The fair wage-effort hypothesis in a multi-period context

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Abstract

In this work the fair wage-effort hypothesis of Akerlof and Yellen (1990) is extended into multiple periods. Two types of workers are introduced based on different fair wages, and the resulting asymmetric information problems are solved and compared for the single-period and multi-period cases. The pooling and separating equilibria are examined in both situations. It is shown that in both equilibria there is a threshold for the ratio of the two types, above and below which the firm's optimal strategy is different. The type of worker that is the main beneficiary of the asymmetric information differs under the two equilibria. In addition, it is shown that the firm's per-period profits and workers' utilities change greatly as soon as time is introduced into the model. A further extension is introduced, in which fair wages are allowed to change over time. This shows that firms can lose substantial profits if they do not consider such changes and do not act accordingly.

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1. Introduction

The fair wage-effort hypothesis was defined by Akerlof and Yellen (1990) and states that if a worker is paid less than what is considered 'fair', then he or she will exert an amount of effort that is proportionally lower than maximum. This is modelled by the equation $e=min(w/w^*, 1)$, where *e* denotes effort, *w* is the wage given and *w*^{*} is the fair wage. This hypothesis is strongly based on the notion of gift exchange and reciprocity of workers, which mean that workers consider wages as gifts and will provide more effort (more gifts) in exchange when they are paid more. There are several other efficiency wage theories arguing that by increasing wages the firm is able to increase productivity or decrease certain costs, leading to more profit. Such theories were originally devised to explain the phenomenon that wages are set higher in firms than what would be explained by simple demand and supply. The fair wage-effort hypothesis is one of the most significant of these theories, partly because in their 1990 paper Akerlof and Yellen presented a functional form to model this hypothesis, making a more detailed analysis of the theory possible. The aim of this thesis is to introduce time into the model and examine the impacts of having multiple periods.

Much work has been done regarding the analysis of the fair wage effort hypothesis. It was tested empirically many times and significant evidence was obtained supporting this phenomenon (Fehr, Kirchsteiger and Riedl, 1993, Fehr and Falk, 1998). Several extensions of the model were introduced (Gan, 2000, Charness and Kuhn, 2004, Siemens, 2005), but all of these – together with the original work – neglect the fact that variables may change over time.

The model is extended in several ways in this work. The most important extension is the introduction of time and the comparison of results between the static and dynamic models. First two types of workers are introduced based on their fair wages – more and less enthusiastic types. Asymmetric information is assumed and wages, efforts, profits and utilities are analysed under screening and adverse selection, comparing the results to the perfect information case. As a next

step multiple time periods are introduced, and the corresponding pooling and separating equilibria are compared to the static results. It is shown that the utilities of the two types change greatly under more periods. In the static version of the model the type of workers that benefit the most from asymmetric information depend on the type of equilibrium, whereas when time is included neither type gain extra utility, with the less enthusiastic workers being worse off in several cases than if there was perfect information. As a final step a short introduction is given on what would happen if fair wages can change over time as well. This is likely to be the case in real life, since as workers get older their perception of fair wage is likely to change – for example due to gaining experience or losing motivation because of the working environment. It is shown that if fair wages are allowed to change then a firm not taking this possibility into account can lose substantial profits. Hence, the effects of time and particularly the effects of changing fair wages can be significant, which is why such an extension of the fair wage-effort hypothesis is likely to prove useful.

The structure of the thesis is the following. The next chapter details the literature corresponding to the fair wage-effort hypothesis. In chapter 3 two types of workers are introduced based on their fair wages. Asymmetric information is assumed and the resulting pooling and separating equilibria are examined, with the results compared to the perfect information case. Chapter 4 contains the introduction of multiple periods and the corresponding pooling and separating equilibria are compared to those obtained in the static case. Chapter 5 provides a short introduction into the possibility of changing fair wages over time and mentions a basic strategy of the firms to deal with such an issue. Chapter 6 contains the conclusions, summing up all of the main findings.

2. Literature Review

The literature on efficiency wage theories can be broadly put into two categories: those that develop the theories and models and those that test them. The theory part of the work dates back to before the 1960's, as can be seen from Baldamus (1957), in which the effects of wage on effort are already examined. At the same time, the main work in testing efficiency wage theories was only developed in the 1990's. This is mostly due to the fact that it was in 1990 that Akerlof and Yellen introduced the fair wage-effort hypothesis that led many economists to empirically test its validity and which hypothesis is the base of this thesis.

The fair wage-effort hypothesis (Akerlof and Yellen 1990) proposes that there exists a fair wage for every worker such that if a worker is given a smaller wage then he or she will proportionally reduce their effort from the maximum. Akerlof and Yellen developed the fair wage-effort hypothesis from the point of view of a gift exchange between workers and employers. The main idea is that workers view their salary and the opportunity to work as gifts from the employer, to which they respond by giving a certain amount of effort. This is described in more detail in Akerlof (1982 and 1984). This leads to the idea of fairness, which states that if workers believe that they are not treated fairly then they will respond by providing less effort. The fair wage-effort hypothesis is already introduced in Akerlof and Yellen (1988), but it was not until their paper in 1990 that they used an actual functional form as a model.

The fair wage-effort hypothesis is only one of many efficiency wage theories, which were developed to explain the phenomenon that firms tend to pay higher wages than what would be explained by standard neoclassical theory of the labour market. In particular, it was noted that wages go beyond the equilibrium point that would be specified by demand and supply. Naturally, this results in involuntary unemployment, and one of the main goals of the 1990 paper by Akerlof and Yellen was to find an explanation for such a phenomenon using the concept of fair wages.

The fair wage-effort hypothesis is based on the idea that wages are increased to increase effort levels directly. However, there are a number of other views, including the theory that with higher wages, getting fired becomes more costly leading to less shirking and slacking off at work (Shaphiro and Stiglitz, 1984). An alternative theory is the turnover cost model examined by Campbell (1994). According to this model higher wages lead to less quits (turnover) by the workers thus decreasing turnover costs for the firm. The concept of fairness is not only about individual workers themselves, but can be about others as well. This view suggests that workers compare their salaries to that of others, and if they are paid less, will decrease their effort accordingly (Rees 1993, Akerlof and Yellen 1990, Campbell and Katz 2001).

Since Akerlof and Yellen introduced the functional form for the fair wage-effort hypothesis, a number of articles have analysed extensions of this model. The first major extension was by Gan (2000), where the author introduced uncertainty into the model by defining the fair wage parameter to be a random variable with a given distribution. Charness and Kuhn (2004) separated workers within the same firm into two types based on their productivity. They used the assumption that fairness depended on wages paid to co-workers and showed that there was no evidence that workers' effort would depend on the wages of others. One of the main questions of the paper was whether the use of wage compression and wage secrecy was justified by effort levels. Siemens (2005) also analyses fairness by examining a model with a continuum of potential employees who differ in productivity and the extent of their fairness (inequality aversion) concerns. Workers were split into two types based on productivity and further two types based on being fair-minded or not. Compared with the above articles, some authors have attempted to explain the phenomena mentioned above from a neo-classical point of view. For example, Campbell and Katz (2001) shows that workers' behaviour of reducing effort when the wage of others is higher or when the firm's profitability is substantially higher can be derived from a neo-classical utility function.

In this thesis the goal is also to look at an extension of the fair wage-effort hypothesis. This

work examines the case when fair wage is allowed to change over time and the consequences for the firm's profits are analysed based on whether the firm reacts or does not react to such changes. Of course this requires the introduction of more than one time period first. To make matters more interesting, two types of workers are introduced based on different fair wages. The resulting pooling and separating equilibria of wages are examined both for the single-period model (based on theory that can be found in many textbooks such as Mas-Colell, Whinston and Green, 1995) and for the multi-period model (following the theory outlined in Bolton and Dewatripont, 2005). The importance of dynamically changing parameters – the focus being on fair wages – is supported by Campbell (1994), in which it is argued that workers' quits also depend on the change in the wage and not just on its level. Furthermore, Sanyal and Haruvy (forthcoming) argue that workers' perception of 'fair wage' changes dynamically based on past experiences and experiments showed the dependence of effort choices on the past values of wages.

Much work has been done regarding the empirical testing of efficiency wage theories. Krueger and Summers (1998) checked the magnitude of wage differentials for equally skilled workers and found evidence for major variations in wages that cannot be explained by standard competitive theories. This demonstrates that theories such as that of gift exchange are needed. Leonard (1987) found empirical evidence that there is a trade-off between wage premiums and supervisory intensity and turnovers, supporting theories based on turnover costs. However, little evidence was found to support either version of the efficiency wage models.

On the other hand, the Austrian economist Ernst Fehr has conducted a large number of empirical tests that all gave strong support for the fair wage-effort hypothesis. Experiments were conducted under different methods of wage setting between the firm and the workers: in Fehr, Kirchsteiger and Riedl (1993) the authors used a one-sided auction, in Fehr and Falk (1999) they used double auction, while in Fehr, Kirchler, Weichbold and Gachter (1998) bilateral bargaining was used. Fehr and Falk (1997) gives a summary and comparison of these results, which show convincing evidence for the fair wage-effort theory of involuntary unemployment. It was also shown that workers exhibit reciprocal behaviour – where reciprocity is the term used for the reactionary behaviour of workers as defined in Gintis (2000). Moreover, Fehr and Gachter (2000) also show evidence for gift exchange – with higher rent in wages leading to more effort – and it is suggested to be the result of the reciprocal behaviour of workers. Finally, Fehr, Gachter and Kirchsteiger (1996) shows evidence for the theory of fairness regarding the profit of the firm and workers' wages: if the fair wage is partly determined by how much profit a firm can make, then high profit making firms must pay higher wages to induce a given level of effort. A highly significant positive wage-effort relation was also found and an additional interesting feature of the results was that the firms acted reciprocally as well: they gave punishments or rewards even after the efforts were realised, even though it was costly for them to do so.

