (in a set-wise ordering) the set of actions B_i^t that have been tried by agent i's manager by the start of period t, increases in δ. Fix $(\rho_a)_{a\in A}$. Assume, essentially wlog., that all the ρ_a are different.[14] Let then, wlog., the actions be numbered such that $\rho_{a_n} \geq \rho_{a_{n+1}}$. Let $b_{k,i}$ denote the event that '$a_i^* = a_k$', which is also the event that '$a_k \in B_i \& \forall l < k a_l \notin B_i$', where B_i is the set of actions that are eventually tried by the manager of agent i. Note that, conditional on $(\rho_a)_{a\in A}$ and with 1 and 2 in different organizations f and g, $b_{n,1}$ and $b_{n,2}$ are independent. We have thus that $P[a_1^* = a_2^*] = \sum_{n=1}^N P[b_{n,1} \cap b_{n,2}] = \sum_{n=1}^N P[b_{n,1}]^2$. Since I can focus completely on one organization now, I will drop the reference to the agent. Let b_n and $\check{b}_n$ denote $a^* = a_n$ when the discount factor is respectively δ and $\check{\delta} = \delta + \epsilon$ with $\epsilon \geq 0$. I will argue that (1) $P[b_n] \geq P[b_{n+1}]$ and idem for $\check{b}_n$, and (2) $\cup_{n=1}^k b_n \subset \cup_{n=1}^k \check{b}_n$. For point (1), note that when $\rho_{a_{(n+1)}} = \rho_{a_n}$ then, by symmetry, $P[b_{n+1}] = P[b_n]$. Point (1) then follows from the fact that $P[b_n]$ increases when ρ_{a_n} increases. For point (2), note that $B \subset \check{B}$ and that $\cup_{n=1}^k b_n$ are exactly all the sample points for which one or more actions a_n with $n \leq k$ will eventually have been tried. So $\cup_{n=1}^k b_n = \{\omega : \exists n \leq k \text{ with } a_n \in B\} = \cup_{n\leq k}\{\omega : a_n \in B\}$ For any ω for which $a_n \in B$, evidently

[14] With identical ρ_a, the analysis still goes through, but it becomes messy since there is no transparent notation.

$a_n \in \check{B}$, so that $\cup_{n\leq k}\{\omega : a_n \in B\} \subset \cup_{n\leq k}\{\omega : a_n \in \check{B}\}$ or $\cup_{i=n}^{k} b_n \subset \cup_{n=1}^{k}\check{b}_n$. This proves point (2).

By point (2), it follows that there exists a set of events '$\alpha_{n,m} = b_n \cap \check{b}_m$'. For $m < n$, event $\alpha_{n,m}$ denotes the sample points that moved from n to m when the discount factor went from δ to $\check{\delta}$. We can write $\check{b}_m = b_m \cup (\cup_{n>m}\alpha_{n,m}) \setminus (\cup_{n<m}\alpha_{m,n})$ so that $P[\check{b}_m] = P[b_m] + \sum_{n>m} P[\alpha_{n,m}] - \sum_{n<m} P[\alpha_{m,n}]$. It then follows that

$$P[a_1^* = a_2^* \mid \check{\delta}] = \sum_{m=1}^{N}\left\{P[b_m]^2 + 2P[b_m]\left[\sum_{n>m} P[\alpha_{n,m}] - \sum_{n<m} P[\alpha_{m,n}]\right]\right\} + \sum_{m=1}^{N}\left[\sum_{n>m} P[\alpha_{n,m}] - \sum_{n<m} P[\alpha_{m,n}]\right]$$

Since $P[\alpha_{n,m}]/P[b_m]$ and $P[\alpha_{m,n}]/P[b_m]$ tend to zero as $\epsilon \to 0$, the last term will be dominated in the limit as $\hat{\delta} \to \delta$ by both other terms. Then we can write

$$\begin{aligned} P[a_1^* = a_2^* \mid \check{\delta}] &= P[a_1^* = a_2^* \mid \delta] + \sum_{m=1}^{N} 2P[b_m]\left[\sum_{n>m} P[\alpha_{n,m}] - \sum_{n<m} P[\alpha_{m,n}]\right] + o(\ldots) \\ &= P[a_1^* = a_2^* \mid \delta] + \sum_{m=1}^{N}\sum_{n=m+1}^{N} 2\left[P[b_m] - P[b_n]\right] P[\alpha_{n,m}] + o(\ldots) \end{aligned}$$

Note now that $P[b_m] \geq P[b_n]$ in that equation since $n > m$ (and the values go up with lower indices). It follows that $P[a_1^* = a_2^* \mid \check{\delta}] \geq P[a_1^* = a_2^* \mid \delta]$. This completes the first part.

