Reducing income volatility in multi-product companies through better resource sharing policies

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Abstract

This paper examines the effect of competition on internal resources on income volatility of multi-product companies. Therefore the two-shower model of Morecroft et al is tested and analyzed in symmetric and asymmetric situations. Discussing the opportunities and limits of a translation into a company context a stylized company model is derived. After showing the preservation of illustrated dynamic behaviour from the shower model, the contrary behaviour of minimizing the gap of desired income and maximizing total cumulated income is released. Finally the equilibrium model is turned into a growth model by implementing an average growth rate for the desired income and the budget for expenses. The results show a higher potential for oscillations in the growth model and thus an increase in complexity for decision makers to allocate internal resources in the most effective way.

Key words: Shower model, resource sharing, income volatility, multi-product company, budgeting, resource allocation, coupled loops, growth model

Introduction

Cyclical income is a phenomenon which nearly every industry has to cope with. Those oscillations are driven by factors outside and inside the sphere of influence of decision makers. In upside markets the predominant explanation for success given by executives is grounded on their brilliant decisions made in the past. Vice versa downside movements often are linked to market trends and exogenous factors. In reality the cyclicality in performance measures is the consequence of both exogenous changes in the environment and endogenous reactions on these changes and endogeneous actions (Ijiri et al 1968; Warren 2005). Actions and reactions often come along with the reallocation of resources, which are limited and non-exclusive for different sub-units. A corporation has to pay attention on those allocation decisions, because they are the basis for future success or failure of the company (Rumelt 1991; McGahan and Porter, 1997; Bowman and Helfat, 2001; Ruefli and Wiggins, 2003) Thus bigger companies invest much effort to develop and implement guidelines for those decisions. A capital budgeting policy would be one example (Harris/Ravis 1998). It can be seen as a set of guiding principles for the interaction of different hierarchy levels in an organisation with the goal to invest capital in the most effective way (Harris/Ravis 1996). For the organisation it is the challenge to find the right mix between centralisation and decentralisation of corporate power (Stein 2002). This raises the question how much competition on internal resources is desirable for a company.

With this paper we would like to shed some light on the impact of resource sharing policies on income volatility. We analyze the challenge for decision makers to manage a floating budget for expenses and we investigate the effect of different policies on cumulative profit. Our research question points on the desirability and possibility from a companywide perspective to decrease income volatility, which is induced from internal competition on resources, to maximize the returns on invested capital.

We decided to pick up the metaphorical perspective from Morecroft et al (1995) on resource sharing and build upon their two-shower model. First, we rebuild and analyze the two-shower model in the original physical setting of a hot-water sharing system. Second, after discussing the opportunities and threats of adapting this model to the business context, we transform the shower model while keeping as much as possible from the original structure. We succeed in retaining the coupled balancing loops and their dynamic behaviour in the first, elementary company model. Third, we move on from the equilibrium setting to a growth model by adjusting the expenses budget and goals dynamically.

Connection between corporate policy, competition on resources and income volatility

In a company context, there are many different streams of power, which makes it complex to govern those corporations (Handy 1992). For decision makers it is a challenge to balance those streams of power and to channel the available resources in the most effective way. The work on resource based view theory suggests a strong relation between the creation and management of resources and the establishment of competitive advantages (Barney 1991; Grant 1991). There are many possible battle fields within a corporation, for competing on limited resources (Luss/Gupta 1974, Morecroft 1983). As a result, managers of different projects, activities or organisational units have objectives in their local perspective, which not necessary lead into a maximum effectiveness on a corporate level (Laux 2006). A body of literature asserts this issue from the perspective of the coordination of subsidiaries or strategic business units in multinational companies (Shaffer/Hillmann 2000). The motivation for analyzing this cross-border perspective grounds in the different demands from customers in various countries. Local decision makers can estimate those demands and serve customer needs better. Morecroft et al (1995) pick up a corresponding example by using the Yoshida Kogyo K.K. case. This analysis is not only relevant for multinational companies from a subsidiary perspective, rather gets an interesting focus when analyzing the capital budgeting process of companies from the service sector. The characteristics of services i.e. the intangible nature, co-production by the customer, heterogeneity and no possibility of storage make it different to many tangible products from the second sector (Meffert/Bruhn 2000). Drawing attention to service companies which have a diversified product portfolio and operate with specialized teams, related problems by balancing corporate power arise (Eccles/Craines 1988). Those specialized teams act within the company comparable to the subsidiaries in the cases mentioned before. For that reason we translate the shower model into a company context of competition on resources on product group level. The shared resource in our case is the limited budget for expenses. This stands for the ability to pay the current costs as well as to invest in new services and processes. The product groups compete for the access to this shared resource.