A strong critique of the work done by Fehr and the others is given by Rigdon (2002), in which the author argues that although there is a large amount of support for efficiency wages in the above mentioned works, the experiments were conducted strictly in a laboratory environment. Thus, in her experiments Rigdon set up an environment that provided a labor market that largely paralleled natural labor markets. Under such circumstances it was shown that high wages were not followed by high levels of reciprocal effort, hence contradicting the work of Fehr and efficiency wage theories. However, the amount of literature supporting the efficiency wage theories is overwhelming, which means that Rigdon's work only suggests that these theories may break done only in certain situations. Hence extending the model of the fair wage-effort hypothesis to include more details is likely to prove useful.

In addition to the work of Fehr, there are other authors who have found support for efficiency wage theories. Meredith (2006) used a survey that provided strong support for a positive relationship between wages and effort and the knowledge of wage inequity having a negative effect on this relationship. This is completely the opposite of the findings of Charness and Kuhn (2004),

who found that workers are much more concerned about their own wages than that of their coworkers. However, Charness and Kuhn also mention that although there were no significant effects of co-workers' wages on effort in the sample as a whole, the effects became significant for some subpopulations. This suggests that the experimental study of efficiency wage theories and the fair wage-effort hypothesis in particular is far from over and there are still many details to be found. Quoting the author herself in Rigdon (2002, p. 13,351), it is evident that 'more experimental work on the efficiency wage hypothesis is needed'.

3. Multiple types of workers – a static model

The first – and basic – extension of Akerlof and Yellen's (1990) fair wage-effort hypothesis is to examine the situation when there are two types of workers with two different fair wages within one firm. Workers are put in one of two groups: the first group enjoys working more than the second one, which in turn has a higher disutility from effort. The first group is referred to as 'more enthusiastic' workers, while those in the second one are called 'less enthusiastic'. The difference between the two groups is represented by assuming that the more enthusiastic workers have a lower fair wage than the less enthusiastic ones. Fair wage is assumed to be hidden information, and both types can work at the same firm. Thus the firm faces an asymmetric information problem by not being able to tell the exact types of the workers. To deal with such a lack of information, the firm may use adverse selection or screening (Mas-Colell, Whinston and Green, 1995, Bolton and Dewatripont, 2005). The aim of this chapter is to analyse the profit of the firm and the utilities of the two types under pooling and separating equilibria and compare the results to the first-best (perfect information) case.

The basic model

The most important feature of the model is the definition of effort. As mentioned earlier, effort is given by the fair wage-effort hypothesis of Akerlof and Yellen (1990):

$$e = \min\left(\frac{w}{w^*}, 1\right) \tag{3.1}$$

where *w* stands for wage and w^* for the fair wage. This hypothesis states that workers will exert proportionally lower effort than maximum whenever they are paid less than their fair wage. If the wage rate is above the fair wage value, then they will exert full effort, which is normalised to 1. The worker types are defined by w_L^* and w_H^* , where $w_H^* > w_L^*$, w_H^* denotes 'high-type' workers and w_L^* stands for 'low-type' ones. (Perhaps it may be somewhat counter-intuitive that 'high-type' workers are the less enthusiastic type, while 'low-type' workers are the more enthusiastic ones.) The intuition behind the difference in types is that low-type workers gain an extra utility from working, and so they accept a lower wage for the same amount of effort. Furthermore, β denotes the ratio of high types to the entire workforce, which is normalised to 1.

Following Gan (2000), a linear production function is used. Defining θ to be the productivity of every worker, the profit of the firm is given by $\pi = \theta e - w$. Akerlof and Yellen (1990) used a quadratic production function to compare the employment of workers with different types of fair wages at different firms. It can be shown that the main difference between the results under quadratic and linear production functions is that the first one yields an interior solution (due to its concave form), while the second one gives a corner one. Apart from this, there is no significant difference between the two in terms of results and conclusions, and so the work in this thesis is based on the linear model.

Now that effort is given by the fair wage-effort hypothesis, the next step is to define the functional form of the utility of a worker. The concept of fair wages and gift exchange (Akerlof, 1982 and 1984 and Akerlof and Yellen, 1988) are based on the observation that workers respond to higher wages by increasing their effort. Some argue that this is due to strong reciprocal behaviour of individuals (Fehr, Gachter and Kirchsteiger, 1996 and Fehr and Falk, 1997). In this thesis the notion of gift exchange is assumed to be based on the morals of individuals, which could equally come from the local culture or some form of ideology. Thus it is defined that a worker behaves in a morally right way if he or she exerts effort according to the fair wage-effort hypothesis as a reaction to a given wage. If the individual exerts less effort, then the person will have a moral cost (bad conscience, negative judgement by the others, etc.). The utility of a worker is then defined as

$$u(w, e, M) = \begin{cases} w - c(e) - M & \text{if } e < \min(w/w^*, 1) \\ w - c(e) & \text{if } e \ge \min(w/w^*, 1) \end{cases}$$
(3.2)

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where c(e) denotes the cost of effort, and *M* stands for the moral cost of working less than what is deemed right. Regarding the moral cost, it is assumed without loss of generality that both types have the same value *M*. In addition, this moral cost is assumed to be high enough so that the condition $M \ge c = c e_i^{FB}$ (i = L, H) holds^{*l*}. This condition can be interpreted as the moral cost of not working at all being greater when the wage is below the fair wage than the disutility of choosing the highest effort level when the wage is a fair one. In other words, the moral cost is so high that for both types it is always worth exerting the amount of effort specified by the fair wageeffort hypothesis as opposed to shirking.

There are three more assumptions. First, the productivity of every worker is high enough so that the firm would consider employing them. This is given by the condition $\theta > w_H^* > w_L^*$, which states that when either type of workers exert full effort, they will produce more than their cost. Second, the cost function is simplified to the linear case, with $c(e) = c \cdot e$, where *c* is a constant. Among others, Campbell and Katz (2001) use a linear cost function similar to this one, but they additionally assume that c = 1. Under the fair wage-effort hypothesis when the wage is not greater than the fair one, $w-c(e) = w(1-c/w^*)$. Thus, the final assumption is that $c < w_L^* < w_H^*$, which states that increasing the wage of the individual will always increase her utility. In particular, a worker's utility will be positive when he or she exerts full effort and receives the fair wage.

Putting all of the above together, the maximisation problem of the firm is then

$$\max_{\mathbf{w}_{L}, \mathbf{w}_{H}} \beta \big(\theta \, \boldsymbol{e}_{H} - \boldsymbol{w}_{H} \big) + (1 - \beta) \big(\theta \, \boldsymbol{e}_{L} - \boldsymbol{w}_{L} \big)$$

s.t.
$$u_i(w_i, e_i, M_i) \ge u_0$$
 $i=L, H$ (PCW)

$$e_i = min\left(\frac{w_i}{w_i^*}, 1\right)$$
 $i = L, H$ (FWEH)

¹ It may be a strong presumption to say that once their wages are fixed, workers would rather work as hard as they can instead of exerting no effort. After all, the firm has no way of monitoring the efforts. However, the whole idea of gift exchange is based on this phenomenon and what is really assumed here is that the wages are high enough for workers to show reciprocity as opposed to being selfish. (Akerlof, 1982, Akerlof and Yellen, 1990)

(PCW) are the participation constraints of the two worker types with u_0 denoting the reservation utility (e.g. from unemployment benefits) and (FWEH) is the equation for the fair wage-effort hypothesis. The participation constraints can be equally written in terms of the wages as opposed to in terms of the utility. This is because utility is linear in wages, which means that $u_i \ge u_0$ if and only if $w_i \ge w_0$, where w_0 stands for the reservation wage. Depending on each individual scenario (e.g. pooling, separating equilibrium), there may be additional constraints, and those will be defined in due course.

3.1 The perfect information case

As assumed originally, there are two types of workers: those with high and low fair wages respectively. To examine the first-best solution for the firm, it is assumed that the types are common knowledge – the employer knows exactly the fair wage of every individual. For each type i = L, H, the firm solves a separate profit maximisation problem, namely

$$\max_{w_i} \theta e_i - w_i \qquad \text{s.t.} \quad w_i \ge \underline{w} \qquad (PCW)$$
$$e_i = \min\left(\frac{w_i}{w_i^*}, 1\right) \qquad (FWEH)$$

Regarding the participation constraint, it is assumed that \underline{w} is sufficiently small so that (PCW) will always hold. This is possible because the linear form of the profit function means that if a type of workers is profitable then the firm will want to increase their wage (and consequently their effort) by as much as possible. Hence, from now on the participation constraint will be omitted unless it is essential to be mentioned. Similarly, FWEH is assumed to hold (unless the worker decides to shirk and endure the moral cost), and so this constraint will not be written down separately every time either.

The assumption $\theta > w_H^* > w_L^*$ means that $\partial \Pi / \partial w_i^* > 0$ for both i = L, H. Similarly,

the assumption $c < w_L^*$ means that $\partial u/\partial w > 0$ for both types for any given wage. These two inequalities mean that it is profitable for the firm to increase wages as long as they yield any additional effort and workers will always prefer more wages. Therefore, the first-best wages and effort are given as $e_L^{FB} = e_H^{FB} = 1$ and $w_L^{FB} = w_L^*$, $w_H^{FB} = w_H^*$. In other words the firm will provide both groups with their fair wages, for which in return they will exert full effort. It immediately follows that the firm's profit is given by

$$\Pi^{\rm FB} = \beta \Pi_{H}^{\rm FB} + (1 - \beta) \Pi_{L}^{\rm FB} = \beta (\theta - w_{H}^{*}) + (1 - \beta) (\theta - w_{L}^{*})$$
(3.3)

and the utility of type i is

$$u_i^{\rm FB} = w_i^* - c.$$
 (3.4)

The profit given here must be the most the firm can get. In the asymmetric information case the profit will be lower and the amount lost will be the cost of information. On the other hand, the workers may benefit or lose from asymmetric information, compared with the utilities obtained here. This, of course, depends on what wage strategy the firm follows, as shown below.

