Dematerialization and Rebound Effect in Replacement Investments within Forest Ecosystem Research: the broad and the narrow Strategy

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Introduction

The mission of the Swiss Long-Term Forest Ecosystem Research (LWF) programme is to improve our understanding of how natural and anthropogenic stresses affect forests in the long term, and which risks for humans are involved. With a network of 17 research sites located all over Switzerland, the long-term response of forest ecosystem components and processes to the most relevant stress factors is monitored. The main emphasis is on atmospheric deposition, the biogeochemical cycles, the climate, the soil, the ground vegetation and the trees.

The two case studies presented in this paper discuss the dematerialization and rebound effects which occur when following two contrasting replacement investment strategies. In Case Study A, with a relatively high capital investment and intensive use of modern communication technology, the rebound is considerable. In Case Study B, the invested capital and the rebound is small. The potential for rationalising the workflow in Case Study A is high whereas in Case Study B no rationalising effect is possible.

Methodology

Case Study A

The first case study concerns the LWF measuring network with 34 gauging stations located on 17 research plots all over Switzerland. Originally, data was stored locally on data-loggers and then manually transferred onto field computers. Unfortunately, it was not possible to extend such logging devices and measure additional parameters. That was one of the reasons why, from 1998 on, more and more of the data-storage devices were replaced and equipped with a modular extendable device. At that time, modern telecommunication technology made it possible to use a communication module to transmit data automatically via the GSM network to the re-

search centre. This led to a considerable dematerialization effect as it was no longer necessary to visit the research plot so often. However, part of this dematerialization effect was counteracted by the fact that more and more project partners used the new modular gauging stations to carry out additional measurements. In many cases, those newly installed sophisticated measurement devices could only be maintained by specialists. This led to more traffic to those particular research sites. Some research plots attracted more new project partners than others as they were better suited for a particular research project.

The case described above is typical of today's replacement investment practice. It is based on attitudes and approaches current in economic literature and relies on information provided by software and hardware producers.

Case Study B

The second case study describes one of the main sources of information within the framework of the LWF Project. Periodical tree inventories on all of the 17 research plots are carried out where certain properties of the same trees are re-evaluated within a period of one or more years. Field computing devices have been used for data-acquisition since the beginning of the inventories in 1985. The use of such devices has the advantages that no media breaks occur and that plausibility checks can be done in the field, when correcting data is still easily possible.

In 1999, the six year old field computing devices had to be replaced because the maintenance costs became too high. The remaining operational machines were used for another project. At the time there were no human resources available to write a new data acquisition programme. Finances were also scarce. Therefore it was decided to reuse the old programmes and only to replace the hardware. After an extensive search new devices were found which had more or less the same functionality and computing power but whose price was only about 10% and whose weight was only 25% of the old ones. These new devices were intended for use as pocket agendas and had a DOS Operating system like the old machines. The old software could be reused on the new computers with only minor adjustments.

The approach to the problem in this example is not common practice nowadays. In fact, the solution found was criticised for not being very innovative and labelled as makeshift but accepted because of the perceived financial constraints. In contrast, people working in the field liked the light, reliable device and were pleased with its long-lasting batteries and the fact that they could use the same familiar software.

Results for Case Study A

Rebound and dematerialization effect of the replacement investment described above are analysed for selected research plots. In this case, decreasing or increasing

transportation is the only variable cause for a higher or lower rebound. Finally, the rebound effect in gauging stations with lower or higher attraction for new measurement projects is calculated and discussed.

Methods of capital budgeting are used in order to evaluate the profitability of the investment. Calculations show that the payback period is between 1.5 and 3.3 years, depending on the specified scenario. From an economic point of view the investment is worthwhile because the payback period is much shorter than the depreciation period of about 7 years. Sensitivity analysis shows that the initial investment could be more than twice as high until break-even is reached.

Results for Case Study B

The dematerialization effect is discussed and analysed. The functions of the old and new computers are nearly equal and almost no rebound effect takes place. It should also be remembered that savings occur not only by buying inexpensive hardware but also by prolonging the life-cycle of the software used.

Capital budgeting calculation methods cannot be used because it is not possible to assign any “profits” to the activities carried out within the framework of this case study. From an economic point of view, given the circumstances of Case Study B, it is sufficient to minimise the initial investment. This example shows that it is possible and useful under certain conditions to realise replacement investments with a considerable dematerialization effect and only a small rebound.

Discussion

In this chapter, the pre-conditions, advantages, risks (especially technological risks) and general characteristics of different strategies for replacement investments are evaluated from the point of view of dematerialization and rebound. Two main investment strategies can be defined

1. Broad strategy (from Case Study A): Replace old technology with modern technology and use its potential for dematerialization. Dematerialization occurs mainly because the new technology leads to a more optimised workflow or to a more optimised (production) process. It is named “broad” because of its broader problem focus: devices with additional and/or different functionality replace the old equipment.
2. Narrow strategy (from Case Study B): Replace old technology with new technology with similar functionality and performance characteristics to the old one. Dematerialization occurs because the new devices are produced with less material and energy input and/or use fewer energy resources when operating. It is

called “narrow” because of its narrow focus on replacing equivalent functionality.

To use the broad strategy standard methods and techniques can be applied. The first pre-condition for using the narrow strategy is open-mindedness towards non-standard approaches. Another more technical pre-condition is that the technical performance characteristics of the new device are more or less equal to those of the old device. The main advantages of this strategy are low rebound, a good dematerialization effect and (hopefully) a lower initial investment. Different risks are present with both strategies.

Conclusion: The narrow strategy is difficult to realise

Both investment strategies have their useful areas of application. However, it is often more difficult to realise an investment with the narrow strategy. The main reasons for this are as follows:

1. Products with the desired technical specifications are not available or the range of obtainable products is limited.
2. Product information for suitable products is difficult to find and might have to be sought in unusual market segments.
3. The requirements for a process or a particular device have to be determined carefully. It is essential to distinguish clearly between necessary and desirable features.
4. The solution found has to be tested extensively and in detail because this particular configuration might never have been in operation before. For this reason the technical risk for a narrow strategy might be higher than for a “conventional” solution.
5. A change of personal attitude and/or of point view might be required of the people involved in the decision-making process. By simply following mainstream IT replacement investment philosophy and considering only marketing information from IT producers, narrow investment strategy solutions will easily be ignored.

Taking dematerialization and rebound effects into account adds an additional dimension to a replacement investment process. Often it is not possible to choose the pure form of the narrow or the broad strategy. However, the two strategies described above can be combined to find an optimal, project-specific solution. Under certain conditions the narrow investment strategy is a valuable alternative or addition to the broad approach and could help direct progress in IT towards lower rebound.