For the second part, let again the $(\rho_a)_{a\in A}$ be given and fix the manager's prior. Let $\tilde{a}$ be the action that the manager originally thinks is best, i.e. $\tilde{a} = \text{argmax}_{a\in A}\, r^0_{a,m}$. Let again $\check{\delta} > \delta$, so that for any ω, $B \subset \check{B}$. Since the manager originally thinks $\tilde{a}$ is best, $\tilde{a} \in B$ and $\tilde{a} \in \check{B}$. If $\forall a \in \check{B}\ \rho_{\tilde{a}} \geq \rho_a$, then $\forall a \in B\ \rho_{\tilde{a}} \geq \rho_a$. This proves the proposition. ■

Note that δ also captures at least part of the cost of learning: it determines how long one has to suffer the (potential) suboptimal performance of an action to learn that action's payoff. It would be easy to show that diversity of culture and managerial influence also increases in other costs associated with learning. Assume for example that there is a cost of changing actions. In that case, the manager will simply try less actions, which will also increase heterogeneity among firms and increase the influence of the manager.

6.6 Other aspects of culture

There are many important aspects of culture that I have not dealt with in this paper, but for which the model could have interesting implications.

Culture and turnover The relationship between culture and turnover is complex. On the one hand, the fact that the new members of the organization have less of the shared experience implies that they will have less shared beliefs with the rest of the organization. New members, however, can learn from the organization's experience by deducing information from the organization's actions, by (imperfectly) observing the beliefs of colleagues, and from stories about the past successes and failures of the organization. Sorting in the hiring

of new members may also make their beliefs more aligned with the most recent beliefs of the organization. This will, for example, be very important when there is a management change. Finally, the impact of turnover on communication and socialization investments is ambiguous: while the effect of socialization is likely higher with new members, the payoff from these investments are lower when members stay shorter.

The role of turnover is thus clearly a research topic on itself. Note that some firms with extremely high turnover are notorious for their strong cultures. Consulting is a case in point.

Culture and Change Culture is often mentioned as an impediment to change. In the current model there does not seem to be such effect, except for a potential spurious relationship in which the belief strength of the organization's members causes both homogeneity and resistance to change. Introducing change in the model could, however, affect the results quite profoundly.

Variability of performance Sørensen (2002) argues that a strong culture should reduce the variability of performance over time and shows that this holds indeed in the data set of Kotter and Heskett (1992). The current model suggests one reason for such relationship: if the β and α_j get drawn randomly in each period, more homogenous beliefs about what to do will definitely cause more systematic behavior over time and thus also less variability in performance.

Distinctiveness of culture The analysis in this paper has focused on internal homogeneity. To understand the importance of homogeneity and culture, however, it would be useful to compare this to the heterogeneity of beliefs across organizations.

7 The interaction between sorting and learning

While a general analysis of the combined effect of sorting and learning is outside the scope of this paper, it is nevertheless worthwhile to consider their interaction. The key thing here is that sorting and learning are substitutes. On the one hand, since sorting is costly, we will see less of it when learning is cheap and effective. In particular, when $\delta \uparrow 1$, there will almost immediately be nearly complete homogeneity of beliefs through learning. In that case, the manager has no reason to spend time and effort on selecting employees with the right belief. On the other hand, sorting will reduce the initial heterogeneity and therefore also the effects of learning and the incentives to invest in it.

The substitution effect can be very strong. In some extreme cases, homogeneity may even decrease when learning becomes cheaper, through its negative substitution effect on sorting. The same goes in the other direction, from sorting to learning.[15] Such examples are truly extreme, however, and only work for very specific realizations of the beliefs and parameters. The comparative statics of section 4 thus probably extend to a combined model.

[15] Examples are available from the author.

The interaction between sorting and learning may play a big role in the analysis of the content of beliefs. In particular, learning has a homogenizing effect not only within firms but also to a lesser extent across firms. Sorting, on the other hand, only homogenizes within firms. In fact, with sorting employees of different firms will sometimes be more likely to disagree than randomly selected members of society. The culture-like effects of homogeneity are therefore typically stronger with sorting than with learning. This does suggest that culture will be especially obvious in environments or on dimensions where learning is relatively slow or costly: sufficiently slow or costly to limit experimentation that could lead all organizations to reach consensus, which would reduce the distinctiveness of an organization's beliefs, and to make sure that the firm has real incentives to sort.