Understanding and analyzing the two-shower model

Morecroft et al (1995) clearly distinguish between the metaphorical and analogical value of the two-shower model. The analogical model is limited to the original shower problem and the related physical system. They argue that a translation into a company context is problematic, because of the different time scales, the problem that many factors building a company performance goal and that the rules behind the corporate policies are less precise than the physical rules of a shower system (Morecroft et al 1995). Nevertheless Morecroft et al (1995) mention "a strong similarity in feedback structure". We decide to use the two-shower feedback structure in a metaphorical way as a bridge from an every day phenomenon to the organisational decision-making. We have therefore rebuilt the shower model, illustrated in figure 1 and manipulate this system to learn from its highly demonstrative feedback mechanisms.

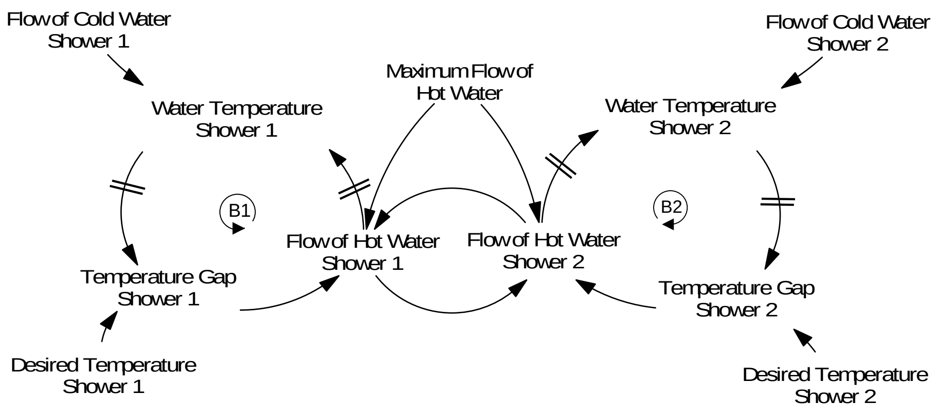

Figure 1 : The Two-Shower Model (Morecroft 2007)

First, we investigate the dynamic behaviour of the system in a totally symmetrical situation. In this case the person in shower 1 and the person in shower 2 start in the same moment having an identical desired temperature of 38° Celsius. Based on the potential dynamics the feedback structure showing in figure 1 can generate, we expect to find constant oscillations, diminishing oscillations and exploding oscillations. In figure 2 the base run with a time to adjust tap setting of 1.5 seconds for both showers shows an identical constant oscillation of the temperature of both showers. The run turns into a goal seeking status by a symmetrical extension of the time to adjust tap setting to 5 seconds for each shower.

In the next step we try to improve the policy by adjusting the pipeline delay and the time to adjust tap setting. The sensitivity analysis in figure 3 points at a minimum of the cumulative temperature gap for a pipeline delay of 0.125 seconds and a time to adjust tap setting of 0.175 seconds. While minimizing the pipeline delay it is surprising, that the time to adjust tap comes up with the best policy not at the border. Running the model with the reduced adjustment times, the optimized run shows an improvement to the base run.

