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*A comparative analysis of job rotation and
specialisation*

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The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

Preface

Before you lies the dissertation “*A comparative analysis of job rotation and specialisation*”, research about the choice between job rotation and job specialisation for both the employee and the employer. This thesis is written to fulfil the graduation requirements of the bachelor programme Economics and Business Economics at the Erasmus University. I was occupied writing this research from April 2022 till August 2022.

Together with my supervisor, Jurjen Kamphorst, I developed a microeconomic model for both utility for the employees and profit for managers to answer my research question. I would like to thank Jurjen for his help and excellent guidance during this period.

I hope you enjoy your reading

Fleur van der Zijden

Abstract

Job rotation is an emergent topic in the business field. It means that workers rotate between different tasks, instead of specialising into one specific job. There are already many existing studies in the field of specialisation and rotation, but this paper adds more insights to the present findings. A broad literature research in this paper shows the most important existing topics in this field. The research question in this thesis is: *When is job rotation better for the employee and the employer, compared to specialisation?* To answer this question, I came up with three sub-questions: What is the effect of possessing certain skills for the choices in the model? What is the effect of specialising and rotating workers on the profit of a firm? Which types of industries will benefit from using job rotation, compared to specialisation? These questions are answered using a microeconomic model that is specially made for this research. The model consists of a utility function for workers and a profit function for firms. This model consists of three players: the manager of a firm and two workers. These workers can be allocated between two different tasks: T = Rotation and T = Specialisation. The manager offers a contract to a worker, which they then can accept or reject. Afterwards, the payoffs are received. Some of the main insights after analysing this model are that both specialisation and rotation have different advantages and disadvantages for employees as well as firms. Employees obtain more skills when they specialise, which increases their human capital. On the other hand, specialisation leads to boredom. In the end, the workers are indifferent between accepting or rejecting the contract offer. The profit is dependent of the price of the product and is, with specialisation, influenced by skills and boredom. If the skills of the workers are high and boredom is low, profit will be higher with specialisation of both workers. To convince the workers to accept the contract, the manager should offer them a higher fixed wage or other advantages outside the contract such as free days or accessibility to trainings. This paper also investigates which industries would choose rotation over specialisation but this is difficult to research precisely. Some deficiencies of this research are the missing variables in both functions. A recommendation for further research can be to apply this model to a real-life example to make the outcomes less theoretical and more practical. Additionally, separate research that focusses on different types of industries to investigate whether they should specialise or not, can also be an interesting addition to the existing literature.

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1. Introduction

1.1 Motivation

Job rotation, a topic in the business field that is becoming increasingly popular among businesses. Job rotation has multiple definitions. Indeed (2021) defines job rotation as follows: job rotations means that employees move to a different role in the same organisation to make their deployment more flexible. Another definition is from Campion, Cheraskin and Stevens (1994), they say that job rotations are ‘lateral transfers of employees between jobs in an organization.’ In the last years, many articles were written about this topic, as more and more companies use this technique. The management study guide published an article about the benefits of job rotation and mentions six of them. For example, dealing with new challenges, decreasing attrition rate and exploring the interests of employees. Since job rotation becomes an important strategy for many firms, I am wondering what the benefits of job rotation are, because I will join the labour market myself in a few years. Despite the fact that a lot of research has been done, I believe that it is not yet enough. With this thesis, I want to add insights about this topic to the existing literature.

1.2 Relevance

As I said before, job rotation is used by many companies nowadays. This research is relevant because I will discuss the existing literature about job rotation and investigate a part of this topic that has not been studied enough yet. Adam Smith wrote in his ‘Wealth of Nations’ (1776) about the advantages of the division of labour and thereby the specialization. This shows that this topic was already important many centuries ago. Coşgel and Miceli (1999) wrote a paper about the benefits and costs of job rotation and came to the conclusion that the effect of Job rotation differs per business. That job rotation has lots of benefits is also found by Ortega (2001). He states that rotating employees among different tasks, increases their human capital and decreases their boredom. Not only job rotation has an effect on the job satisfaction for employees, many other aspects play a role, such as: employment conditions, selection and requirements (Van Wyk, Swarts & Mukonza, 2018). More aspects of job rotation are investigated, but these will be discussed in the literature review part of this paper. However, the specific effect of Job rotation on certain skills compared to specialization has not been studied before. Furthermore, I will investigate the link between these skills and types of industries to make conclusions about firms that may and may not use job rotation. Because this is a new

investigation in the job rotation literature and it can help firms making the right choice, this paper is economically and scientifically relevant.

1.3 Research questions and method

In this thesis, I study the choice between job rotation and job specialisation in a setting where workers gain expertise in their job, as well as becoming bored by it. The research question for this thesis is:

When is job rotation better for the employee and the employer, compared to specialisation?