3.2 Asymmetric Information – Adverse Selection and the pooling equilibrium

Moving away from the perfect information case, the firm now cannot tell the type of each worker. However, it is still assumed that there are only two types, and the firm knows the values $w_{\rm L}^*$ and $w_{\rm H}^*$ of the two fair wages. The proportion of the two types is common knowledge, and so β is also known. To maximise its profits, it can either give a common wage or try to separate the two types by offering two different contracts. The first method leads to the pooling equilibrium described here, while the second one gives the separating equilibrium discussed in section 3.3. The aim of this section is to compare the results of the pooling equilibrium with the first-best solution.

In the pooling equilibrium the firm provides a single wage to all workers. Hence the profit maximisation problem is the following.

$$\max_{w} \beta(\theta e_{H} - w) + (1 - \beta)(\theta e_{L} - w) \qquad \text{s.t.} \quad e_{L} \le 1, \quad e_{H} \le 1$$

Since $\theta > w_H^* > w_L^*$, each worker type will be profitable on its own. This means that the firm will want to increase w at least as long as it leads to an increase in efforts from both types. Thus w is at least as large as the low types' fair wage, i.e. $w \ge w_L^*$ for sure. Also, there is no point in increasing w above w_H^* since that will not yield additional profits, and so $e_H = w/w_H^* \le 1$.

Let $w = w_L^* + w_{\epsilon}$ and the maximisation can be written as

$$\begin{aligned} \max_{w_{\epsilon}} \beta(\theta e_{H} - w_{L}^{*} - w_{\epsilon}) &+ (1 - \beta)(\theta e_{L} - w_{L}^{*} - w_{\epsilon}) \\ &= \beta \left[\theta \left(\frac{w_{L}^{*} + w_{\epsilon}}{w_{H}^{*}} \right) - w_{L}^{*} - w_{\epsilon} \right] - (1 - \beta)w_{\epsilon} + (1 - \beta)(\theta - w_{L}^{*}) \\ &= \beta \left(\frac{\theta w_{L}^{*}}{w_{H}^{*}} - w_{L}^{*} \right) + \beta \left(\frac{\theta w_{\epsilon}}{w_{H}^{*}} - w_{\epsilon} \right) - (1 - \beta)w_{\epsilon} + (1 - \beta)(\theta - w_{L}^{*}) \end{aligned}$$

The first and the last terms are constant, and so a change in profits depends on

$$\beta \left(\frac{\theta w_{\epsilon}}{w_{H}^{*}} - w_{\epsilon} \right) - (1 - \beta) w_{\epsilon}$$

Hence, the firm will want to increase w_{ε} if and only if $\beta \left(\frac{\theta}{w_{H}^{*}} - 1 \right) - (1 - \beta) \geq 0$ or simply²

$$\beta \geq \frac{w_H^*}{\theta}$$

The only restriction on β is that it is between 0 and 1, and since $\theta > w_H^*$ the above inequality can hold. Thus, there are two situations. If $\beta \ge w_H^*/\theta$ then the firm will increase the wage until both types exert full effort, i.e. $w = w_H^*$ and $e_L = e_H = 1$. On the other hand, if $\beta < w_H^*/\theta$, w_{ε} will be set to zero and the optimal wage is $w = w_L^*$, leading to efforts of

² This is a weak inequality, because it is assumed that if the firm is indifferent, it will give the maximum wage.

 $e_L = 1$ and $e_H = w_L^* / w_H^*$ of the two types respectively.

This means that if the ratio of high types is large enough in the sense that it is at least as large as the ratio of their cost to productivity, then their aggregate profitability will be high enough for the firm to consider their presence and want to induce them to exert maximum effort. Note that in the pooling equilibrium low types always work at full effort level and receive at least their fair wages. In other words the number of high types is high enough so that their production will compensate for the extra cost spent on low types.

Calculating the profit, the following results are obtained. If $\beta < w_H^*/\theta$, then

$$\Pi_{1} = \beta \left(\theta \frac{w_{L}^{*}}{w_{H}^{*}} - w_{L}^{*} \right) + (1 - \beta)(\theta - w_{L}^{*})$$
(3.5)

Similarly, if $\beta \geq w_H^*/\theta$, then

$$\Pi_{2} = \beta \left(\theta - w_{H}^{*} \right) + (1 - \beta) \left(\theta - w_{L}^{*} \right) - (1 - \beta) \left(w_{H}^{*} - w_{L}^{*} \right)$$
(3.6)

Both (3.5) and (3.6) must be less than the first-best profit, Π^{FB} and the difference is attributed to the firm's cost of information. The cost of information is given by

$$\Pi^{\text{FB}} - \Pi_1 = \beta(\theta - w_H^*) - \beta \left(\theta \frac{w_L^*}{w_H^*} - w_L^* \right) \qquad \text{if } \beta < w_H^* / \theta \text{ and} \qquad (3.5a)$$
$$\Pi^{\text{FB}} - \Pi_2 = (1 - \beta)(w_H^* - w_L^*) \qquad \text{if } \beta \ge w_H^* / \theta. \qquad (3.6a)$$

The first-best profit is attained only when $\beta = 0$ or 1 and it can be shown that the cost of information in the two cases are the same at $\beta = w_H^*/\theta$. This is the proportion of high-type workers for which the profit of pooling equilibrium will be minimal, as shown in Graph 3.1. The profit decreases initially as β is increased, since (3.5a) shows that the cost of information is an increasing function of β . However, for $\beta \ge w_H^*/\theta$ all workers are paid w_H^* and exert full effort, which means that the profit will be equivalent to that in the full information case when there are

only high types ($\beta = 1$). Hence, from the point $\beta = w_H^*/\theta$ onwards the profit function will be a flat line with value $\Pi^{FB}(\beta = 1)$. It may be slightly confusing that the cost of information given in (3.6a) is a decreasing function of β , which seems to suggest that the profit should be increasing. However, the cost of information is the difference between the first-best and the pooling equilibrium profits, where the first-best profit is also a decreasing function of β . With more and more high types, the firm needs to pay more wages in total to obtain the same total production. Therefore, the decrease in the cost of information is due to the decrease in the first-best profit, while the actual profit stays at a constant value.



Graph 3.1 Profits in the pooling equilibrium as a function of β

Keeping in mind the assumption about the moral cost, $M \ge c = c e_i^{\text{FB}}$ for type *i*, the utilities of the workers are given as

$$u_L = w_L^* - c = u_L^{\text{FB}}$$
 and $u_H = w_L^* - c \frac{w_L^*}{w_H^*} < u_H^{\text{FB}}$ if $\beta < w_H^* / \theta$ and
 $u_L = w_H^* - c > u_L^{\text{FB}}$ and $u_H = w_H^* - c = u_H^{\text{FB}}$ if $\beta \ge w_H^* / \theta$.

In the pooling equilibrium low types will always receive at least as much utility as in the first-best case. It means that the value of information benefits the more enthusiastic workers. High

types, however, receive less utility than in the first-best situation provided there is only a small number of them ($\beta < w_H^*/\theta$), but are equally happy when there is a larger number of them. This can be interpreted as the firm considering only those workers, whose type is dominating the labour market. When it is dominated by low types (i.e. there is only a small fraction of high types), the firm will give wages as if there were only low-type workers. The amount of profits lost due to underpaying high types and receiving non-maximal effort is then considered as a small – but unavoidable – sacrifice. Similarly, when the market is dominated by high types, the firm will adjust the wages to their needs and accept the losses made by overpaying the low types.

When comparing the two types, high types always receive at least as much utility as low ones. This is somewhat counter-intuitive, because it means that workers who are 'more enthusiastic' and are content with lower wages will receive less utility overall. However, this is not entirely surprising. Being 'more enthusiastic' in this context means that workers are more thankful for the firm for employing and paying them. This thankfulness is a subjective element that reduces their perception of a fair wage and leads to more effort for the same wage even if that extra effort is more costly to them. Compared to this, high types will not feel the need to exert as much effort for a given wage, and so they will receive the same benefits for a lower cost, making their utility higher. In a sense this means that the firm is exploiting the low types more, which will be the same for the separating equilibrium below. However, when time is introduced in chapter 4, the effort provided by low types will be rewarded by more.

3.3 Asymmetric Information – Screening and the separating equilibrium

As introduced in the previous section, the firm no longer knows the type of each worker, but it knows their proportion and the value of each fair wage. In this section it is demonstrated how the firm can use screening to separate the two types and the resulting separating equilibrium is compared to the first-best solution.

For the separating equilibrium an additional 'motivator' other than the wage is needed to be able to differentiate between low-type and high-type workers. With only a single wage variable increasing the utility of workers, if two wage-effort contracts are proposed, all workers will simply pick the one with the higher wage and adjust their efforts accordingly. Of course this assumes that the firm has no way of monitoring or enforcing the amount of effort specified in the contract. Alternatively this can be rephrased in the sense that if the firm accepts that it has no way of influencing effort because it is fully specified by the wage rate and the fair wage-effort relationship, then all it can offer in a contract is the level of wage, which is obviously not enough to separate the two types.