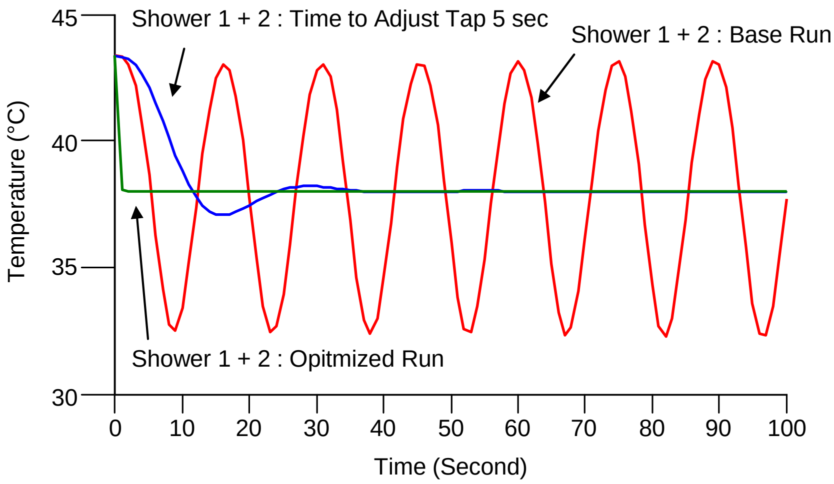

Figure 2 : Temperature in a Symmetric Situation

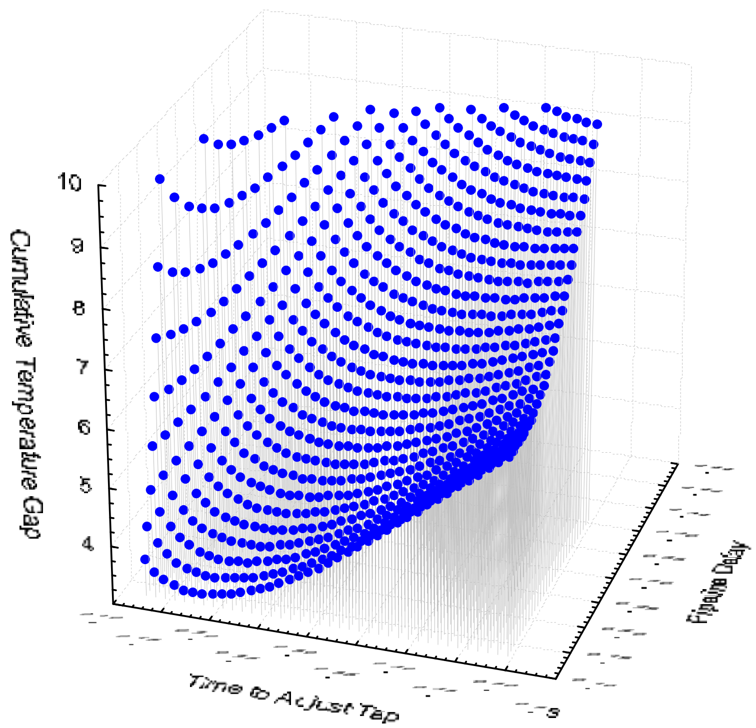

Figure 3 : Sensitivity Analysis Delays in a Symmetric Situation

The relation between the time to adjust tap and the pipeline delay in the case of symmetry is analyzed by a stepwise increase of the pipeline delay from 0.1 seconds to 1 second and the corresponding optimal time to adjust tap for the minimal cumulated temperature gap, the other variables ceteris paribus. This comparison brings up a constant relation between the two delays. As illustrated in figure 4 the time to adjust tap increases in higher steps than the pipeline delay does.

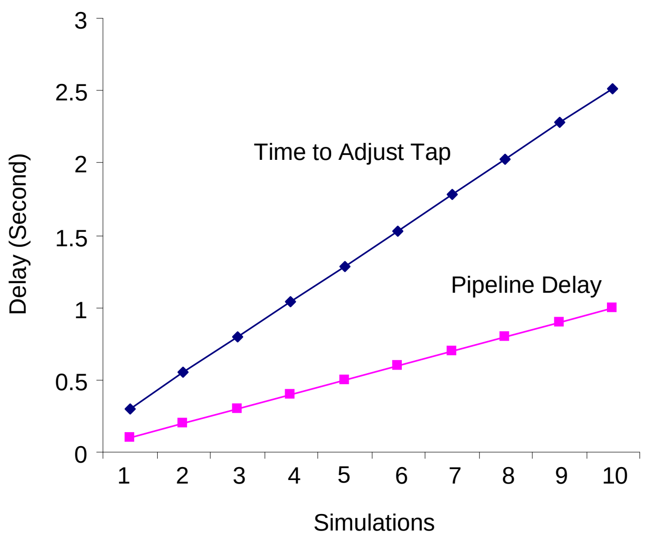

Figure 4 : Relation between Pipeline Delay and Time to Adjust Tap

Besides the variation of the delays a second sensitivity analysis with the optimized delays is conducted by manipulating the temperature of hot water and the flow of cold water. The analysis comes up with a minimum cumulative temperature gap of 0.0075 with a temperature of hot water of 85° Celsius and a flow of cold water of 0.42 litres per second. This optimized configuration results from the improved ability of regulating the temperature through the higher temperature of hot water and a lower impact of the cold water through a slower flow of cold water. After having discussed these four possible adjustments, we investigate the behaviour of the model resulting from an adjustment of the desired temperature, as an example for a change of the environment of the system. In the context of this optimized run, the optimal desired temperature is 43° Celsius, which makes the temperature gap zero. This is due to a convergence of the desired temperature and the temperature from the initial tap setting. In this situation there is no longer the need of an adjustment and consequently no potential for oscillations.