To answer this research question, there are several sub-questions that will be answered separately. These sub-questions are:

1. *What is the effect of possessing certain skills for the choices in the model?*
2. *What is the effect of specialising and rotating workers on the profit of a firm?*
3. *Which types of industries will benefit from using job rotation, compared to specialisation?*

The questions will be answered by using a specific microeconomic model made for this thesis. In most micro economic models, employees want to achieve the highest utility possible, which is why the model in this thesis is also built around utility. This model is based on the model of Cosgel and Miceli (1999). Their paper looked at benefits and costs of job rotation compared with specialisation. They talked about the influence of skills on job rotation but did not include this as a variable in their model. The model in this thesis consists of a utility function for employees and a profit function for firms. The three players in the model are: a profit maximalising manager of a firm and two employees. The manager can choose to either rotate or specialise the workers in period 2. He offers the employees a contract which they can accept or reject. The model contains variables for skills and boredom. In this thesis, the variable skills displays the level of a specific skill someone possesses. To clarify, this does not display the amount of different skills a worker possesses. In short, possessing skills increases the utility and decreases the amount of effort needed to produce. Whether a manager chooses to rotate or to specialise their workers is a trade-off between revenue and costs.

1.4 Structure

The thesis will start with a literature review of the most important existing papers about the topic Job rotation. Secondly, the model will be explained that is used to answer the research question in this thesis. After a clear explanation of all the variables in the model, it will be analysed to answer the sub-questions. The analysis part will consist of several segments in which different parts of the functions will be investigated. First, the contracts with the optimal bonus and the optimal efforts will be analysed. After that, the equilibria of the model will be given in chapter 4.2. The influence of skills in the model will be separately discussed in part 4.3 and part 4.4 gives a theoretical explanation of the types of firms that are more likely to use job rotation. In the conclusion and discussion, the research question is answered and some flaws of this thesis will be addressed, as will be the suggestions for further research.

2. Literature review

Job rotation is a topic that keeps many businesses busy. Therefore, a lot of research has already been done on this topic on a broad scale. To define the topic of this thesis, it was important to investigate which aspects of job rotation have already been studied. The most important or outstanding studies will be discussed in this chapter. First, all the papers with aspect that I used in some way in my thesis will be discussed. These are aspects such as: job satisfaction, boredom, employee performance and the choices of firms for job rotation. After that, some other features of job rotation are discussed such as career outcomes, learning and organizational commitment. These effects are not taken into account in this thesis. Before moving on, I will define some important concepts that will come by in the literature review and further in the thesis. With employee and employer learning is respectively meant what the worker and the manager learn in different situations like rotation and specialisation. Employee motivation is the intrinsic motivation for workers to do their best at work and achieve a high productivity. Now, moving on to the first important literature, the paper from Coşgel & Miceli (1999) will be discussed extensively because this thesis is mostly based on their paper. They develop a simple model in which costs and benefits of job rotation are compared with specialisation, for both employees and employers. This model is used to make conclusions about the self-selection of employees in job rotation and the choice of firms to use job rotation in the workplace. The paper tells that workers who rotate from task to task, are more able to solve problems as they possess more skills, which they found theoretically. Because they did find this outcome but did not include skills as a variable in their model, I decided to that. Thereby, in contrast to the study from

Coşgel and Miceli, I will not look at the self-selection of workers into jobs. In my model, the workers will be offered a contract for either rotation or specialisation which they can accept or reject. Furthermore, many firms take advantage of using job rotation as it solves labour shortage when your current employees can finish different tasks. Thereby, firms that apply job rotation are tend to be more innovative as their workers have different ideas that can be applied. However, the paper from Coşgel & Miceli mentions that the outcome of job rotation still differs a lot per firm and per person as one can obtain more utility from rotation than the other. It talks about certain attributes that firms should possess to be able to successfully implement job rotation.

A study with data from several big companies in Taiwan showed that these employees were highly satisfied by job rotation (Huang, 1999). The paper found these results by collecting data from workers from different industries. The two hypotheses in this paper about job satisfaction and training are: 'Employees who perceive their companies as practicing job rotation will have higher job satisfaction than those who don't.' And: 'Employees who perceive their companies as practicing job rotation will evaluate the companies' training effectiveness more positively than those who don't.' These hypotheses were supported by the data. Furthermore, research showed that job rotation increases the satisfaction of workers, as long as some key factors were taken into account (Van Wyk, Swarts & Mukonza, 2018). Examples of the key factors the paper talked about are the conditions of employment, job requirements and job descriptions. However, the research had a very small sample, which made the results less valid. Part of the model in this thesis is boredom for employees. One may experience more boredom when performing repetitive tasks (Fisherl, 1993). And feeling less bored when doing more high-skilled and varied jobs. Boredom leads to distress, less productivity and depressive complaints. These problems can be solved by choosing the right job craft (van Hooff & van Hooft, 2014). Job crafting and seeking challenges affects work engagements, which then affects job boredom. These choices can prevent boredom in the job for the long term (Harju et al., 2016). However, some studies found the opposite effect where performing monotonous tasks do not increase boredom (Tsai, 2016). Because of these different findings, I decided to add boredom as a variable to the model in this thesis to investigate it myself.