One possibility for the extra 'motivator' is the concept of 'overtime work'. Suppose the firm can provide the opportunity for workers to work an additional few hours – which is referred to as overtime work – for an extra amount of money. It is assumed that both the effort and wage for the overtime work is independent from those during normal work time and that the total utility of a worker is the sum of utilities coming from normal and overtime work.

The production function of the overtime work is also linear just like the production function during normal working hours. Thus, $f(\tilde{e}) = \tilde{\theta} \tilde{e}$, where \tilde{e} is the effort spent in overtime and $\tilde{\theta}$ is the constant of production. Since workers get tired by the time they start the overtime work, it is assumed that their productivity drops below that of the normal working hours. Moreover, it is assumed that $\tilde{\theta} < w_L^* < w_H^* < \theta$, meaning that even when workers exert full effort, the firm will make a loss from overtime work, even when it employs only low types. Under the fair wage-effort hypothesis this means that the firm will always make a loss in overtime, since the previous condition leads to $\tilde{\theta} \tilde{e}_i - \tilde{w} < 0$ for i = L, H. This assumption is needed, because otherwise the firm would have employed workers for overtime in the first-best case as well.³ Intuitively this means that

³ It is possible to analyse the case when the firm makes a profit from overtime work as well. In that model both types

the firm is using overtime work as a way to screen workers for an extra cost.

With this additional tool at hand, it is now possible for the firm to propose two contracts leading to a separating equilibrium. Let these contracts be denoted as⁴ (w_H, \tilde{w}) and (w_L) for high and low-types respectively, with \tilde{w} denoting the payment for the extra shift. Note that \tilde{w} may be less than w_L . This is because they both represent the total amount received for a certain type of work. For example, w_L is the wage received for 8 hours of work, while \tilde{w} is given for an extra 2 hours of overtime work. The hourly wage of the latter may be higher (to induce workers to stay), but in total the first one will be larger, otherwise all workers would choose the contract designed for the high types. The profit maximisation of the firm is then

 $\max_{w_H,w_L,\tilde{w}} \beta(\theta e_H - w_H) + (1 - \beta)(\theta e_L - w_L) + \beta(\tilde{\theta}\tilde{e}_H - \tilde{w})$

Since overtime work is treated separately from normal work, individuals will have a separate reservation utility as well, denoted by \tilde{u}_0 . This is the opportunity cost of working more hours, and includes, for example, the amount of leisure time lost. It is assumed that disutility of effort when the worker works overtime is greater than when he or she works during normal working hours. As a result, the reservation utility \tilde{u}_0 will be much higher than the normal reservation utility u_0 , and so \tilde{u}_0 will have a much larger role in the constraints than u_0 does for the normal working hours. The separation of the two types using the overtime work is based on the fact that low types will always have a lower utility than high ones under the same wage⁵. Moreover, low-type workers must be paid a higher amount than high-type ones in order to surpass their reservation utilities. This leads to the setting up of the incentive compatibility constraints ensuring that each type will choose the contract designed for them:

would be employed for overtime, but in their contracts different wages would be specified. The assumptions used here simplify the model so that the optimal wage for the low types' overtime work is 0 (see below). As a result, it is easier to solve the model, while the main results will be very similar to those in a model in which the firm makes a profit in overtime.

⁴ The general way to specify the two contracts would be to say that the workers are offered the contracts (w_H, \tilde{w}_H) and (w_L, \tilde{w}_L) However, it can be easily shown that since overtime work is assumed to be unprofitable, the firm will always set $\tilde{w}_L = 0$. For simplicity this is already assumed, and the suffix of the high types' overtime wage is dropped.

⁵ This is because $u_H(\tilde{w}) = \tilde{w}(1 - c/w_H^*) > \tilde{w}(1 - c/w_L^*) = u_L(\tilde{w})$ for all sufficiently small \tilde{w} .

$$u_L(w_L) + \tilde{u}_0 \ge u_L(w_H) + u_L(\tilde{w})$$
(ICL)

 $u_H(w_H) + u_H(\tilde{w}) \ge u_H(w_L) + \tilde{u}_0 \tag{ICH}$

Or re-writing these in terms of the wages and efforts,

$$w_L - ce_L(w_L) + \tilde{u}_0 \ge w_H - ce_L(w_H) + \tilde{w} - ce_L(\tilde{w})$$
(ICL)

$$w_H - c e_H(w_H) + \tilde{w} - c e_H(\tilde{w}) \ge w_L - c e_H(w_L) + \tilde{u}_0$$
(ICH)

In other words, the reservation utility of low types is so high (or their received utility is so low) that they prefer the contract with no overtime work. Finally, the constraints on effort must still hold, i.e.

 $e_H \leq 1$ and $e_L \leq 1$.

To solve this problem, first note that high types must be paid their fair wages during normal working hours. To show this, suppose that they are paid less. If (ICL) is slack, then the firm can increase w_H and obtain a higher profit. This is done until either $w_H = w_H^*$ or (ICL) binds. The former is the required result, so suppose that (ICL) binds. The right hand side of this equation is $(w_H + \tilde{w})(1 - c/w_L^*)$, which means that the firm can increase w_H and decrease \tilde{w} and keep (ICL) binding. This change is not constrained by (ICH) and both parts will increase the profit of the firm. Hence it is optimal to increase w_H until $w_H = w_H^*$. (This needs the extra assumption that w_H reaches w_H^* before \tilde{w} decreases to zero – otherwise there may be a conflict with (ICL) – but in fact it will be shown that (ICL) will be slack at the optimum.)

Increasing w_L until it reaches the value of the fair wage is profitable for the firm. However, if (ICH) is binding, then w_L can only be increased if \tilde{w} is also increased at the same time. Increasing the overtime wage may be more costly than the gain from increasing w_L , depending on the value of β . If $(1-\beta)(\theta/w_L^*-1) > \beta(\tilde{\theta}/w_H^*-1)$ then it is profitable to increase w_L even at the cost of increasing the overtime wage. This holds if and only if

$$\beta \leq \frac{\theta/w_L^* - 1}{\theta/w_L^* - 1 + \tilde{\theta}/w_H^* - 1} = \tilde{\beta}$$
(3.7)

In other words, it holds if and only if the proportion of high types is lower than the relative profitability of low types compared to the total profit obtained from their work and the loss on overtime work. Or simply put, there are enough low-type workers to compensate for the loss made by high types in overtime.

If (3.7) holds, then w_L is increased until $w_L = w_L^*$. Provided that $w_L \le w_L^*$ and $w_H \le w_H^*$ the two incentive compatibility constraints can be re-written as

$$w_L + \frac{\tilde{u}_0}{1 - c/w_L^*} \ge w_H + \tilde{w} \tag{ICL}$$

$$w_H + \tilde{w} \ge w_L + \frac{\tilde{u}_0}{1 - c/w_H^*} \tag{ICH}$$

Once w_{H} and w_{L} are fixed, the aim is to minimise \tilde{w} , which means that (ICH) will be binding, while (ICL) will be slack, since $1/[1-c/w_{L}^{*}] > 1/[1-c/w_{H}^{*}]$. This is true when $\beta > \tilde{\beta}$ as well, since in that case $w_{L} < w_{L}^{*}$. In this case it is profitable to increase \tilde{w} and decrease w_{L} while keeping (ICH) binding. This is done until w_{L} reaches the reservation wage of low types, below which low-type workers will not accept the contract. Notice, that this is the only time when the participation constraint of any type of workers has come into effect. In all previous cases it was always profitable to increase wages because of the relationship between wages, effort and productivity. For $\beta \leq \tilde{\beta}$ this is still the case, whereby no participation constraints will be binding. This is not in line with the typical separating equilibria (Mas-Colell, Whinston and Green, 1995, Bolton and Dewatripont 2005), where the participation constraint for the 'less profitable' type was usually binding. In other words, the fair wage-effort hypothesis explains why firms pay wages above reservation wages for all types, even for the less profitable ones and even in cases when the firm tries to screen them.

Depending on the value of β the profit defers greatly. If $\beta \leq \tilde{\beta}$,

$$\Pi_{s,1} = \beta(\theta - w_H^*) + (1 - \beta)(\theta - w_L^*) + \frac{\beta \tilde{w}_1}{w_H^*} (\tilde{\theta} - w_H^*)$$
(3.8)

whereas if $\beta > \tilde{\beta}$,

$$\Pi_{s,2} = \beta(\theta - w_H^*) + \frac{(1 - \beta)w_L^0}{w_L^*}(\theta - w_L^*) + \frac{\beta \tilde{w}_2}{w_H^*}(\tilde{\theta} - w_H^*)$$
(3.9)

 w_L^0 is the reservation wage for low types, and \tilde{w} is given by the binding (ICH) in both cases:

 $\tilde{w}_1 = w_L^* - w_H^* + \tilde{u}_0/(1 - c/w_H^*)$ in (3.8) and $\tilde{w}_2 = w_L^0 - w_H^* + \tilde{u}_0/(1 - c/w_H^*)$ in (3.9).

The cost of information for the firm is then

$$\Pi^{\rm FB} - \Pi_{s,1} = \frac{\beta \tilde{w}_1}{w_H^*} (w_H^* - \tilde{\theta}) \qquad \text{if } \beta \le \tilde{\beta}, \qquad (3.8a)$$

and
$$\Pi^{\text{FB}} - \Pi_{s,2} = (1 - \beta)(\theta - w_L^*) \left(1 - \frac{w_L^0}{w_L^*} \right) + \frac{\beta \tilde{w}_2}{w_H^*} (w_H^* - \tilde{\theta}) \quad \text{if } \beta > \tilde{\beta}.$$
 (3.9a)

The profit as a function of β is depicted in Graph 3.2. Until $\beta = \tilde{\beta}$ the cost of information increases according to (3.8a), and after that point the proportion of low types becomes so small that cost will be determined by equation (3.9a). This is shown by the non-linear jump in the profit. Assuming that w_L^0 is significantly less than w_L^* , the cost of information will be lower in (3.9a) than in (3.8a), which is why the jump in the profit function is positive. Also assuming that the coefficient of $(1 - \beta)$ is larger than that of β , the profit will increase until $\beta = 1$. The cost of information is positive in (3.9a) even for $\beta = 1$, and so the separating equilibrium profit will be below the first-best profit at this point.