8 Empirical Implications

While there is an extensive body of informal and related evidence that lends credibility to the ideas suggested in this paper, it is insufficient to draw definite conclusions. In this section, I will first review some of that related evidence, and then consider some empirical strategies that would allow more definite conclusions.

Much of the informal evidence comes in the form of case studies, such as Donaldson and Lorsch (1983) or Schein (1985) who concluded that organizations have shared beliefs and assumptions, and that this homogeneity is generated through sorting, experience, and learning. They also suggested some of the 'facts' that we checked in the second part of the paper. More systematic related evidence comes from the social psychology and sociology literature. While that literature empirically supports the idea that organizations are homogenous (Denison 1990, Hofstede, Neuijen, and Ohayv 1990) and that both sorting and socialization play a role (Meglino, Ravlin, and Adkins 1989, Chatman 1991, Judge and Bretz 1992, Cable and Judge 1997, Chatman, Carroll, Harrison, and Lee 2001), it is usually difficult to establish a clear and close fit between the data and the model in this paper. It is in particular difficult in these empirical studies to distinguish between values and beliefs, between normative and positive evaluations, and to understand who precisely is the subject who is supposed to hold these beliefs or values. A typical and often cited study in this context is Chatman (1991), who assessed person-organization fit and how it is influenced by hiring and socialization. She asked organizational members to assess their organization's value or belief system and asked new recruits to indicate what values or beliefs they consider desirable. She then showed that the fit between the recruits and the organization at the time of recruiting increased in variables related to sorting and that the fit at a later stage increased in variables related to socialization. To see what makes it so difficult to relate this type of study to the current paper, consider the following. Recruits were asked how desirable attributes such as 'being team oriented', 'having a good reputation', or 'decisiveness' were as part of their ideal organization's value system.[16] But what does it mean that 'being team oriented' is part of an organization's value system? Does that mean that 'the organization' gets utility from having

[16]In making their assessments, the recruits were forced to choose between socially equally desirable statements. While 'decisiveness' and 'being supportive' are both desirable for any organization, the method forces you to choose which of the two is most appropriate.

employees who get utility from working in group? Or does that mean that the members of the organization are convinced that teamwork is the way to success in this business and that they therefore like people with the same conviction? While the latter interpretation fits perfectly with the current theory, the former does not. The way the questions are phrased, however, does not allow us to distinguish. On the other hand, even though it is not conclusive, the evidence is definitely suggestive with respect to the basic ideas and premises of this paper.

More important, studies such as Chatman (1991) suggests a direct test of the theory. Adapting their Q-methodology to focus explicitly on beliefs, convictions, and assumptions, and measuring these at different point in times, would allow us to test whether the beliefs have a firm fixed effect and whether that increases over time, how 'fit' and turnover are related, and how the belief homogeneity relates to factors such as importance of employee decisions, performance of the organization, or age of the organization, and to determinants such as investments in hiring and socialization.

An alternative approach is to take actions as expressions of beliefs and thus test whether behavior is more similar within than across organizations, whether the similarity increases over time, and whether it relates to aspects such as past performance and age of the organization. Combining this paper with the results of Van den Steen (2004), one could test whether managers who can select their own employees delegate more and monitor less, or whether long-time members of an organization have an easier time coordinating.

There are also some indirect tests, although the potential for alternative explanations is larger. A first possibility is to test the prediction that successful firms spend more effort on hiring and socialization. While one could argue that the causality goes in the other direction, one then needs to explain why the unsuccessful firms did not increase their hiring and socialization investments. The theory also predicts that successful firms in which employees make important decisions should be hiring most on 'fit'. Another possibility is to test whether firms change more under outsider-successors than under insider-successors. One could also test, in the style of Bertrand and Schoar (2003), whether people who worked for the same organization tend to act in similar ways after they leave.

A final possibility are experiments in the style of Weber and Camerer (2003). A possible setup would have groups of people repeatedly take actions and see whether groups develop internally homogenous beliefs about the optimal actions, whether with team production teams would hire based on the beliefs of applicants, whether such beliefs can persist over generations of players, and whether they satisfy the comparative statics suggested in the paper.

9 Conclusion

The key conclusion of this paper is that organizations have a natural tendency to develop homogenous beliefs, through sorting and learning. While such homogeneity may be good or bad, organizations will often be too homogenous from an outsider's perspective. This is especially true for older organizations and those founded by a leader with very strong views. Given the connection with corporate culture, the paper implies that firms may often have

too much culture for their own good.

While most of the economics literature has approached agency issues from the perspective of governance structure and contracts, this work also suggests a third path to solving agency problem: affecting the agents' objectives directly. Choosing the right agent, with the right values and beliefs, may sometimes be more effective than choosing the right contract. Influencing the agent, through learning and socialization, may be equally effective.