One of the assumptions in this thesis is that the manager wants to achieve maximum profit. Therefore, the outcome of job rotation in terms of performance is an important aspect. Kampkötter et al. (2018) studied the influence of job rotation on employee performance. An

empirical analysis with a large panel data set from German banking firms is performed to investigate the outcomes of job rotation. The paper focusses on two things: how previous performance affects the propensity to rotate and how this rotation influences the performance after that. Some of the main findings are: low skilled workers are more likely to rotate, based on their prior performance but the outcome of performance after rotating is not statistically significant. On the other hand, high skilled workers are less likely to rotate, but if they do, the difference in performance is significant and bigger. These outcomes suggest that firms should focus on rotating high skilled workers because the gain from performance is bigger than the costs for rotating.

One of the papers from Ortega and Eriksson (2006) studies the choices of the firms to adapt job rotation. With the use of survey and panel data, the paper found that businesses that, on average, spend more on training are more likely to rotate their employees among jobs. Furthermore, it was found that rotating is more useful for employees if they already have more sets of knowledge. The main reason for firms to implement job rotation in this dataset was the employee learning hypothesis. Employer learning and employee motivation were not statistically supported. In my model, the manager has to divide its workers between different tasks. This can also be seen as employer learning because he has to investigate which worker fits where best.

Besides the study from Ortega and Eriksson (2006), another research studied a situation where managers should choose a division of tasks for their workers. While making this choice, there is a trade-off between extra costs for the firm and reducing boredom for employees. The study found several benefits for the firm when rotating the workers. First of all, employees have less familiarity with their assigned tasks when rotating. This results in an easier choice for them when choosing appropriate actions. Furthermore, workers will be less bored which may result in more motivation and production for the firm. Lastly, if workers perform different tasks over a period, they obtain less confidential information because they perform the task for a short time. This results in the fact that information spill-over, in a negative way, is less likely to occur (Arya and Mittendorf, 2004).

Most papers talk about the advantages of implementing job rotation for both workers and managers. However, this thesis focusses on the trade-off between specialisation and rotation. Several studies have been conducted on the advantages of specialisation. Specialisation would

lead to more productivity and more competitiveness (Aiginger, 2000). An early paper from McKenzie (1953) already proved the advantage of specialisation when analysing the world production. With free trade, the countries would specialise into different productions itself which results in more productivity.

The next aspects of job rotation and specialisation have not been included in the model in this thesis, but are worth mentioning. A study showed that rotation occurred more in the early career and that age, tenure and performance are positively related to rotation rates (Campion, Cheraskin & Stevens, 1994). However, not all results were significant so the outcomes are provisory. Studies in Malaysia (Zin, Shamsudin & Subramaniam, 2013) and in Australia (Jans and Frazer-Jans, 2004) both found that job rotation results in more experience in different tasks and therefore contributes to better career options in the future. The research found that interest, technical knowledge and administrative knowledge influence career development. Some main finding in the paper are: employees who rotate, obtain more skills and therefore increases their abilities. This finding is in line with the finding from the paper from Campion, Cheraskin & Stevens (1994). Secondly, in Japan, career development and promotion opportunities are measured over a long period looking at job experience. Thirdly, the paper explains that job rotation contributes to the option for employers to assign employees to the right job for them. If employees do the same tasks in their whole career, it is more difficult to determine whether this job fits them best. The last theory is that rotating employees over jobs, increases their flexibility as a worker. This flexibility can have an effect on their opportunities for jobs in the future.

Additionally to having better career options is the fact that employees may learn more from job rotation than from specialisation. This can be explained by the fact that employees who rotate, gain more different skills than employees who stay at the same job for a long period. Research has shown that rotating decreases the boredom of employees and increases the innovation in the firm. However, firms who were already more innovative, were also more likely to adapt job rotation than firms who were not that innovative. Research also found that the rotation of employees was more likely when there was little known about the abilities of employees beforehand (Ortega, 2001). Ortega linked this finding to employee learning with saying that firms with more high tenure employees were less likely to implement job rotation because they simply did not need to learn something about their employees.

What is the effect of learning from your job on your further career? Why would it be rewarding for employees to accept job rotation? Zin (2015) links the learning part of rotation to career opportunities using three indicators of job rotation (business knowledge, administrative knowledge and technical knowledge). In this paper, several definitions of career management from different authors are given. One of these definitions comes from Christopher (1994) who says that ‘individual career management can be defined by the effort of employees to advance their own career goals.’ They found that administrative knowledge and technical knowledge, obtained from job rotation, have a positive effect on career management.

Earlier, we saw studies about the job satisfaction and the productivity of employees. When making the choice whether to rotate or not, managers have to look at long term effects to avoid their employees to leave the company. A research that was done among Ilam University staff found a significant positive relation between job rotation and organizational commitment. This was explained by saying that rotating tasks in the university improves the skills to do certain tasks. The rotation is done with a realised planning and therefore workers did not get exhausted of repeatedly doing the same tasks, which makes them more satisfied and possibly more committed to their jobs (Shiri, Yari and Deghani, 2012).