The utility of workers also depends on the value of β :

$$u_{L} = w_{L}^{*} - c = u_{L}^{\text{FB}} \text{ and } u_{H} = w_{H}^{*} - c + \tilde{w} - c \,\tilde{w} / w_{H}^{*} > u_{H}^{\text{FB}} \quad \text{if } \beta \leq \tilde{\beta}, \text{ and}$$
$$u_{L} = w_{L}^{0} - c w_{L}^{0} / w_{L}^{*} < u_{H}^{\text{FB}} \text{ and } u_{H} = w_{H}^{*} - c + \tilde{w} - c \,\tilde{w} / w_{H}^{*} > u_{H}^{\text{FB}}. \quad \text{if } \beta > \tilde{\beta}.$$



These results show that high types will always benefit from separating equilibrium compared with the first-best case. Low types, on the other hand, are indifferent if their proportion is larger than a given threshold, and will be worse off if there is only a small number of them. Therefore, the beneficiaries of imperfect information are the high types in the separating equilibrium, which is not surprising since they are the ones that are getting extra payment from overtime work.

3.4 Comparing the screening and pooling equilibria and concluding remarks

From the above results it is immediately clear that low types prefer the pooling, and high types like the separating equilibrium more. This is expected, because in pooling equilibrium the firm is likely to overpay those who would normally accept less, and in separating equilibrium the extra work and wages are provided to the less enthusiastic workers.

The choice between the two equilibria depends on the realised profits, which is ultimately determined by the ratio of the two types and the loss made on overtime work. If \tilde{w}_1 is sufficiently large or $\tilde{\theta}$ is sufficiently small – thus leading to a large loss from overtime work – the cost given in

(3.8a) will be larger than the cost in (3.5a) for any $0 < \beta < w_H^*/\theta$. Similarly, if \tilde{w}_2 is sufficiently large, (3.9a) will give higher cost than (3.6a). The only exception is near $\tilde{\beta}$, where there is a jump in the profit of the separating equilibrium. Thus it is possible that there is a small range of β for which the separating equilibrium becomes more profitable.

When choosing between the two equilibria, the decision of the firm will be based mostly on the cost of overtime work, but also on the ratio of workers. In most cases the required wage given for overtime work and the productivity of workers during the extra hours will determine whether the firm would want to separate the two types of workers or provide the same payment to them. Since the values of \tilde{w}_1 and \tilde{w}_2 depend ultimately on the reservation utility of individuals for the overtime work, this will also have an indirect effect. However, there will always be a small margin in the proportion of high-type workers for which the firm will prefer the separation of the two types.

This is when the number of low-type workers is high enough to counter-balance the loss made in overtime work, yet there are still enough high-type ones so that it is worth giving the corresponding fair wages to each type - i.e. it is worth screening the individuals.

Another interesting observation is that apart from a single case, all workers are given higher wages than their reservation wage. This is an unexpected result in asymmetric information, and is entirely due to the introduction of the fair wage-effort hypothesis. In almost all cases it is worth increasing the wages above their minimal level so that workers will induce higher effort leading to more profits. This could easily explain why many firms pay more than the minimum wage even if that is above the equilibrium level determined by demand and supply.

As a final remark, it was noted that high types always receive more utility than low types. This is because either they work less for the same wage or they are given the opportunity to work longer hours and receive more payment. This is natural, since the firm has no motivation to give a bonus to more profitable workers or to penalise less enthusiastic ones in such a static model. The profits are already realised, and even if the firm is able to tell the type of each worker (separating equilibrium), it cannot use it any further. However, this is almost never the case in real life, and such a profit maximisation needs to be examined in a multi-period context, as given in the next chapter.

4. Multiple types of workers – multi-period models

In the previous chapter the fair wage-effort hypothesis was extended by using two types of fair wages. So far only a static model was used, and the aim of this chapter is to extend it into a multi-period one. The extension of the single-period perfect information model in section 3.1 to two (or more) periods is straightforward: the optimal strategy for the firm is to use its one-period strategy in every period. The extensions of the pooling and separating equilibria are much more interesting, and need to be analysed in more detail.

By introducing time and multiple periods it might be possible for the firm to obtain additional information between periods. Suppose that the firm is able to do exactly that and after every period it is able to use the production results to deduce the amount of effort spent by each worker⁶. The optimal strategy is then to use one of the single-period strategies developed in chapter 3 and use the first-best wages in all following periods once the efforts are observed. Obviously, this is not always possible – for example, the firm might be employing thousands of workers with the only observable result being their aggregate production. Hence as the single-period pooling and separating equilibria are extended to multiple-period ones, the models are separately analysed for the two cases when the firm can and cannot observe individual efforts after each period.

4.1 Dynamic Pooling Equilibrium

The extension of the pooling equilibrium is first examined for the case when the employer can observe each individual's production at the end of each period. The first strategy considered here is a multi-period contract between the firm and its workers, in which the pooling equilibrium wage, w_p is given to all workers in each period. This yields the single-period pooling equilibrium profit for the firm in each period – given by equations (3.5) and (3.6), depending on the value of β .

⁶ This, of course, is based on the fact that output depends deterministically on effort. The situation where a random effect also has an impact on production is a possible extension of this model.

This will be the optimal strategy and the maximum profit the firm can receive (in a pooling equilibrium) when there is no possibility for renegotiation with the workers.

When renegotiation is permitted, the optimal strategy is to use the pooling equilibrium wages of the single-period model in period 1, and since efforts are observed after period 1, give the first-best wages to the relevant types in all of the following periods. However, it is shown below that the firm can achieve more profits than in the first-best case by inducing high-types to behave as if they were low types.

Let *t* denote the time period and for the moment assume that there are only two periods (t = 1, 2). After t = 1, the firm can observe how much output each worker produced. Since production is a function of effort only, the employer can immediately deduce whether the person is a low-type or a high-type worker. As a reaction, the firm has two typical choices. It can either threaten to fire high types or it can promise a bonus to all those exerting low-type effort. However, the firing of workers could be an incredible threat (Gintis, 2000) if either it is too costly to fire an employee or if the employment of high types is profitable.

Let $\pi_H = \theta e_H(w_p) - w_p$ be the profit (or loss) gained from employing a high-type worker, where w_p denotes the pooling equilibrium wage obtained in section 3.2, and let $c_F > 0$ be the cost of firing. As long as $\pi_H \ge -c_F$ the firm will retain high-types in period 2.⁷ If these values are known to the workers, the threat becomes incredible and will have no effect. The high types will simply exert effort that is optimal for them and will still be employed. Since π_H may be negative, but more importantly since low types may be much more profitable, it becomes more beneficial for the firm to find another way motivating high types to exert more effort. This can be done through the introduction of bonuses, as shown later.

For the moment it is assumed that $\pi_H < -c_F$ and so the threat of firing is credible. High types now need to choose between staying high types or exerting low-type effort in period 1. Let δ

⁷ Note that it is implicitly assumed that the firm cannot replace high types with low types from the labour market. Hence the decision is entirely about retaining or firing high types.

be the discount factor for both the workers and the firm, and assume that the total utility of an individual is the sum of utilities gained from each period. The utility of high types when exerting high-type effort is then

$$U^{H} = u_{H}(w_{p}^{1}, e_{H}(w_{p}^{1})) + \delta \cdot 0 = w_{p}^{1} - c e_{H}(w_{p}^{1})$$
(4.1)

Under the low-type effort, their utility changes to

$$U^{L} = u_{H}\left(w_{p}^{1}, e_{L}(w_{p}^{1})\right) + \delta u_{H}\left(w_{p}^{2}, e_{L}(w_{p}^{2})\right) = w_{p}^{1} - c e_{L}(w_{p}^{1}) + \delta (w_{p}^{2} - c e_{H}(w_{p}^{2}))$$
(4.2)

where w_p^t denotes the wage of all workers in period *t*. Hence as long as the value given in (4.1) is less than the value given in (4.2), high types will exert low-type effort. If the employer provides a high enough wage in the second period, it can induce high types to pretend to be low types and exert more effort. In this case, the profit maximisation is

$$\max_{w_{p}^{1},w_{p}^{2}} \theta e_{L}(w_{p}^{1}) - w_{p}^{1} + \delta \Big[\beta (\theta e_{H}(w_{p}^{2}) - w_{p}^{2}) + (1 - \beta) (\theta e_{L}(w_{p}^{2}) - w_{p}^{2}) \Big]$$

s.t. $U^{H} \leq U^{L}$ (ICH)⁸

where U^{H} and U^{L} are given in (4.1) and (4.2).