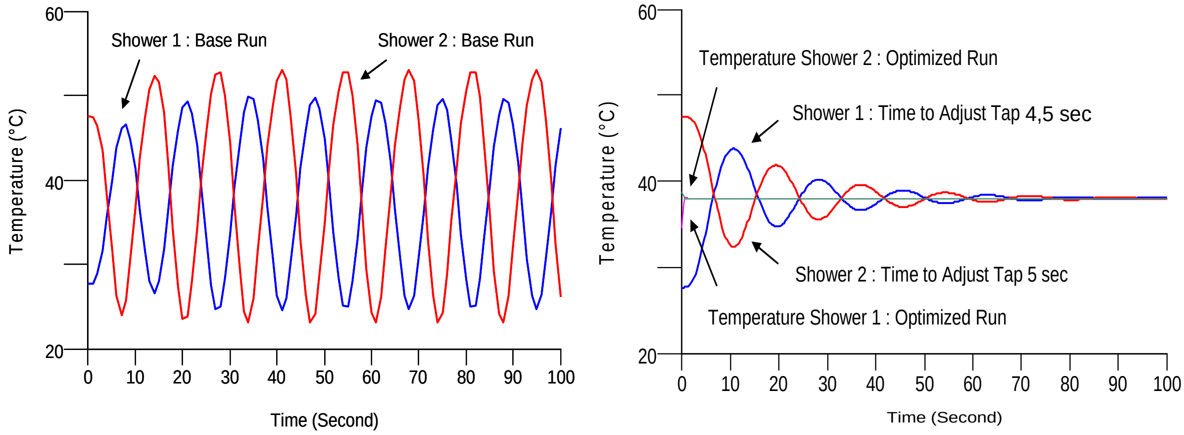

Figure 5 : Temperature in an Asymmetric Situation

In the next step the symmetric situation is turned into an asymmetric initialisation. Asymmetry in our context is defined as a different initial temperature gap in shower 1 and shower 2. This is induced by a differing initial tap setting in shower 1 of 0.25 instead of 0.5 and an increase in the time to adjust tap setting in shower 1 from 1.5 seconds to 2.5 seconds in the symmetry case. Based on this initialization values, illustrated in figure 5, we get a corresponding behaviour to Moorcroft's results in an asymmetric situation (Morecroft 2007). The temperature of shower 1 + 2 oscillates in a constant manner with some tendency to turn into an exploding process (figure 5).