3. Model

3.1 Utility model employees

In the model, we have three players: a manager and two employees. The manager wants to maximise its profit. There are only 2 different tasks that should be performed in the firm. The manager chooses between two types of task allocation (T): $T = R$ (rotation) and $T = S$ (specialisation). We have two identical workers (in terms of age, gender etc.), who only differ in the ability of certain skills. Both workers worked for the firm previously. The paper focusses on the choices that are made in the upcoming period. The timeline for this model is as follows: The manager chooses which task he allocates to his employees, and offers them a contract with a specific fixed wage for the offered task and a bonus. After this, the employees may accept or reject the offer. They have an outside option (V) with a utility of 0. If the worker accepts the contract, they choose an optimal effort and payoffs are received. In this thesis, I will determine the subgame perfect equilibrium by performing backwards induction. The steps for finding this

equilibrium are discussed in the analysis part. The individual utility functions of rotating workers (U_r) and of specialising workers (U_s) are given below:

$$U_r = Y_r - \frac{1}{2}e^2$$

$$U_s = Y_s - \frac{1}{2}e^2 * \frac{1}{s} - \delta$$

The participation constraint, with $V = 0$, for workers in this model is:

$$U \geq V$$

The effort (e) of a worker is convex, which means that it has decreasing returns to scale. This is plausible because marginal effort may decrease when people have to work longer. Therefore, the effort in this function is quadratic. Variable s displays the skills a worker possesses. Owning skills decreases the amount of effort needed to perform a task. Here, the value of s is $s \geq 1$. Skills are improved by doing the same job for a longer time, thus specialisation. In this study, I only look at the development of a specific skill from specialisation. In real life, it is reasonable that workers obtain more different skills as they perform multiple tasks, thus with rotating, but that case will be omitted in this study. As mentioned earlier, workers might get bored when doing the same job for more periods. This is one reason why job rotation is implemented in some businesses. Boredom is added by the variable δ and has a value of $\delta \geq 0$. This value will get higher when workers become more bored. In this model, I assume that workers who rotate jobs will not be bored and workers who specialise will experience a certain amount of boredom. Employees receive an income for their work, which is given as the variable Y in the utility function. Variable Y consists of a fixed wage (w) and a bonus (b) in the form of a piece rate per produced product. Therefore, Y looks as follows:

$$Y = w + bQ$$

Where a worker who specialises receives:

$$Y_s = w_s + b_s Q$$

And a worker who rotates receives:

$$Y_r = w_r + b_r Q$$

The optimal amount of bonus (b) the manager offers for each situation will be derived in the analysis. Working a job result in production in some kind of way. This amount production is given as Q and is dependent of the effort a worker puts in his job:

$$Q = e$$

3.2 Profit firms

Besides the utility of the workers, the model also contains the benefits for the firm. The benefits can be measured in terms of profit for the firm (π). The profit is dependent of the production of the workers, which is a direct outcome of the effort they put in, and the price for their product/service they make, minus the wage and bonuses they pay for those workers. Therefore, the profit function will look like this:

$$\pi = p * Q - Y$$

The profit function consists of two parts: the first part is the revenue part, which is the income for the firm. The revenue is a multiplication of the products and the price the firm receives for the product. The production functions were already given in part 3.1. In this model, I will assume that the price (p) is a fixed price that will not change over time.

The second part is the costs' part for the firm. The Y in this function is the total amount a firm pays in a specific period as wage for the workers. This consists of a fixed wage and a piece rate bonus, as explained earlier.

4. Analysis

In this section, we derive the subgame perfect equilibria of the model to answer the sub-questions of the thesis. This will be done by performing backward induction. First, the optimal effort for workers and contracting will be discussed. After this, the payoffs and the equilibria of this model will be discussed in part 4.2. Because this thesis distinguishes itself from other

researches in terms of adding skills, part 4.3 will discuss the influence of possessing skills on the worker and the manager. And lastly, in part 4.4, there will be a theoretical discussion that uses consisting literature about which industries acquire certain skills and how that relates to the model.

4.1 Contracting and optimal effort for workers

As mentioned earlier, the manager offers a contract to his workers, which they may accept or reject. The contract differs between a rotating task (R) or a specialising task (S). Which contract the manager offers, depends on which task results in the highest profit for the firm. The contract scheme (C) consists of a fixed wage and a bonus per product (piece rate).

$$C = w + bQ$$

The optimal amount of fixed wage and bonus rate will be derived in the following parts. The participation constraint was $U \geq V$, thus workers will accept the contract if their utility while working is higher than the outside option (which is 0). To investigate whether rotating or specialising result in the best outcome for the firm, both situations will be analysed in, respectively, parts 4.1.a and 4.1.b.