The participation constraints also have to hold for each period: $w_p^t \ge w$ for t = 1, 2, but noticing that these will always be slack, they are omitted for simplicity. This optimisation can be immediately extended to *n* periods. If (ICH) holds for period 1, then it will hold for period 2, period 3, and so on. Therefore it must hold for all periods, and letting $n \rightarrow \infty$ the firm will have to set the same wage for each period, solving:

$$\max_{w} \left(\theta \frac{w}{w_{L}^{*}} - w \right) (1 + \delta + \delta^{2} + ...) = \max_{w} w \left(\frac{\theta}{w_{L}^{*}} - 1 \right) \left(\frac{1}{1 - \delta} \right)$$

s.t. $u_{H}(w, e_{H}(w)) \leq \left(\frac{1}{1 - \delta} \right) u_{H}(w, e_{L}(w))$ (ICH)

Since all workers will exert effort according to the behaviour of low types, there is no point

⁸ There is no need for an incentive compatibility constraint for the low types, because the moral cost, M is so high that there is no incentive for low types to behave as high types and exert less effort than what is proposed by the fair wage-effort hypothesis.

for the firm to set $w > w_L^*$. Substituting in for the utility functions in (ICH) gives

$$w\left(1-\frac{c}{w_H^*}\right) \leq \frac{1}{1-\delta}(w-c),$$

which can be reordered to obtain

$$w \ge \frac{c}{\delta + (c/w_H^*)(1-\delta)}$$
(4.3)

For $\delta \approx 1$ (4.3) becomes $w \ge c$. It is profitable for the firm to increase w to get more effort from the workers, and as $w_L^* > c$ the optimal wage will be $w = w_L^*$ and (OCH) will be slack. The result depends on the discount factor, and there is a threshold below which high types value present utility so high that they would rather not spend as much effort as low types. This scenario would not provide any new results; hence it is assumed that δ is sufficiently high.

The profit for the firm in this case is $\theta - w_L^* \ge \Pi^{FB}$ for all β and will be equal only for $\beta = 0$. Therefore such a set-up is better than even the perfect information case studied in section 3.1. This is very counter-intuitive, but it shows how much more power the firm has over its employees as soon as there is more than one period. In the single-period set-up even if there was perfect information the firm has no way of retaliating against shirking employees, which makes it more vulnerable. Although it was assumed that there was imperfect information here, the fact that the firm can observe efforts after period 1 is what makes its position especially strong. It may be the case that the firm needs to pay a certain monitoring cost for this information. That could reduce its profits by so much that even repeating a simple, single-period pooling equilibrium would yield higher profits.

The utility of the workers is straightforward. For low types, $u_L = w_L^* - c = u_L^{\text{FB}}$ and for high types it is $u_H = w_L^* - c < u_H^{\text{FB}} = w_H^* - c$. In fact, for this amount of wage, high types would receive a utility of $w_L^* - c(w_L^*/w_H^*)$ and so this situation can be seen as a great loss for them. Even though high types receive more utility than what they would get under not pretending to be low types, clearly the firm benefits from the multi-period set-up at the expense of the high types only.

The problem with the firm threatening to fire is not just the possibility of this being an incredible threat. Such an attitude may decrease the morale of workers and thus may have negative effects in the long-term. Therefore, if wages are considered to be a gift and effort is adjusted accordingly, then threats will also create disutility that will inevitably lower efforts as well.

Now suppose that the firing of high types is an incredible threat. So instead of threatening to fire, the firm proposes to give a bonus to everyone who has exerted low-type effort. Let *b* denote the amount by which low types' wages are increased in the next period. In a two-period model the utility of high types when exerting their own effort is:

$$w_p - c e_H(w_p) + \delta \left(w_p - c e_H(w_p) \right)$$
(4.3)

while providing low-type effort in period 1 and behaving normally in period 2 gives

$$w_p - c e_L(w_p + \delta b) + \delta (b + w_p - c e_H(w_p))$$

$$(4.4)$$

The timing of the model is the following. Once the contract is accepted, the firm gives w_p to workers, after which they exert some effort in period 1. The firm observes efforts and pays $b + w_p$ to all those who have exerted low-type effort. The term δb is included in the first-period effort of lowtypes, because workers exerting low-type effort expect the payment of the bonus, and so it is assumed that they will adjust their effort accordingly even before the bonus is actually paid. To induce high types to exert low-type effort, the incentive compatibility requires that the value given in (4.3) is below that in (4.4).

Since the solution to the two-period model is almost identical to that of a model with n > 2periods, only the general problem will be solved. The utility in (4.4) can be rearranged to give

$$\delta b + w_p - c e_L(w_p + \delta b) + \delta (w_p - c e_H(w_p))$$
(4.4a)

so that it is more evident that the extra payment δb belongs to the work in period 1. Comparing (4.3) and (4.4a), high-types will exert low-type effort in period 1 if and only if

$$\left(w_{p}-ce_{H}(w_{p})\right) \leq \delta b + w_{p}-ce_{L}(w_{p}+\delta b)$$

$$(4.5)$$

Moreover, the utility received in periods 2 and 3 for different behaviour are identical to those given in (4.3) and (4.4) for periods 1 and 2. Hence if (4.5) holds for period 1, it will hold for period 2 as well and extending it further, it will hold for all periods. Thus (4.5) is the incentive compatibility constraint in any multiple-period model, and letting $n \rightarrow \infty$ the problem of the firm is to set *w* and *b* that maximises

$$\max_{w,b} \left[\theta e_{L}(w+\delta b) - w - \delta b \right] \cdot \frac{1}{1-\delta}$$

s.t. $\left(w - c \frac{w}{w_{H}^{*}} \right) \leq w + \delta b - c \frac{w+\delta}{w_{L}^{*}}$ (ICH)

It looks as if this problem is a single-period one and thus would not require the introduction of multi-periods. However, that is not true. In a model with only one period, the corresponding strategy of the firm is to propose a single wage and offer that a bonus will be given to all those who have exerted low-type effort (assuming that once the work is done the firm can observe efforts). After work is done, no matter what effort levels were observed, the most profitable decision for the firm is not to give a bonus to anyone. Hence the concept of the bonus becomes incredible, which will be anticipated by the workers. As a result workers will not adjust their effort to the expected bonus, and the situation is as if the bonus was not offered at all.

On the other hand, in a model with more than one periods, if the firm decided not to pay bonuses after it has promised to do so, it is intuitive to assume that the morale of workers will decline. This decline in morale can be modelled in many ways – for example all low types becoming high types or every worker exerting half the effort from that point onwards – but at this stage it is sufficient to say that it will have a large negative impact on profits. Hence once the firm has promised bonuses, it will be too costly for it not to pay them, making the promise credible. The introduction of time and multiple periods is therefore important because it acts as a motivator for the firm and so it indirectly encourages workers to adjust their efforts before the bonus is materialised⁹.

Solving the optimisation is straightforward: as $\theta > w_L^*$ the firm will want to increase the total payment $w + \delta b$ to as much as it can, giving the corner solution $w + \delta b = w_L^*$. Inserting this into (ICH), it must be that $w(1-c/w_H^*) \le w_L^*(1-c/w_L^*)$. Hence the firm may set w to any value satisfying

$$w \leq w_L^* \frac{(1-c/w_L^*)}{(1-c/w_H^*)} < w_L^*$$

and the incentive compatibility constraint will be satisfied. This means that in the end every worker will exert full effort and receive a remuneration of w_L^* . The utility of each type is again $u_L = w_L^* - c = u_L^{FB}$ for low-types workers and $u_H = w_L^* - c < u_H^{FB} = w_H^* - c$ for high-type ones, and the profit is $\Pi = \theta - w_L^*$ for each period. This is exactly the same result as obtained when the firing of workers was permitted, which shows that the strategy of 'motivating with extra wage' is equally good as 'motivating with the threat of firing'. In fact, since the threat to firing can have negative long-term impact on morale, motivating with extra wage is that much more effective.

In either case, with multiple periods the firm is not only able to overcome imperfect information, but it can increase its per-period profit above the amount it would receive under full information in a single-period set-up. In exchange it exploits high-types more, meaning that the low types – the more enthusiastic workers – become the main beneficiaries of work. This is in line with the results obtained in section 3.2, where it was possible for a low-type worker to gain more utility than under the first-best case. Under the strategy shown here, however, the low types will always do as well as in the first-best case, independently of β . The power of the firm came from the fact that it can observe effort after each period. This is a very strong tool against asymmetric information, and

⁹ It is interesting to think that a firm – which is led by individuals – may be affected by gift exchange, meaning that if it observed high effort from workers, it will give them bonuses even if it decreases the profit. This way it would be possible to credibly offer bonuses in a single period. However, gift exchange is based on the fact that individuals react to gifts by giving something back because the thought of doing so increases their utility. A firm is assumed to maximise profits, not utility, which implicitly means that the idea of gift exchange cannot be applied to them.

without it total profits will decline greatly.

Suppose now that the firm is unable to observe workers' efforts after each period. Since the pooling equilibrium does not determine the types, the firm will be unable to draw any conclusions about the workers. Therefore, the multi-period strategy becomes the repetition of the single-period pooling equilibrium wage in every period. This will give the same results as obtained in section 3.2. If the firm can observe individual outputs, but output is also influenced by a random factor – i.e. the firm can only observe efforts in a probabilistic sense – then the problem becomes similar to moral hazard ones. This set-up is not analysed in this thesis, but is an interesting way of extending the use and effects of the fair wage-effort hypothesis.

4.2 Dynamic Separating Equilibrium

If it is not possible for the firm to observe the exact amount each individual has produced, there are generally two options to use. The first one is to provide some form of bonus or threat based on the total production figures at the end of each period. This would result in a game theoretic problem similar to public goods, where the high-type workers could become free-riders. The other method is to screen the workers by providing contracts that are unique to each type.

Looking at the latter case when the firm wants to separate the two types, the aim is to offer two contracts (w_L^1, w_L^2) and (w_H^1, w_H^2) , with w_i^t denoting the wage that would be given to type *i* in period *t*. Ideally low types will choose the first contract and high types the second one. The problem, however, is that since the firm is unable to monitor individual efforts, the level of effort will be determined by the fair wage-effort hypothesis for each type independently of which contract was chosen. As a result, both types will simply choose the contract that offers the highest total wage (weighted with the discount factor).