While there is informal evidence that lends support to the theories of this paper, including the the fitted 'facts' on culture, systematic empirical evidence that really fits the model of this paper is lacking. This should be a priority area for future research.

A Further Discussion of Employee Involvement in the Learning Model

Why can't other firms learn if employees can? Proposition 3b in the main text raises an issue. I mentioned there that employees can learn through socialization, for example by hearing stories about the organization's great successes and failures. But if employees can learn about the firm's past successes and failures through stories and symbols, why can't other firms do the same and learn from their best competitors? Doesn't this contradict the assumption that no one outside the firm can observe the manager's actions and outcomes? The answer is twofold. On the one hand, competitors can learn these things to some degree, but, as I mentioned earlier, all we really need for the results in this paper is that employees learn more than outsiders. On the other hand, employees will always learn more that outsiders through a combination of 2 factors. Much of this information is tacit and therefore difficult to convey. It is only through repeated stories in the right contexts, and in combination with other means such as symbols and examples, that the true meaning will slowly come through.[17] This factor combines with the second: within the firm, all current employees tell stories to one new recruit, and everyone has a slightly different version to translate their tacit knowledge about the firm's way of doing things. It is the pattern of consistent stories that are repeated over and over by many different sources that really stick, especially if they are combined with personal coaching. A competing firm that hires away a few employees, on the contrary, can never really replicate this pattern. Not only will there be only a few new hires who try to communicate to a lot of established employees, but the new hires also seldom come in a position where they can teach others through coaching (except when they get hired as CEO, but then we are in a completely different case). So a firm's employees will always learn far more than its competitors. This is further strengthened by the fact that firms have incentives to communicate to their employees, but will avoid communicating their experiences to competing firms, which relates to the idea that an important role of the firm is to control access (Rajan and Zingales 1998).

Other mechanisms how employee involvement increases homogeneity in a learning model. There is a different mechanism than that in the main text through which the importance of employee decisions will affect homogeneity in a learning model: if employees make important decisions, then the manager has more incentives to experiment to make sure these employees hold the 'right' beliefs. This result, however, is completely driven by the assumption that only the manager's actions and outcomes get observed. Since this assumption was made for analytical reasons rather than to match reality, I do not consider it a very realistic or very interesting conclusion.

This leads, however, to a third mechanism that *is* very interesting. In particular, when the actions and outcomes of all employees are observed by all, there will eventually be perfect consensus, in the sense that they all choose identically the same action and agree on its performance.

To see this formally, consider the original model, except for the fact that now all actions and outcomes are observed by all members of the firm. Note that this is the one exception (already

[17] To see the importance of reading a story as part of a pattern, consider the IBM story that the CEO was once refused access to a secure area since he didn't have the right badge on him. One interpretation of this story is that in IBM, rules are more important than position. A second interpretation is that for IBM, security is everything. Yet another interpretation is that in IBM, everyone is equal. Without more context, one cannot understand what message is being conveyed with the story.

mentioned in section 2) where I will assume that the actions and outcomes of non-manager employees are observed. Let a sample point $\hat{\omega}$ denote a realization of all randomness, including mixed strategies. The following proposition says that eventually all agents will undertake the same action.

Proposition 13 *In any Markov-perfect equilibrium, there exists almost surely a $T^*(\hat{\omega})$, such that after T^* all agents undertake the same action $a^*(\hat{\omega})$ forever after. A Markov-perfect equilibrium always exists.*

Proof : I first show that a Markov-perfect equilibrium always exists. I do the proof by induction on the size of the set of actions that have been tried, which I denote B. Let for any state S, $b(S) = \#B$.

Note first that when $b(S) = N$(i.e. the set $A \setminus B = B^c$ is empty), it is optimal for all agents to play $\hat{a} = \text{argmax}_{a \in B} \rho_a$ in every period that follows. So, for all states with $b(S) = N$, the strategies and value function are well-defined.

Assume now that the value function and continuation strategies are well defined for all states in which $b(S) = k \geq m$. Consider a state S with $b(S) = m - 1$. Consider now the normal form game with the same set of players, each with $B^c \cup \hat{a}$ as the action set, and the following payoffs. Whenever any agent chooses an action in B^c (so that the state will transition to a state with $b(S) = k$ with $k \geq m$) each agent gets the respective immediate payoff of his action plus the continuation payoff which follows from the induction step. When all agents choose $\hat{a}$, the payoffs to all are $\frac{\rho_{\hat{a}}}{(1-\delta)}$. Pick any (possibly mixed-strategy) equilibrium of this normal form game (of which there exists at least one) and define these as the equilibrium strategy for this state. These strategies are well-defined and clearly Markov, and it is straightforward to check that this is indeed an equilibrium. The value functions follow.