4.1.a A rotating worker

In this part, the situation of a worker who receives an offer to rotate between jobs is explained and analysed. To find the profit maximizing contract for the firm, we start with deriving the optimal amount of effort the worker chooses. These steps are given below:

$$(1) U_r = w_r + bQ - \frac{1}{2}e^2$$

Recalling that $Q = e$, we obtain:

$$U_r = w_r + be - \frac{1}{2}e^2$$

Take the first order condition of (U) to (e):

$$\frac{\partial U}{\partial e} = b - e = 0$$

$$(2) \mathbf{e^* = b}$$

From this optimal effort, we can conclude that the amount of effort put in is positively dependent of the bonus rate the firm offers. A higher bonus results in a higher amount of effort put in by workers who rotate jobs. The participation constraint ($U \geq V$) is:

$$U_r = w_r + bQ - \frac{1}{2}e^2 \geq V$$

With $V = 0$ and replacing Q and e^* gives:

$$w_r + \frac{1}{2}b^2 \geq 0$$

The fixed wage w_r that the firm will offer to attract the worker to stay is:

$$(3) \mathbf{w_r \geq -\frac{1}{2}b^2}$$

Therefore, this is the wage w_r the manager will choose to reach the highest profit.

To find the profit maximizing amount of bonus, the profit function of the firm must be derived to bonus (b). The steps for this are given below:

$$\pi = p * Q - Y$$

$$Q = e$$

$$Y = w_r + bQ$$

Replacing Q , e , w_r and Y and deriving this function to b gives (4):

$$\pi = p * b - \frac{1}{2}b^2 + b^2 - b^2$$

$$\frac{\partial \pi}{\partial b} = p - b = 0$$

$$(4) \mathbf{b_r^* = p}$$

We can see that the optimal bonus is dependent of the price of a product. Now that we know the amount of fixed wage and the optimal amount of bonus a firm should offer for a rotating worker, I will move on to the situation of a specialising worker.

4.1.b A specialising worker

The same thing as we did for a rotating worker, will be done with a worker who gets offered a contract (C_s) to specialise into a single task. Again, I will first derive the optimal amount of effort the worker puts into work by taking the first derivative of utility (U) to effort (e). The steps are shown below:

$$(5) U_s = w_s + bQ - \frac{1}{2}e^2 * \frac{1}{s} - \delta$$

Recalling that $Q = e$, we obtain:

$$U_s = w_s + be - \frac{1}{2}e^2 * \frac{1}{s} - \delta$$

$$\frac{\partial U}{\partial e} = b - \frac{e}{s} = 0$$

Rewriting this condition to get the effort gives:

$$(6) e^* = bs$$

As we can see in (6), the optimal level of effort is only dependent of the bonus and the skills. This is an interesting outcome because this means that skills are a very important addition for the workers. If they possess more skills, their optimal level of effort will be higher, and this will have a positive effect on their utility. Furthermore, a higher amount of bonus will motivate the workers to put in more effort. The other way around, more effort results in more production and therefore more income in terms of received bonuses. This can be a reason for employees to put more effort in their job. This already answers part of the sub-question: *What is the effect of possessing certain skills for the choices in the model?* Of course, not all skills are relative for every job, this assumption will be discussed later in part 4.3 of the report.

The participation constraint ($U \geq V$) is:

$$U_s = w_s + bQ - \frac{1}{2}e^2 * \frac{1}{s} - \delta \geq V$$

With $V = 0$ and replacing Q and effort gives:

$$w_s + b^2s - \frac{1}{2}b^2s^2 * \frac{1}{s} - \delta \geq 0$$

The fixed wage w_s that the manager will offer to attract the worker to stay is:

$$(7) w_s \geq \frac{1}{2}b^2s^2 * \frac{1}{s} + \delta - b^2s$$

Therefore, this is the wage w_s the manager will choose to reach the highest profit possible while keeping its workers.

To find the profit maximizing amount of bonus, the profit function of the firm must be derived to bonus (b). The steps for this are given below:

$$\pi = p * Q - Y$$

$$Q = e$$

$$Y = w_s + bQ$$

Replacing Q , e and Y and deriving this function to b gives (8):

$$\pi = pbs - \frac{1}{2}b^2s^2 * \frac{1}{s} - \delta$$

$$\frac{\partial \pi}{\partial b} = ps - bs = 0$$

$$(8) b_s^* = p$$

Simultaneously as with a rotating worker, the optimal bonus is dependent of the price of the product. The firm will offer this optimal amount of bonus because with every amount lower, the workers will give less effort and with every amount higher than this, there will be unnecessary costs for the firm. We can conclude that the optimal amount of bonus for the firm is always equal to the price. This can be explained by the fact that profit is maximum if marginal revenue (MR) is equal to marginal costs (MC). The marginal costs in this model is the bonus, because the only other costs in this model are the wages but they are fixed. The marginal revenue in this model is the price, because this is what the firm earns when they sell a product.

Therefore, when analysing what the optimal bonus will be to receive the maximum profit, it is logical that the bonus is equal to the price. The maximum profit will be further analysed in section 4.2 as well as the equilibria for the model.

4.2 Equilibria and Payoffs

In part 4.1, I already investigated the condition under which a worker will accept a contract, the participation constraint, and what their optimal amount of effort will be in different situations. Furthermore, I derived the profit maximising amount of bonus for a firm and the minimum amount of fixed wages that the firm should offer a worker. In this part I will analyse the choice for rotating or specialising workers and the outcome for the firm. With this analysis, I will answer sub-question 2:

What is the effect of specialising and rotating workers on the profit of a firm?