Even though there is more than one period, the separating equilibrium breaks down because

effort is not controlled. In this sense the multi-period model is no different from the single-period one. To solve this problem, the firm either needs to monitor effort or use the same overtime-work scheme as in section 3.3. It is not always possible to monitor effort, or even if it is, a random element may be included in the result. In addition, monitoring also means additional costs; and although the provision of overtime work also has its own costs, it also results in extra production. Due to all of these reasons it is very unlikely that the firm could benefit more from monitoring than from providing an additional effort scheme that would naturally separate the two types of workers.

Suppose, then, that the firm can specify overtime work conditions as given in 3.3. The most profitable strategy is to offer the two contracts (w_H, \tilde{w}) and (w_L) as specified in that section, but only for the first period. After t = 1, the employer will know the type of each worker and it can offer the first best wages w_L^{FB} and w_H^{FB} . The aim of the firm is therefore to use the multi-period set-up to determine the types in the short-term and then exploit the workers as much as possible. As a result the firm is able to achieve more profits than if it was to offer the separating equilibrium contracts proposed in section 3.3 for each period. In addition, if δ is high enough, the solution where the firm is able to offer w_L^{FB} and w_H^{FB} from the second period onwards will result in more profits for each period on average than in any of the single-period pooling or separating equilibria.

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Of course, this solution is common knowledge to the workers, so low types will know that if they pretend to be high types in period 1, then they will receive high-type wages from thereon. This creates motivation for low types to behave differently from their types. Low types will receive $w_{H}^{FB} = w_{H}^{*}$ and they would still provide full effort as given by the fair wage-effort hypothesis, and so will receive more utility than under the wage rate $w_{L}^{FB} = w_{L}^{*}$. Hence the firm will have to give a higher wage than just w_{L}^{*} after period 1 so that low types are happy to behave normally in period 1 and get separated from high-types.

Without solving this optimisation one thing is clear: the opportunities of the firm for

screening the workers have largely increased by the introduction of more than one periods. It is possible to efficiently use many periods to substantially increase profits compared to simply repeating the strategy devised for the single-period models.

With more than one periods the firm is able to identify the different types of workers in many situations and thus increase its profits. However, in real life the preferences of individuals change very often. This is no exception for fair wage: the subjective elements can very easily fluctuate over time. For example, a worker may become demotivated due to her working environment. As a consequence her fair wage will become higher. Similarly people who have worked for many years at the same company may feel that they should be getting a pay-rise. This means a higher fair wage again, but only after a certain number of years. Under changing fair wages the firm will never be able to tell the types of workers – even if it determines the type in one period, it may be the opposite in the next one. Therefore, in order to properly analyse the fair wage-effort hypothesis over time, fair wages must be allowed to change with time, and this has to be incorporated in the model. The next chapter introduces a basic model in which fair wages are allowed to change over time and the effects of this dynamics on the firm are examined.

5. Changing fair wages over time

Many of today's economics models analyse a static situation, or if they are extended to multiple periods it is often assumed that the preferences or the behaviour of individuals are the same throughout. However, this is a very strong assumption, because preferences are usually the pinnacle of most studies, and so whenever these change the impact can be substantial. This paper is no exception. In the previous chapter the fair wage-effort hypothesis was extended to multiple timeperiods with two types of workers. The fair wages were implicitly assumed to be constant over time, and the aim of this chapter is to give a short introduction on how this assumption can be relaxed. As soon as fair wages are allowed to change, the firm may need to come up with new strategies to affect those changes. One of such strategies is also mentioned in this chapter, and it is shown that if the firm does not take changing fair wages into account, then it may end up with substantially lower profits.

5.1 The effects of changing fair wages under no adjustment by the firm

Changes in fair wages emerge very naturally among workers. For example, workers can easily become demotivated because of a negative working environment or the negative attitude of their bosses. In other cases workers might anticipate higher wages as they get older – due to their improving skills or obtaining new positions with more responsibility. At this stage only a very basic model is used to allow for changing fair wages.

Keeping the two-type model used in the above sections, suppose that after every period each worker will change his type with a given probability. Let p_H denote the probability of a low-type worker becoming a high-type one, and p_L the probability of a high-type worker turning into a low-type one. The proportion of the two types is now time-dependent, and if β_t is the proportion of high

types in period *t*, then the proportion of high types in period *t*+1 will be $\beta_{t+1} = \beta_t (1-p_L) + (1-\beta_t) p_H$ and the proportion of low types is simply $1 - \beta_{t+1}$.

For simplicity it is assumed that a firm that does nothing to prevent or alter the changes in the fair wages will have $p_L = 0$ and $p_H = p$, for some 0 . In other words if the firm does nothave a strategy to accommodate its workers over time, then a small proportion of low-types willbecome less motivated and become high types. At the same time, due to a lack of encouragement,none of the high types will start working harder and thus will not become low types. Assume thatthe firm is unable to observe the exact effort levels after each period (so that the firm cannotencourage all workers to exert low-type effort as in section 4.1). In this case, there are two options:either use the static pooling equilibrium wages in each period or use the separating equilibrium.

For the pooling equilibrium case (section 3.2), the firm was giving a wage of $w = w_{H}^{*}$ for all workers when $\beta \ge w_{H}^{*}/\theta$. Since β_{t} increases over time in this set-up, the optimal wage will be constant over time with $w = w_{H}^{*}$ and so if $\beta_{t} \ge w_{H}^{*}/\theta$ already holds for the first period, then the firm will not lose from being ignorant – i.e. not considering the possibility of changing fair wages. If $\beta_{1} < w_{H}^{*}/\theta$, then it is optimal to give $w = w_{L}^{*}$ to all workers in the first period. If the firm is ignorant in this case, then it will give this wage for all following periods. However, at some point in time the number of high-types will be significantly larger than low ones and it will become optimal for the firm to switch strategies. This is because for all *t* with $\beta_{t} \ge w_{H}^{*}/\theta$ the optimal strategy is to set $w = w_{H}^{*}$. Of course, this means that the firm should be making the amount of profit given in equation (3.4) for all such *t*, but instead it makes the amount given in (3.3), which is going to be less. Defining the 'ignorance' of the firm to be its behaviour of not considering the possibility of changing fair wages, the cost of ignorance will be the difference between (3.4) and (3.3): There will be a positive cost of ignorance only after a given amount of time – i.e. once $\beta_t \ge w_H^* / \theta$ – but after that point this cost will increase with each period.

Suppose now that the firm decides to screen the workers, and once their type is determined, gives each worker the corresponding first-best wage. In the first period the firm will use the separating equilibrium wages, and so even if it is ignorant, initially it will receive the same profit as in section 4.2. However, after period 1 the number of low types will decrease, but an ignorant firm will not take this into account. Such a firm will keep giving the first-best low-type wage, w_L^* to even those who have become high types. From each of those workers the firm receives a profit of $w_L^*(\theta/w_H^*-1) < w_H^*(\theta/w_H^*-1)$. The latter expression is what the firm would get if it knew exactly who have changed types. As time goes on, the number of those who have become high types will increase and so the cost of ignorance will also increase. Thus, the firm's profit will definitely decrease as a result of changing fair wages, unless it decided to do something about it.

5.2 A Basic model adapting to changing fair wages

The way a firm could become more profitable in the long run is either to decrease the number of enthusiastic workers becoming demotivated (decrease p_H) or to increase the number of less enthusiastic individuals becoming more motivated (increase p_L). As an introduction it is assumed that the firm may pay a cost of *C* to decrease p_H to 0. Typical examples for such a strategy would be to hold events such as dinners, trainings and Christmas parties for the employees. These indicate that the workplace has a nice environment, and is worth exerting the effort for.

Under the pooling equilibrium it was shown that if $\beta_1 \ge w_H^*/\theta$ then the firm will not incur any losses due to decreasing enthusiasm of low-types. Hence when there are sufficiently high number of high-type workers the firm will not hold special events to indicate how pleasant the working environment is. If one can assume that there is self-selection, and high-types tend to work for governmental organisations and low-types for profit-oriented companies, then perhaps this is the reason why a ministry department does not hold motivation building events for its workers as opposed to large multinational companies.

When $\beta_1 < w_H^* / \theta$, the decline in profits is given by (5.1) for period t, hence the firm will hold special events provided

$$C < \sum_{t=2}^{n} \delta^{t-1} \left(w_{H}^{*} - w_{L}^{*} \right) \left(\frac{\beta_{t} \theta}{w_{H}^{*}} - 1 \right)$$
(5.2)

if the firm plans ahead for *n* periods.

For the separating equilibrium case, in each period there will be a fraction of workers who are mislabelled to be low types, when in reality they have already become high types. Each of these workers gets a wage of $w = w_L^*$ instead of the first best $w = w_H^*$. The firm's profit from each of these workers is $w_L^*(\theta/w_H^* - 1)$, whereas it would receive a profit of $(\theta - w_L^*)$ had the worker stayed as a low type. In each period the fraction of workers is β_t , hence the amount of low-type workers turning into high-type ones is $p_H(1 - \beta_t)$. Therefore, the total loss in period (t + 1) for the firm compared to the non-changing fair wage case is

$$p_{H}(1-\beta_{t})\left[(\theta-w_{L}^{*})-w_{L}^{*}(\theta/w_{H}^{*}-1)\right] = p_{H}(1-\beta_{t})\theta(1-w_{L}^{*}/w_{H}^{*})$$
(5.3)

Therefore, the firm will proceed to pay the cost to keep the low types' morale provided

$$C < \sum_{t=2}^{n} \delta^{t-1} p_{H} (1 - \beta_{t-1}) \theta (1 - w_{L}^{*} / w_{H}^{*})$$
(5.4)

An alternative approach to the same problem would be to start from the assumption that under normal circumstances workers are happy, and so initially $p_H = p_L = 0$. The firm then has a choice to hold events such as trainings and team-building holidays to achieve additional motivation for its workers. This means that the firm could pay a cost of *C* to attain $p_L = q > 0$. It can be shown through a very similar analysis to the above that there is a range of values for *C* for which the firm will largely benefit from such motivation raising events. Of course, from the viewpoint of a human resource manager the most interesting question would be to see which one was more profitable: to decrease p_H or increase p_L – in case both were positive – assuming that the human resource branch of the firm has a fixed budget for such purposes. Obviously there is no unique answer to this question, since the results depend on the parameters (*C*, p_H , p_L and β_t) of the model.