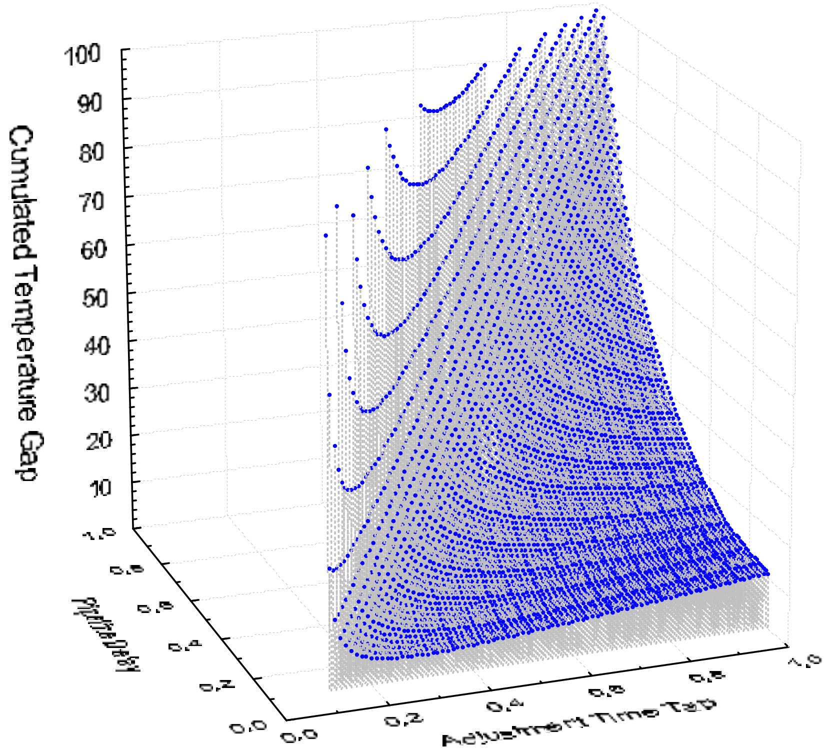

Figure 6 : Sensitivity Analysis Delays in an Asymmetric Situation

The optimization of this system shows the tendency of an assimilation of the different times to adjust tap setting towards 0.3 seconds. This leads to the optimized run illustrated in figure 5. Based on this finding we repeat the sensitivity analysis from the symmetric case with the different initial tap settings and find for both showers a new minimum for the time to adjust tap setting of 0.3 seconds and a pipeline delay of 0.1 seconds. The minimum cumulative temperature gap is higher in the asymmetric context with 4.6 respective to 3.18 in the symmetric case. The increased gap in the asymmetric situation discloses a higher demand on the management of this kind of asymmetric systems resulting from higher oscillations. After having a deeper understanding on the dynamic behaviour of the two-shower model we translate this into a company context.

Application and translation of the two-shower model in a company context

The translation from the two-shower to the company model with a product group focus is guided by the segmentation of the structure derived from the single-shower model. This is divided into three parts: decision making, action, piping and water flow (Morecroft et al 1995). Looking at the decision making process in an organisational context this three phases can be identified as well. In our case the piping and water system is displayed as the budgeting system shown in figure 7. The invested money enables a certain income within the product group driven by the expense income ratio. There is a time lag between the resulting potential income and the realized income, because of the different short-term or long-term effects of the investments, according to the delay between the temperature at the tap and the shower head in the shower model. In the company model there is no equivalent to the constant stream of cold water. For this reason we simplify the structure of the model and concentrate on the shared resource, the budget for expenses.