Furthermore, I will derive the subgame perfect equilibria with the corresponding payoffs. As seen in part 4.1, the optimal level of effort is dependent of the bonus and, for specialising workers, the skills. Therefore, we can say that when the bonus increases, the amount effort will rise as well. Concluding, the optimal amount of effort is not dependent of the fixed wage and thus the workers care more about the bonus than about the fixed wages.

4.2.a Maximum profit

To find the maximum profit, we use the function: marginal revenue (MR) = marginal costs (MC). The MR and MC can be found to derive the first condition of the total costs (TC) and total revenue (TR) functions. These functions and the first order conditions are given below:

$$TR = p * Q$$

$$TC = Y = w + bQ$$

Deriving them to the first order condition gives MR and MC:

$$\frac{\partial TR}{\partial Q} = MR = p$$

$$\frac{\partial TC}{\partial Q} = MC = b$$

$$(9) MC = MR \rightarrow b = p$$

We can conclude that the price a firm asks, is the same as the bonus a firm pays their workers. If they choose this price, their profit will be maximal. This is in line with the profit maximising bonuses found in part 4.1. To answer the sub-question, the effect of specialisation and rotation on the profit of a firm is dependent of the bonus/price they choose. A higher bonus results in more effort put in by workers and the price will also be higher. More effort results in more productions and thus more revenue. Whether the firm makes a profit or not, depends on the level of fixed wage and the number of products that are sold.

4.2.b Subgame perfect equilibrium

Now that we have analysed all the choices and outcomes, I will clarify all the options with their payoffs which will eventually lead to the equilibrium of this model. Because in this model, the manager chooses a contract first, I will start with the choices of the manager.

The manager can choose to allocate its workers over two tasks: T = R and T = S. He offers a worker a contract ($C = w + bQ$), so the manager chooses a wage (w) and a bonus (b). Recalling from previous chapters, T = S (specialisation) comes with the following characteristics:

$$w_s \geq \frac{1}{2} b^2 s^2 * \frac{1}{s} + \delta - b^2 s$$

$$b_s^* = p$$

T = R (rotation) comes with the following characteristics:

$$w_r > \frac{1}{2} b^2 - bQ$$

$$b_r^* = p$$

To sum up, the manager can choose between specialising and rotating: (T=S, T=R). The payoffs for the manager will be given later because we move on to the choice of the workers first.

The two workers either receive a contract for specialising or for rotating. After receiving the offer, they can accept (A) or reject (RJ) it. When they accept the offer, they choose an optimal amount of effort (e) which results in utility (U). If they reject the offer, they have a utility of $U = 0$. Recalling, they accept the offer if the utility from working is higher than 0.

The contract a worker receives to specialise is $C_s = w_s + b_s Q$. Recalling that $Q = e$, $e = bs$ and $b = p$ gives:

$$C_s = \frac{1}{2} p^2 s^2 * \frac{1}{s} + \delta$$

If the worker accepts it, the utility (U_s) for the worker is as follows (10)

$$(10) \quad U_s = \frac{1}{2} p^2 s^2 * \frac{1}{s} + \delta - \frac{1}{2} p^2 s^2 * \frac{1}{s} - \delta = 0$$

To sum up, a worker who receives a contract to specialise has two choices: (A, RJ) with the following payoffs: (0, 0). This means that the worker is indifferent between accepting and rejecting the offer.

The contract a worker receives to rotate is $C_r = w_r + b_r Q$. Replacing b and eliminating similar parts gives:

$$C_r = \frac{1}{2} p^2$$

$$e^* = b$$

If the worker accepts it, the utility (U_r) for the worker is as follows (11):

Recalling that $Q = e$

$$(11) \quad U_r = \frac{1}{2} p^2 - \frac{1}{2} p^2 = 0$$

To sum up, a worker who receives a contract to rotate has two choices: (A, RJ) with the following payoffs: (0, 0). This outcome is equal to workers who receive a contract to specialise and this means that the worker is indifferent. In these situations, things like joy or satisfaction from work may play a role, but these variables were not implemented in the model in this thesis.

If a worker decides to accept the offer, the payoffs are earned for both the worker and the manager. The payoffs for the workers are given above, the payoffs for the manager will be given below in terms of profit.

If a worker is going to specialise, this will result in the following profit (π_s) for the firm (12):

Recalling that the profit is: $\pi = p*Q - Y$

$$(12) \quad \pi_s = \frac{1}{2}p^2s - \delta$$

If a worker is going to rotate, this will result in the following profit (π_r) for the firm (13):

$$(13) \quad \pi_r = \frac{1}{2}p^2$$

These profits are based on one worker. If both workers receive the same contract or one specialises and one rotates, the profit will be the sum of both individual profits. Remarkable to see is that the profits from rotation are only dependent of the price. A higher price results in a higher profit. With specialisation, a higher profit can be achieved when the boredom (δ) is low and $s > 1$. All different equilibria with their own payoffs are given below.