The power of the fair wage-effort hypothesis is that it draws a relationship between wage and effort, stating that production increases as wage is increased. However, there can also be nonlinear changes in effort attributed to factors other than wages. These are the factors that lead, for example, to changes in the workers' perception of the fair wages. A firm can attain substantially more profits by taking these changes into consideration and trying to influence them through events and benefits – other than wages – even if these are costly. Firms can use such benefits not only to preserve the attitude of the workers but also to provide extra motivation. As opposed to increasing wages, this is likely to result in a non-linear increase in the workers' effort. Thus a similar result can be achieved through motivating events and benefits compared with simple wage increases. This might give an additional explanation in the ongoing debate of the literature that some firms pay very different wages from others that have an almost identical workforce. A large firm, for example, might find that paying one lump-sum cost for worker-motivating events and benefits will be less costly to induce higher effort per worker than paying higher wages to each individual. In any case, looking at the fair wage-effort hypothesis in a multi-period context where fair wages can also change may shed light on other puzzling questions and is worth examining in more detail.

6. Conclusions

The fair wage-effort hypothesis was extended in several ways in this work. First, two types of workers were introduced based on the fair wage and the effects of asymmetric information was analysed. Different results were obtained for the cases when the firm tried to separate the two types using overtime work, and when it provided the same wage to all workers. In the second step the importance of time was shown: with more than one period to consider the effects of asymmetric information changed greatly, both in terms of the profit of the firm and the utility of workers. As a final step, the possibility of changing fair wages was examined. It was concluded that such changes can have a substantial impact, and so are worth examining in more detail.

When examining the effects of asymmetric information, the first immediate result was that apart from a single situation, participation constraints did not matter. This is the opposite of standard results of adverse selection and screening, in which at least one type's participation constraint is binding. The fair wage-effort hypothesis means that if it is profitable to employ one type, then it will be profitable to give them as high wages as possible due to the wage's effect of increasing effort.

Naturally, under asymmetric information the firm always had lower profits than under the perfect information case, but the beneficiaries were not always the same type of workers. Under pooling equilibrium the low types were either as well off as under perfect information or received higher wages, while high types were never better off and sometimes were even worse off. In the separating equilibrium this was the opposite: high types benefited most from screening, while low types were sometimes worse off. Under both the pooling and separating equilibria there existed a threshold for the fraction of high types, under which different strategies were optimal to follow. For the pooling equilibrium, this threshold was determined by the high types' fair wage: the more costly it was to motivate high-type workers to reach their full effort, the more of them were needed to

surpass this value. Once their fraction was above the limiting ratio, it became optimal to pay all workers the fair wage of the high types. This is because the profit generated by the high types' additional effort outweighed the cost of overpaying low types. When there were significantly more low types, the wage dropped to their fair wage – there were simply not enough high types to generate enough extra profit. Hence, when there are significantly more of those who are 'less enthusiastic', all workers will be better off than when more enthusiastic workers dominate the market. This phenomenon can be interpreted in the way that when more enthusiastic workers are rare, their unlikely presence will lead to them being rewarded by more than necessary. On the other hand, when most of the market is made of more enthusiastic individuals, the 'norm' will adjust to this and being less enthusiastic is punished by a lower utility.

For the separating equilibrium to exist, the notion of overtime work was introduced, which was not paying well enough for low types to take the opportunity. Thus, in the equilibrium only high types stayed for the overtime work, and received more wages in total. Overtime work was assumed to be unprofitable, which meant that the firm was making less profit overall than in the perfect information case. The threshold of the fraction of high types was based on the profitability of low types under their fair wage. More profitable low-type workers meant a higher threshold, which was not good for low types, as they only received their fair wage when the number of high types surpassed this threshold. With the number of high types below this limit, low-type workers were given only their reservation wage, while high types always received their fair one. These results came from the fact that while the firm can increase the wage of high types without any consequences (thus increasing profits), it could only increase low-type wages as long as it stayed lower than what would have induced high types to pretend to be in the more enthusiastic group. The results on the wages means that the separating equilibrium is very similar to the pooling one: low-type workers prefer a labour market which is dominated by high types.

The cost of information was found to be the highest for the firm when the number of

workers was balanced between the types – essentially meaning that less is known about the types. The choice between the pooling and the separating equilibrium ultimately depends on the cost of overtime work: too low productivity or too high overtime wages means that pooling is better for almost all fractions of the high types. On the other hand, the fraction itself is important as well: when it is close to the threshold value of the separating equilibrium, then the separating equilibrium will yield more profits. Alternatively to the overtime introduced in this model, it is worth examining the case when overtime work requires some necessary fixed effort from workers. It is easy to show that in this case low-types will choose the contract with overtime work, while high types will decline it. As a result, low types will receive higher wages and thus higher utility.

In chapter 4 the great importance and effects of time – in the sense of multiple periods – was shown. The firm had the choice of either providing multi-period contracts, in which it pays the single-period wage in every period. This was optimal when renegotiation was not permitted. If the firm was able to observe the effort of workers after the first period, then it was more profitable to introduce renegotiation. After paying either the pooling or the separating wages in period 1, the firm was able to offer the full information wages from the second period onwards.

However, it was shown that under the pooling equilibrium the firm was able to achieve even more profits. Either by the threat of firing or giving bonuses, it could motivate high types to pretend to be low ones, because then they will get more wages over their lifetimes. This is achieved through paying low types their fair wage, while underpaying high types, and so it did not mean increased costs for the firm. Hence, the firm will in fact make much more profit than even under the perfect information case: it managed to use time to its own advantage.

In this set-up, the low types are equally well off as in the first-best case, but high types have to give up quite a lot of their utility. This is the first set-up, in which the more enthusiastic workers are at least as well off as high types in absolute terms. This is counter-intuitive, because more enthusiastic workers are supposed to enjoy work more, and so should be receiving more utility. However, suppose that the utility function was extended, so that an extra negative constant term was introduced, which came from spending time at work. This would be greater (in absolute value) for less enthusiastic workers, and so suddenly less enthusiastic workers would have a lower utility than the more enthusiastic ones. Therefore, the comparison of the utilities of the two types is not so relevant, as it is always possible to translate the utilities by a constant based on workers' type.

It was also noted that a bonus can achieve the same motivational effects as the threat to fire workers. However, the threat of firing may have a negative impact on morale with negative consequences in the long term. Therefore, the provision of bonuses can be seen as a better way of inducing high effort. A possible extension of the model is to assume that a firm can only observe efforts plus some random shock. In this case the problem becomes that of a moral hazard one, and could be similarly analysed.

To achieve separating equilibrium in multiple periods, the introduction of overtime work was still needed. Once that was done, the strategy was straightforward: pay the separating equilibrium wages, observe the resulting types and use the perfect information case. This, of course, only works if renegotiation is possible, while under no renegotiation, the single-period wages would be paid in all periods.

In the last chapter a short introduction was given on the possibility of changing fair wages. It was shown that if high and low types may interchange, then a firm not noticing that may lose substantial profits. In addition, a basic way of influencing changes in fair wages was mentioned. The firm can pay a cost on the wellness of workers at the company, and in turn workers will feel more comfortable working there. With higher morale, there will be more low-types than high types in the long run, yielding more profits.

In real life changes in fair wages may be even more complicated than shown in this thesis, with much greater effects (e.g. many workers leaving the firm, trying to cheat the firm, etc.), and so more analysis of changing fair wages (and changing taste in general) may prove useful. For

example, changing fair wages may explain non-linear changes in effort (as opposed to the fair wage-effort hypothesis that explains linear changes) or inconsistent effort (changing effort over time but under the same conditions). The cost of making workers feel more comfortable may be very high, so that such employee policies are more likely to be worth doing at large companies with many workers. After all, a lump-sum cost can be still much less than increasing the wage of every worker.

There are several empirical tests that might be worth conducting regarding some of the results mentioned here. First of all, it would be interesting to see if indeed it is the 'less enthusiastic' workers who would rather choose overtime work and receive the extra wages.¹⁰ Second, the ratio of high and low-type workers could be examined and the corresponding wages. Under both the pooling and separating equilibrium several results were shown that depended on whether the market is dominated by more enthusiastic or less enthusiastic workers. For example, it could be checked whether when there are mostly less enthusiastic workers than the more enthusiastic ones are rewarded by more than when there are a large number of more enthusiastic workers. Empirical tests regarding the changes in effort and in the perception of fair wage over time would also be interesting to consider. Similarly, an analysis of companies that do and do not employ motivation inducing events together with possible reasons behind these decisions might prove useful.

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All of the above results show that considerable work is still needed to be done regarding the fair wage-effort hypothesis. It can be extended in many ways, including the introduction of time and changing fair wages. Workers with different skills can also be added – for example two more types can be introduced based on different productivity. A few new empirical tests can also show the significance of such extensions. It seems that the fair wage effort hypothesis of Akerlof and Yellen (1990) has opened the floodgates for a large number of ideas, and the number of possibilities and directions in which one can proceed does not seem to have decreased in the past 15 years.

¹⁰ Perhaps it can be observer that 'more enthusiastic' ones do more hours of work for free?

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