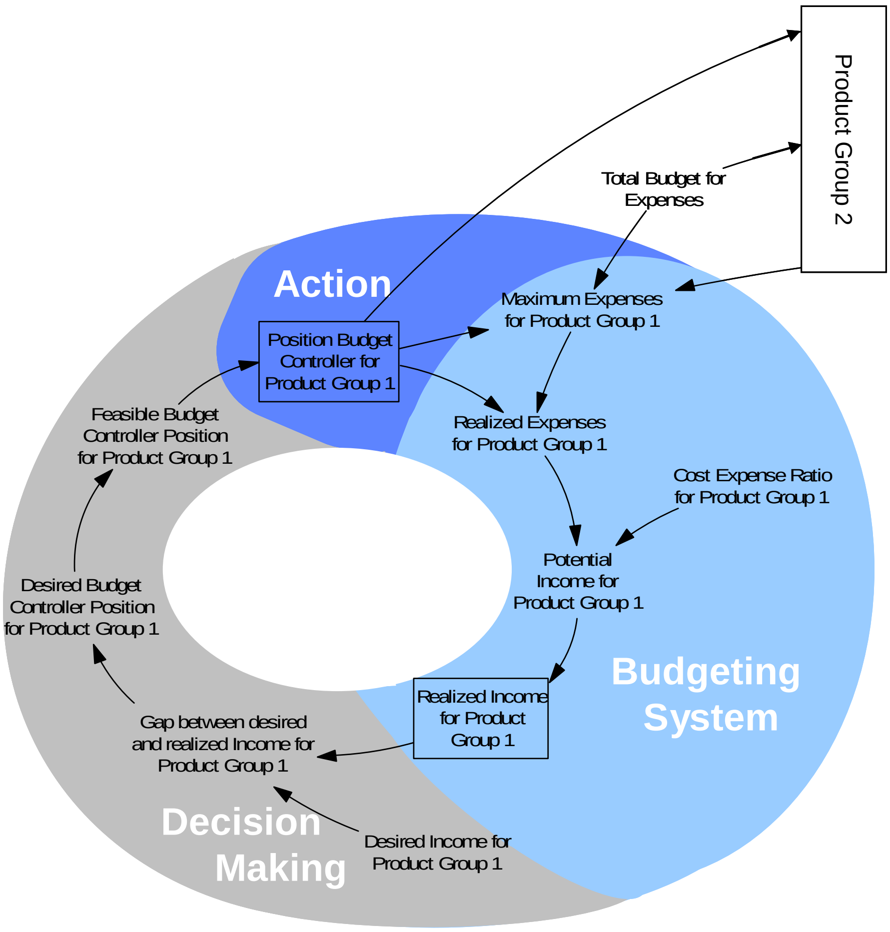

Figure 7 :The translated Company Model

The second part, decision making, is strongly related to the gap-adjustment structure from the shower model. An exogenous performance goal is set and leads to the gap between desired and realized income. The corresponding desired adjustment of the budget controller is the ratio of the gap and the maximum expenses with highest controller position, derived from the maximum expenses for the product group. To ensure the maximum controller position of 1 equals the maximum realisable expenses, the feasible budget controller position is the minimum from the desired budget controller position and 1.

The decision making leads into the third part of the model with the adjustment of the budget controller. The effect of the decision causes a delay in the adjustment because of the internal processes related to approval and compliance issues. We decide to keep the controller with its stock-flow structure from the shower model as a metaphor for the budgeting process and the related adjustments in an organisation. At first glance it might seem irritating, but from a metaphorical perspective the budgeting process shows some parallels to the given structure. Decision makers perceive the gap from desired and realized performance goal, but they do not know for sure which portion of additional budget will enable them to close the gap (Horvath 2003). The budget controller should be seen as the instrument and process to get access to the budget of expenses. Morecroft et al (1995) refer to the differences of a temperature goal and a performance goal in a company context. The desired income, as a performance goal differs from the fixed temperature goal, because of a maximization component for the income. This difference will be considered and discussed during the analysis.

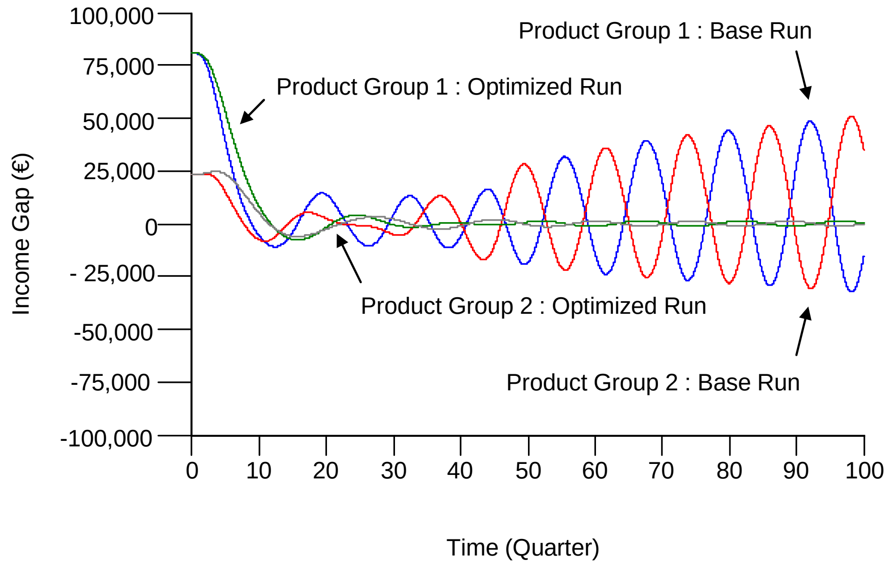

Figure 8 : Income Gap in an Asymmetric Situation

We repeat the analysis conducted on the shower model, to show the preservation of the illustrated dynamic character in the company model. In this model the target variable is according to the temperature gap the income gap. The simulation brings up in an asymmetrical situation of different budget controller positions (product group 1 = 0.25, product group 2 = 0.5) comparable results to the shower model as illustrated in figure 8. The base run shows for both product groups an exploding character, which sums up after the time of 100 quarters to a gap of T€ 3,415. By optimizing the time to adjust budget controller for product group 1 to 3.97 quarters and for product group 2 to 4.28 quarters as well as the time to tap the income potential for both product groups to 4 quarters the exploding oscillations can be turned into a goal seeking process with highly reduced oscillations and a reduced income gap of T€ 950. This behaviour is desirable in the context of using the shower model in a metaphorical way. However, as mentioned before the performance goal differs from the requirements of the fixed temperature goal. Thus we decide to focus on the organisational context on the maximization of the cumulated income. The hypothesis is that the maximized cumulated income comes up with the lowest oscillations of the system. We start analysing a symmetric situation with identical budget controller positions of 0.5 for both product groups.