Equilibrium (a, b and c), both workers receive a contract to specialise, which they can either accept or reject:

- a. $(T = S, A) \& (T = S, A) \rightarrow (\pi_s, U_s) \& (\pi_s, U_s)$
- b. $(T = S, A) \& (T = S, RJ) \rightarrow (\pi_s, U_s) \& (0, 0)$
- c. $(T = S, RJ) \& (T = S, RJ) \rightarrow (0, 0) \& (0, 0)$

Equilibria (d, e and f), both workers receive a contract to rotate, but can either accept or reject it:

- d. $(T = R, A) \& (T = R, A) \rightarrow (\pi_r, U_r) \& (\pi_r, U_r)$
- e. $(T = R, A) \& (T = R, RJ) \rightarrow (\pi_r, U_r) \& (0, 0)$
- f. $(T = R, RJ) \& (T = R, RJ) \rightarrow (0, 0) \& (0, 0)$

Equilibria (g, h, i and j), one worker receives a contract to specialise and one worker receives a contract to rotate (which they can either accept or reject):

- g. $(T = S, A) \& (T = R, A) \rightarrow (\pi_s, U_s) \& (\pi_r, U_r)$

- h. (T = S, A) & (T = R, RJ) → (π_s, U_s) & (0, 0)**
- i. (T = S, RJ) & (T = R, A) → (0, 0) & (π_r, U_r)**
- j. (T = S, RJ) & (T = R, RJ) → (0, 0) & (0, 0)**

Because workers are indifferent between accepting or rejecting the offer, the manager should change the contract to convince the employees to accept the contract. If s is big and δ is lower than the extra profit from skills, the profit from specialisation (S) will be higher than from rotating (R) for the firm. The condition is given below:

$$(14) \quad \mathbf{S \textit{ if } s > 1 \textit{ and } \delta < \frac{1}{2} p^2 s - \frac{1}{2} p^2, \textit{ else } R}$$

To clarify this condition, if $s = 1$, the profit will be $\frac{1}{2} p^2$, therefore this part is subtracted to only look at the extra profit from skills. In this case, the manager is likely to offer both workers a specialisation contract. To convince them to accept the offer, the manager should offer a wage (w_s) a bit higher than the lower limit (7) so the utility (U) of the workers is > 0 . If this is the case, the workers will accept their offer because it is higher than rejecting and receiving a utility of $U = 0$. However, the effect of offering such things can not be said with certainty because this was not implemented in the model in this thesis. If the variables s and δ do not fulfil these conditions, the manager will achieve more profit with rotation. In this situation, the manager has to attract the workers to accept the contract for rotation in the same way as he can do for specialisation. Because this thesis has a small focus on the influence of skills on the choices that are made in the model, the next chapter will discuss this.

4.3 Skills

Earlier in this thesis, I already assumed that the workers in this model already possess a basic degree of skills of $s = 1$ before the contracting. This is because all workers perform one specific task in the first period, where they obtain basic skills. If workers keep doing the same task, thus specialise in period 2, their skills will be improved. In part 4.1, I partly answered sub-question 1. In this part, I will look further into the influence of skills to answer this sub-question correctly. As stated earlier, workers in this model are indifferent between the two tasks. However, while looking at the utility of employees that specialise, function (5), a higher degree of possessed skills will decrease the amount of effort needed, which will then increase the utility. Summarized, the variable 'skills' has a positive correlation with utility. At the same

time, specialisation comes together with a certain degree of boredom. The condition under which the manager would offer a specialisation contract is given in (14). In this condition, it is said that $s > 1$. The manager will choose specialisation if the profit is higher than from rotation ($\pi_s > \pi_r$). For which degree of skills is this the case? This comparison is given in (15). Recalling that $\pi_s = 1/2 p^2 s - \delta$ and $\pi_r = 1/2 p^2$

$$(15) \quad \frac{1}{2} p^2 s - \delta > \frac{1}{2} p^2$$

Rewriting this to the skills gives (16):

$$(16) \quad s > \frac{\delta}{\frac{1}{2} p^2}$$

For every s lower than this, it is more profitable for the manager to offer rotation contracts. However, when offering the contract to the worker, the manager should also make the contract more appealing for the worker to make them accept it. This case was already discussed in part 4.2. In some industries, specialisation fits better than job rotation and vice versa. This distinction is analysed in part 4.4.

4.4 Industries with job rotation

In this part, the last sub-question will be answered by using insights from previous parts and supplement them with theories from existing papers. Sub-question 3 of this thesis is: *Which types of industries will benefit from using job rotation, compared to specialisation?* As I have shown earlier, specialisation increases the skills a worker possesses, while this remains the same if the worker rotates. This results in the fact that industries that require a lot of skills, are more likely to specialise instead of rotate their workers. In part 4.1, I already talked about the condition under which a manager would offer its workers a specialisation contract (14). Industries where workers gain more in depth skills when specialising, are therefore more likely to implement specialisation compared to rotation, according to my model. However, when the boredom from work is higher than the extra gain from skills, this will have a negative effect on the profit of a firm. In this case, managers should consider implementing rotation instead of specialisation. Part of the question is about which types of industries require certain amounts of skills. As already discussed in the literature review, Kampkötter et al. (2018) found that