For the first part of the proposition, consider a period in which the state is S with $b(S) = k$. If, in that period, the agents undertake m (distinct) unknown actions $a \in B^c$, then the state transitions to some S' with $b(S) = k + m$. Consider now some state S. If the strategy of at least one player, say i, is to play some unknown action $\tilde{a}_i \in B^c$ with at least some probability, then the state will almost surely transition at some point to a state S' with $b(S') > b(S)$. Since $b(S) \leq N \; \forall N$ there can be only a finite number of such transitions, so that, almost surely, after some time only known actions get played. If the strategy is for all players to play $\hat{a}$ for sure, then the state remains the same for the next period, so that the same strategy is optimal forever after. It follows that all players play $\hat{a}$ forever after. This then completes the proposition. ■

This is actually a very strong result. In the end, all members of the same organization will come to act *identically*. When only the manager takes actions it often happens that an action never gets tried even though some employee is convinced that that action dominates all others. In that case, disagreement on the optimal action persists. When each agent is free to pursue his or her preferred actions, such disagreement cannot persist. This does still not imply, however, that the members of the organization will try all actions.

B Corporate Culture

When coming into contact with an organization, people are often struck by the fact that members of the organization seem to act and think similarly, but differently from members of similar other organizations. It is as if each organization has its own 'personality.' Moreover, this 'personality'

may remain remarkably constant over time. Even when many of the original members are gone, the new generation thinks and acts in very much the same way as their predecessors. It is essentially this character of an organization, which some have more than others, that has been called its 'culture.' Given the rather vague phenomenon, it is not surprising that there are many divergent definitions in the literature. Moreover, as the term became more popular, it also began to live a life of its own. Lazear (1995) provides a survey of suggested definitions. Rather than trying to replicate such survey here, the purpose of this section is to present the view in the management literature on which this paper is based, and compare it to some key alternatives.

B.1 Examples of corporate culture

To fix ideas it is useful to start out with presenting examples, drawn from personal experience and case descriptions.

The first example is a comparison between the Brussels offices of Arthur D. Little and McKinsey in the mid to late nineties. These local offices served similar clients, were started at about the same time and were similar both in size and in personnel composition.

Arthur D. Little's consultants proudly stated that their firm was an organized chaos or chaotic organization and that it had as many strategies as there were consultants. While formal training existed, every team really went its own way. Data analysis was not so important, but listening to people was key. Conclusions were often backed up by quotes from clients, or by stories. It was important to have an open mind and not to come too quickly to conclusions. There were very few formatting standards for presentations. Performance evaluations were done every few months via informal 5-minute chats. Every consultant was responsible for his or her own staffing via a market-based system. People took lunch while working in their office. Team lunches were exceptional. Arthur D. Little called itself 'the Company.'

McKinsey's well-developed consulting methodology, on the contrary, guided each study pretty closely. A new study started by collecting all 'knowledge' about similar studies that had been conducted in the past in other offices. From the start of the study, consultants were supposed to think in terms of final client recommendations. Any conclusion had to be backed up by data. There were strict formats for the presentations, decided upon by a global committee of senior directors. There was a clear one-firm policy: the process, rules and systems should be similar all around the globe. Consultants got evaluations every 6 or 12 *weeks*, using extensive and formal evaluation forms. Staffing was centralized and future assignments were chosen to improve on weaknesses. Consultants spent nearly all their time at the client site. Lunch (and for out-of-office teams also dinner), were taken as much as possible with the team. McKinsey called itself 'the Firm.'

These were two firms that were essentially in the same business but worked in very different ways. There were no obvious structural limitations or legacy systems that prevented one to switch to the other's model. Both were aware of the differences. In fact, these differences in behavior seemed to reflect differences in opinions and beliefs among the most senior people about the relative importance of 'the one best way of doing things,' individual creativity, teamwork, the most effective process of doing consulting, etc. A telling fact is that new consultants at McKinsey receive a copy of the book *Perspective on McKinsey*, by Marvin Bower, McKinsey's de facto founder. The book is accompanied by a memo from Bower, urging 'not to give or loan copies to people outside the Firm.' The book essentially gives Bower's perspective on the 'lessons that I believe might be learned from our successes, mistakes, and failures, [...].' Some McKinsey people refer to it as 'the bible.' It seems a conscious effort to influence the beliefs of new employees. The fact that it is explicitly for

internal use only, is a clear statement that this is not posturing for the outside world, but valuable information from which new employees can and should learn.