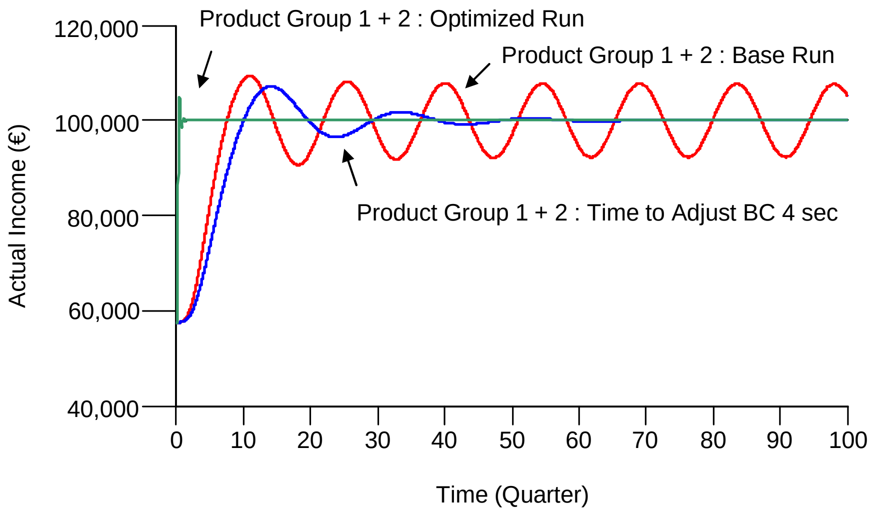

Figure 9 : Actual Income in a Symmetric Situation

Corresponding to the shower model the symmetric runs, illustrated in figure 9, demonstrate the expected behaviour of a higher cumulated income for the optimized runs with € 19.98mio respective € 19.66mio for the base run. This result suggests a negative relation of the cumulated gap and the cumulated income and leads to the favourable policy of minimizing oscillations. However, analyzing an asymmetric situation with the different initial budget controller positions of 0.25 for product group 1 and 0.5 for product group 2 the results differ from the expected behaviour of the system. The base run in figure 10 shows comparable exploding characteristics of the actual income as of the income gap.

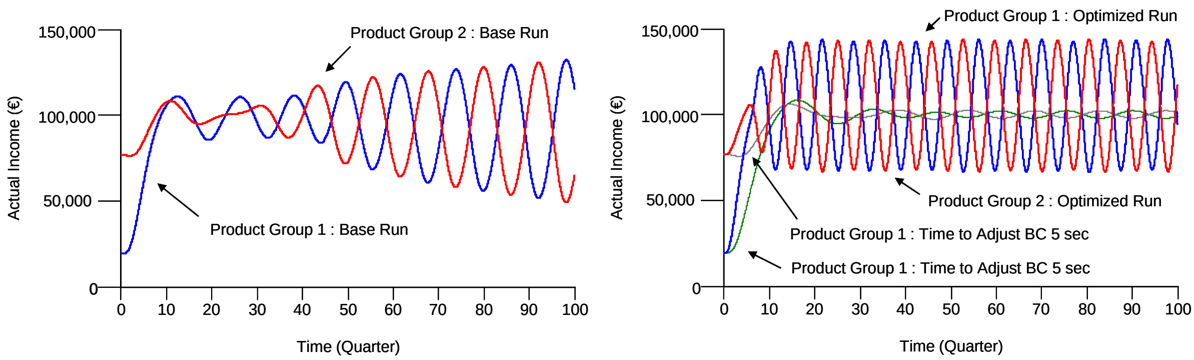

Figure 10 : Actual Income in an Asymmetric Situation

In contrast the optimized runs suggest an increase of oscillations to maximize the cumulated income. This behaviour is contrary to the suggested policy of minimizing the oscillations. In reality this optimization would not lead to the most effective resource allocation, because there are costs related to the adjustment of the expense budget (Horvath 2003). These can be research costs, administrative costs or adjustment costs. One example is the compensation payments related to layoffs in the course of staff reduction. In consideration of those costs we derive from the actual income the profit after adjustment costs. The simulation runs bring up that cost of € 2,500 per 1% adjustment of the budget controller still leads to high oscillations.