companies should focus on rotating low-skilled workers and specialising high-skilled workers. This was found in a study in the German banking sector. Schoenstein, Ono and LaFortune (2016) studied the skills needed for the health sector. They found that employees in the health sector do need multiple skills but that it is the most important that the skills are sufficiently developed for the tasks. They also mention that educating a new doctor or nurse takes a lot of time. For the health sector, it is therefore obvious to implement specialisation into a certain direction of health care. Furthermore, they state that every employee must possess basic skills as a person such as: problem solving skills, teamwork and decision making. Researchers who agree on the fact that some soft skills are necessary for everyone to possess are Majid et al. (2012). They investigated the perception of students of the importance of skills and found that most students agreed that possessing soft skills is essential. On the other hand, Trevithick (2000) published a handbook for social work with explanations about all the skills one must possess to work in social work. She mentioned that there are some skills that require some more practicing, but that approximately 50 skills are needed to complete your job sufficiently. The last example comes from Nickson et al. (2012). They studied the need for skills in the retail industry in the UK, because it is generally said that retail is the industry that helps unemployed to a job. After doing a survey on 173 retailers, they concluded that possessing a few soft skills is helpful in doing your job. However, comparing this to the case of the health sector, employees in retail are more likely to rotate jobs because they do not necessarily need specific skills for different tasks. To conclude, managers who have to make a choice between rotation and specialisation should first consider the industry their firm is in and how important the possession of skills is. After this, they compare the gain in skills with the boredom in specialisation to decide whether implementation of specialisation will lead to more profit or not. Now all the sub-questions are answered, these will be repeated in the conclusion together with an answer to the research question.

5. Conclusion

Job rotation versus job specialisation is a topic that already has been a point of discussion for a long time. In this paper, I developed a simple microeconomic model with the utility of employees and the profit for firms to make different conclusions about job rotation compared to specialisation. This model consists of three players: a manager and two workers. The manager allocates the workers between two tasks: rotating and specialising. He offers them a contract, which they then can accept or reject and after that, payoffs are received. I analysed the

model to find the subgame perfect equilibrium. Some important aspects of the model are: boredom only comes when specialising into a job, skills are gained when specialising and workers accept the contract when their utility (U) is bigger than the outside option (V), which is 0. The research question from this thesis was: *When is job rotation better for the employee and the employer, compared to specialisation?* To answer this question, I came up with three different sub-questions which are answered in the analysis part. These sub-questions were focussed respectively on the effect of skills on employees, the influence on profit of firms and which types of industries benefit from job rotation. All-in all I can conclude that possessing skills, increases the utility for a worker in this model because less effort is needed to produce the same amount of output. However, requiring skills can only be done when specialising, which comes with a certain amount of boredom. Workers in this model are indifferent between accepting or rejecting the contract offer in all situations. The profit of the firms is directly influenced by the price the firm asks for its products. However, with specialisation the profit is also influenced by the skills and the boredom of the workers. If the manager wants the worker to accept a certain contract, he must convince them by raising the fixed wage or by giving them other advantages in the job. This way, the workers may get more utility from working than from not working. If the skills (s) are rising and the boredom is low, managers can earn more profit from specialising both workers. Generally, more difficult jobs such as health care, are less likely to rotate because workers need highly developed skills to perform tasks. On the other hand, are retail businesses more likely to rotate because a broad set of skills is useful for the employees. These findings answer the research question for this thesis in various ways.

6. Discussion and Recommendations

This thesis uses a simple model with only some variables that were needed for the research. This choice was specifically made to focus on the important aspect for the research question. I am aware that more aspects affect the profit and the utility of people than that are included in the model in this thesis. For example, firms have more costs than only wages. However, including these would not impact the outcome of the research because most of these costs are constant over time. Another example that influences the utility of workers is the work environment in the firm. I believe that adding this variable will also not have a big impact on the outcome because this model focusses on one specific firm where both workers work and their only outside option is to not have a job which brings a utility of 0. On the other hand, job satisfaction is an aspect that was already studied multiple times (Van Wyk, Swarts & Mukonza,

2018 & Huang, 1999). This variable can influence the outcome of the research because it may influence the choice for workers to accept or reject an offer. I partly covered this by adding boredom, but job satisfaction may have a bigger impact. This thesis is done theoretically without using real data and numbers. However, these outcomes can be used to replenish the knowledge of managers about making choices for rotating and specialising their workers. A consideration for further research can be to apply this model to a real-life example to investigate the model with data. This way, it can be studied exactly which degrees of skills and boredom influence the choice for specialisation. An example for a (sub-)question for further research can be: 'From what degree of skills will managers prefer specialisation over rotation?'. With the following hypotheses: 'If skills $s > 1$ and boredom δ is low, the manager will choose to offer specialisation contracts'. The last recommendation for further research is to perform separate research to find out which firms should apply rotation and which should not. In my opinion, these studies can be valuable additions to the existing literature.

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