Cultures also come in less functional forms. Some companies, such as the former Enron, encourage their people to be aggressive and push limits, even if it gets them close to legal limits. Other organizations, including some government administrations, have implicit shared beliefs that initiative creates personal risks without rewards. Some firms have a strong 'nine to five' culture while in others people always stay late, even if they don't have anything to do. Cultural differences can also relate to the importance of consensus, the treatment of new employees, the level of confrontation, the level of cooperation, the competitiveness, the implicit importance and status of engineers versus marketers, the existence of reserved parking spots for top management, open or closed door policies, etc.

Note that cultures can also develop along other dimensions than firms. We can talk, for example, about a sales culture versus a production culture, or about the culture of academic economists as opposed to that of academic sociologists or engineers. Each of these groups have a set of common experiences they go through, and develop a set of shared beliefs. Moreover, each group will, implicitly or explicitly, attract and retain people who agree with or fit those values and beliefs.

B.2 Definition of corporate culture and the role of learning and sorting

Since culture is a complex social phenomenon, it has multiple dimensions and therefore multiple potential definitions, that all have their value in the right context. While I mention some alternative definitions below, this paper uses what seems to be the most prevalent definition in the management literature: corporate culture as shared values, beliefs, and assumptions which generate behavioral norms and 'the way we do things around here.' Note that the management literature often uses the terms values and beliefs almost interchangeable.[18]

This idea of culture as shared beliefs or values goes back at least to Burns and Stalker (1961) who, in their seminal discussion of 'organic' versus 'mechanistic' organizations, define culture as 'a dependable constant system of shared beliefs.' Other early contributions were the work of Baker (1980) and Schwartz and Davis (1981) who defined culture respectively as 'some interrelated set of beliefs, shared by most of their members' and 'a pattern of beliefs and expectations that is shared by the organization's members.' A key impetus in popularizing the notion of culture was the bestseller *In Search of Excellence* by Peters and Waterman (1982), who defined culture as 'shared values' but stress that they also mean 'basic beliefs.' Donaldson and Lorsch (1983), which is often considered a seminal work on corporate culture, do not mention the word culture, but talk instead about managerial beliefs. Most of these authors suggest that a culture can have subcultures.

Probably the most cited perspective on corporate culture is that of Schein (1985). He defines culture as having three levels. The most visible, but most superficial, level is that of culture as a pattern of behavior. It is 'the way things are done around here,' the norms, the stories, the symbols. These behavioral patterns reflect a second, deeper, level of culture, which are the firm's shared values. Shared values are on their turn driven by the third and most fundamental level of culture: shared assumptions. Kotter and Heskett (1992) base their definition on Schein (1985), but eliminate the distinction between beliefs and values. Note that, although these authors focus on

[18]The issue is not unfamiliar to economists: you need some fairly strong assumptions to separate beliefs and utilities into expected utility. More informally, valuing the environment is closely related to beliefs about where our planet is headed.

culture as shared beliefs, their ultimate interest is in the behavioral implications of such theory. But to develop a systematic theory of that behavior, they believe that we must look deeper, to values and beliefs.

This literature that defines culture as shared beliefs and assumptions often mentions both the role of learning and of sorting. Schein (1985) deems the process of shared experience so crucial that he even includes it in his definition of corporate culture as 'a pattern of shared basic assumptions that the group learned as it solved problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.' He also mentions sorting as a source of shared beliefs, for example when he says that 'Founders of groups tend to have well-articulated theories of their own about how groups should work, and they tend to select as colleagues and subordinates others who they sense think like them.' Donaldson and Lorsch (1983) claim that 'although the founders' personal beliefs lie at the heart of the belief system, corporate history also plays an important part in shaping current beliefs. As the founders and their successors manage by their principles, their experiences lead them to modify the system through the process of incremental change.' but he also notes that the 'newcomer may be chosen, and may choose to join the company, because his personality is compatible with the beliefs of those doing the hiring.' Schwartz and Davis (1981) state that 'culture reflects what has worked in the past.' In their analysis of how cultural change can occur, Kotter and Heskett (1992) observe that 'the importance of results cannot be overstated. These new cultures grew in a cycle that was driven by successful results.' but they also note that the companies that went through cultural change 'replaced managers with individuals whose values were more consistent with the cultures they desired.' All these remarks suggest that culture is developed both through sorting and through joint learning from the company's experiences.