An increase of cost to € 5,000 per 1% adjustment of the budget controller suggests the optimized policy with minimized oscillations as optimal solution. These results lead us to a further investigation of the company model in the context of minimizing oscillation to allocate resources in the most effective way.

From an equilibrium-company model to a growth model

In this last section we turn the equilibrium model into a growth model to point out the effect of changing variables on the income volatility and the additional demands on decision makers. This modification is realistic, because the company environment changes as well and leads to adjustments on goals and budget. This is modelled by a constant average growth rate for the budget of expenses and for each desired income of the two product groups. In our case the average growth rate is equal for all three variables. Due to the increasing actual income and the increasing total budget for expenses we stay with the analysis of the income gap in both environments. The asymmetric situation is once more characterized by a different initial budget controller position (product group 1 = 0.25, product group 2 = 0.5). The comparison of the upcoming oscillations gives a suggestion on the complexity for decision making in a growth environment. As illustrated in figure 11 the income volatility in the growth model is higher than in the equilibrium model. The cumulated gap is in the growth environment with € 4.405mio higher than in the equilibrium context with € 3.415mio. The exploding character and the cumulated gap get enforced due to the constant average growth rate, which makes it more difficult for decision makers to estimate the implications of their actions.

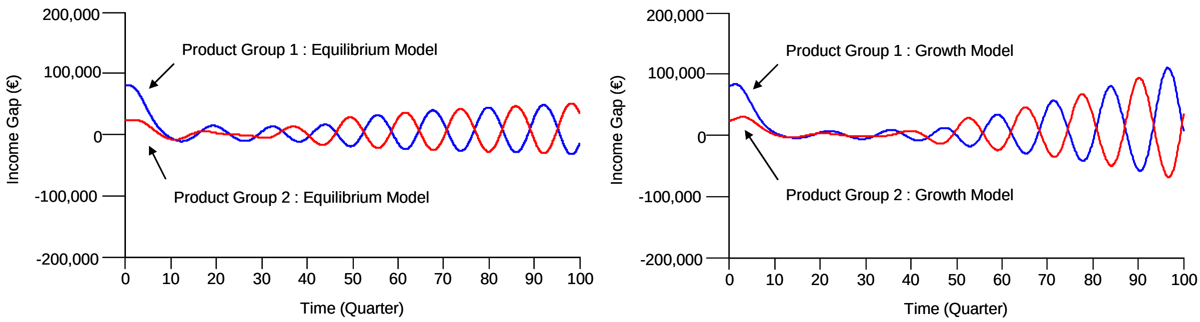

Figure 11 : Income Gap in an Asymmetric Situation in the Growth Model

Summary and Outlook

In this paper we investigate the effect of competition on internal resources on income volatility of multi-product companies. Therefore the two-shower model of Morecroft et al is tested and analyzed in symmetric and asymmetric situations. Discussing the opportunities and limits of a translation into a company context a stylized company model is derived. After showing the preservation of illustrated dynamic behaviour from the shower model, the contrary behaviour of minimizing the gap of desired income and maximizing total cumulated income can be released. The implementation of cost for adjusting budget controller position leads in an economic reasonable context to a positive effect of reducing oscillations of the gap between the desired and realized income. Finally we turn the equilibrium model into a growth model by implementing an average growth rate for the desired income and the budget for expenses. The results show a higher potential for oscillations in the growth model and thus an increase in complexity for decision makers to allocate resources in the most effective way.

The average growth rate is exogenous in the model. There may some arguments that this is not satisfactory to the reproduction of real world business situations. We modelled this system with the goal of a better understanding by simulating the single steps and derive a better insight into the potential of using the two-shower model as a basis for better understanding of endogenous induced income volatility, which looks quite promising. Future research could investigate the endogenous modelling of the performance goals depending on existing resources. This would meet the real world processes of goal setting and adjustment in changing environments better. Furthermore it might be interesting to model the budgeting process as an endogenous variable driven by the feedback mechanism of the product groups. The existing resource budget for expenses would no longer be a constant available amount of money, rather a further indicator for the quality of the decision making within the company.

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