As mentioned earlier, however, there are important alternative to this idea of culture as shared beliefs.[19] An important alternative is the idea that culture is simply a set of conventions, arbitrary 'ways we do things around here'. This is similar to the first notion of culture in the Kreps-Hermalin model. As mentioned earlier, there is some overlap with the notion of culture as shared beliefs since the notion of culture as convention requires a shared belief about what exactly the convention is, and shared beliefs about the world will facilitate the development of conventions.[20] Other important alternatives are the notion of culture as shared language or meaning and the notion of culture as group norms. (Note that a convention is an arbitrary rule that solves a coordination problem while a norm implies some deeper obligation.) Finally, Martin (1992) suggests a 'fragmentation' perspective that has a 'focus on ambiguity as the essence of organizational culture.' Martin recognizes that 'the Fragmentation perspective is difficult to discuss with clarity' and considers it to be founded in the postmodernist tradition. Some would call it an anti-theory, a theory about the non-existence of theory. In her discussion, Martin explicitly states that the Integration perspective, of which this paper is essentially part, 'has become the dominant view of organizational researchers and practitioners.'

[19]Note that this definition does not exclude that a company can have more than one culture: the sales department might develop a (partially) different culture than the production department.

[20]Note that even what seems to be the purest of conventions, which side of the road to drive on, has structural origins. For an extensive study of this 'convention,' see Kincaid (1986).

C Preliminary results

C.1 The Learning Model

The learning model is a simple version of the multi-armed bandit problem. Gittins and Jones (1974) showed that the action choice in such a problem has a very elegant solution, as long as the payoffs of the different actions are drawn from independent distributions, the discounting is geometric, and there is only one decision maker. In particular, one can summarize the attractiveness of each action in one number, its Gittins index, such that the decision maker simply chooses the action with the highest index. While this result is very nice, its conditions, which are relatively strict, limit our degrees of freedom in modelling. Moreover, other general results are often very difficult to come by. There is, however, one further result that is of great importance. Rothschild (1974) showed that the manager will almost surely eventually settle on an action, which I denote a^*, and play that action forever after. The intuition for this results is simple: if she were to play multiple actions infinitely often, then she would know the payoffs of these actions with arbitrary precision and thus at some point it should not make sense any more to experiment.

Let me now use the index result to determine the optimal strategy for the manager. Let $r^t_{a,i}$ denote agent i's belief at the start of period t about ρ_a, and B^t the set of actions that have been tried by period t. Let the sample point ω denote a realization of $(\rho_a)_{a\in A}$ and $(r_{a,i})_{a\in A}$ for all agents.

Lemma 1

- *Consider period t. Let $\hat{a} = \text{argmax}_{a\in B^t}\, \rho_a$ and $\tilde{a} = \text{argmax}_{a\in A\setminus B^t}\, r^t_{a,m}$, then the manager's optimal strategy is to undertake $\tilde{a}$ if*

$$r_{\tilde{a},m} \geq \rho_{\hat{a}} - \frac{\delta}{(1-\delta)} \int_{\rho_{\hat{a}}}^{\infty} (u - \rho_{\hat{a}}) g(r_{\tilde{a},m}, u)\, du \tag{2}$$

  and $\hat{a}$ otherwise.

- *There exists almost surely a period $t \leq N$ such that the manager undertakes the same action $a^*(\omega)$ forever after.*

Proof : The first part follows from the fact that the Gittins index (Gittins and Jones 1974) applies, since this is a multi-armed bandit with independent arms and geometric discounting. The Gittins index for $r_{\tilde{a}}$ is the ρ that makes equation (2) hold with equality. Since the index increases in the mean, it is sufficient to consider only $\tilde{a}$ and $\hat{a}$. The first part then follows.

For the second part, consider the measure-1 set on which the prior beliefs of the agents are all distinct. Note that, if it is ever optimal for the manager to choose a known action $\hat{a}$, then that will be optimal forever after. If an unknown action gets tried after period N, then a known action must have been tried before period N (since there are only N unknown actions), which leads to a contradiction. It follows that after period N only known actions get used, and then it is optimal to use $\hat{a}$ forever. ■

Lemma 2 $\forall t \geq N, \forall a \in A \setminus \{a^*\}, P[\tilde{a}^t_j = a^*] > P[\tilde{a}^t_j = a]$

Proof : Note that, from an employee's perspective, one i.i.d. draw from F simply gets replaced by another i.i.d. draw from F every time the manager tries an action. It follows that an employee's posteriors are i.i.d. draws from F, just like his priors. It thus also follows that at any time t,

$P[\tilde{a}_j^t = a_n] = P[\tilde{a}_j^t = a_m]\ \forall a_n, a_m \in A$. Since ρ_{a^*} is the first order statistic of a (random) number of actions, it follows that $\forall a \in A \backslash \{a^*\}, P[\tilde{a}_j^t = a^*] > P[\tilde{a}_j^t = a]$, which confirms the lemma. ■

C.2 The Sorting Model

Let $r_{a,i}$ denote agent i's belief about ρ_a. The following describes the optimal strategy in the basic model. Let the actions be ordered such that, for the manager's beliefs, $r_{a,m} > r_{a_{m+1}}$.

Lemma 3 *Let* $\hat{n} = \text{argmax}_n \frac{\sum_{m=1}^{n} r_{a,m}}{n} - \frac{c}{\beta_1}\frac{N}{n}$. *If* $\frac{\sum_{m=1}^{\hat{n}} r_{a,m}}{\hat{n}} - \frac{c}{\beta_1}\frac{N}{\hat{n}} < \frac{\sum_{m=1}^{N} r_{a,m}}{N}$ *then the manager does not observe beliefs and just hires the first J candidates. If not, then the manager always observes beliefs and hires a candidate iff* $\tilde{a} \in \hat{A}$ *with* $\hat{A} = \{a_m, m \leq \hat{n}\}$.

Proof :

Note that the payoffs from each employee are independent. So we can assume here that $J = 1$ and just consider the hiring of the first employee. Note also that all that matters to the manager in this model is which action the employee would undertake. The employee simply undertakes the action that has the highest return according to him. Denote such action by $\tilde{a}_i$ for employee i.

Let the manager has a set of beliefs r_{a_n}, with the actions ordered such that $r_{a,m} > r_{a_{m+1}}$. Let the average belief be $\overline{r} = \frac{\sum_{m=1}^{N} r_{a,m}}{N}$. Let V be the expected value from this employee. If the manager decides to just hire the first employee, then $V = \beta_1 \overline{r}$.

Consider now the subgame in which the manager has decided to observe the employee's beliefs (and the cost c is already sunk.) Since this is a search game, there exists a $\hat{n}$, such that the manager hires the candidate iff the candidate's preferred action is in the set of actions $\hat{A}$ with $\hat{A} = \{a_m \quad \text{s.t.} \quad m \leq \hat{n}\}$. So the expected payoff from a hired candidate is $\frac{\sum_{a \in \hat{A}} r_a}{\hat{n}}$. Denote this by $\hat{r}$. Note that when observing the employee's belief is optimal, we must have that $V = -\frac{c}{\beta_1} + \frac{\hat{n}}{N}\hat{r} + \frac{N-\hat{n}}{N}V$ or $V = -\frac{c}{\beta_1}\frac{N}{\hat{n}} + \hat{r}$. It follows that $\hat{n}$ satisfies $\max_n \frac{\sum_{m=1}^{n} r_{a,m}}{n} - \frac{c}{\beta_1}\frac{N}{n}$

So add the next action iff $\frac{\sum_{m=1}^{n} r_{a,m}}{n} - \frac{c}{\beta_1}\frac{N}{n} \leq \frac{\sum_{m=1}^{n+1} r_{a,m}}{n+1} - \frac{c}{\beta_1}\frac{N}{n+1}$ or $\frac{\sum_{m=1}^{n} r_{a,m}}{n} \leq r_{a_{n+1}} + \frac{c}{\beta_1}\frac{N}{n}$. Moreover, observing employees' beliefs will be optimal iff $\hat{r} - \frac{c}{\beta_1}\frac{N}{\hat{n}} \geq \overline{r}$. ■

Lemma 4 *$\hat{n}$ decreases as β_1 increases and c decreases.*

Proof : We add the next action if $\frac{\sum_{m=1}^{n} r_{a,m}}{n} \leq r_{a_{n+1}} + \frac{c}{\beta_1}\frac{N}{n}$. When c increases, the condition is relaxed so more actions will be added. The relationship is the inverse for β_1. So we're left to show that selecting actions becomes more likely as c goes down. The condition for doing so was $\hat{r} - \frac{c}{\beta_1}\frac{N}{\hat{n}} \geq \overline{r}$ so the condition clearly holds. ■

Lemma 5 *Homogeneity, as measured by H_1, H_2, or H_3, increases as $\hat{n}$ goes down.*

Proof : This is immediate for H_1 from the formulas in the proposition. For H_2 and H_3, note that $P[\tilde{a}_i = \tilde{a}_j]$ increases as $\hat{n}$ decreases. The result then follows from the proof of proposition 1a. ■

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