Extended Abstract - Alternative Taxation Scheme for Controlling Rebound Effects in Streaming Services

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Abstract

Digital technologies have a strong influence in our entertainment choices. Streaming services stand out in this aspect. Due to competition and environmental reasons, they may improve the efficiency of their services, which could lead to rebound effects. Given the increase in interest to study how to reduce the extent of these effects, and the scarcity in literature on modeling those anti-rebound measures, we propose a novel modeling scheme. The scheme, based on compartmental methods and implemented in Python, is used to simulate the evolution of a streaming service subject to different taxes. We compare an Environmental Tax and a tax on efficiency gains, called Rebound Tax. For a similar reduction in environmental impact, the latter proved to be more beneficial for companies. While the implementation of both taxes simultaneously offers the greatest reduction in environmental impact, the financial pressure may result too much for some businesses.

Keywords

Rebound Effects, Digital Technologies, Compartmental Modeling, Rebound Tax

1. Introduction and Motivation

It is undeniable that digital technologies increasingly permeate more and more aspects of our lives, especially when it comes to entertainment. Let us leave aside the discussion of whether this is a positive or negative fact to focus on some of the consequences resulting from it.

This is a study about video streaming services (e.g., Netflix). For the purpose of this research, assume that, motivated by the Global Climate Crisis and by the need to outperform their competition, these services allocate a fraction of their revenue to reducing the amount of resources they need to deliver their service. In other words, they invest in increasing their efficiency, which reduces both the costs of running the service and the impact it has on the environment.

It is well known, however, that not with every efficiency improvement comes great environmental benefit; they can sometimes backfire. This is called Rebound Effect: the benefits of

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improving efficiency can be reduced or over-compensated due to changes in how the service or product is used [1]. More technically, applying the classification from [2] to streaming services, we identify Behavioral Effects (Consumer side, indirect rebound effects), i.e., a better service with more and better content leads to people using it more. We also find Producer side, indirect rebound effects (Output Effects): as delivering the service becomes cheaper, more investment can be made in developing a better service with more content and features. Now, studying how to limit the impact of rebound effects in this area is more important than ever.

Usually, research on how to reduce the impact of rebound effects focuses on transportation [3] and manufacturing [4], and there is gap when it comes to digital technologies (especially streaming services). In most cases (like [3] and [4]), the focus is modeling a taxation scheme based on CO_2 emissions. In our study, we compare that approach to one that seems unconventional at first, to see if it could result beneficial for both businesses and the environment. Based on [5], we propose a Rebound tax, a direct confiscation of some economic gains that result from efficiency gains. The effects of applying this rebound tax were not only capable of reducing environmental impacts, but they significantly outperformed the carbon-tax approach.

2. Research Methods and Results

To perform this research, we have used Compartmental Modeling, an approach that, despite its long-standing history in epidemiology [6], has never (to the knowledge of the authors) been applied in the present context. These models are based in grouping the population in different "boxes" or compartments, and defining the flow of people between them. For our case, we adopt the ideas presented in [7] to describe the adoption of a streaming service.

In our model, customers may join or leave the service at any moment, and they pay a monthly subscription to access it. The revenue they generate is destined first towards paying costs and taxes. The rest goes to improving the service, increasing visibility through advertising, or increasing the efficiency of the service for delivering their content. Services may also reduce the price of the subscription to attract more customers.

Using a simulation tool developed in Python, we analyse four tax scenarios: No Tax, Environmental Tax T_{env} (similar to, for example, a carbon tax), Rebound Tax T_{reb}, and Both Taxes (applied at the same time). In this model, the Environmental Tax is proportional to a measure of the environmental impact E_i of the company (that increases with the number of users and the amount of time each user spends daily on the service). When the Rebound Tax is at play, if the service improves its efficiency, 60% of the money they save thanks to that improvement is "confiscated". Mathematically, we define the taxes as

$$T_{\text{env}} \propto E_{it}\,, \tag{1}$$

$$T_{\text{reb}} \propto C_{\text{inf}}(\text{no improvements}) - C_{\text{inf}}(\text{with improvements})\,, \tag{2}$$

where C_{inf} are the infrastructure costs of the company.

In this study, the environmental impact is a simplified notion, an amount that combines the effects of emissions, generation of waste, etc. The way this impact is measured in real scenarios is outside the scope of the study.

We tune the parameters of the model so that the Environmental tax and the Rebound tax achieve the same reduction in environmental impact at the end of the study period. To find which is the best scheme, we look at the revenue generated by the service: the scheme that results in the highest revenue will be the most beneficial one. The results of the simulation are presented in fig. 1.

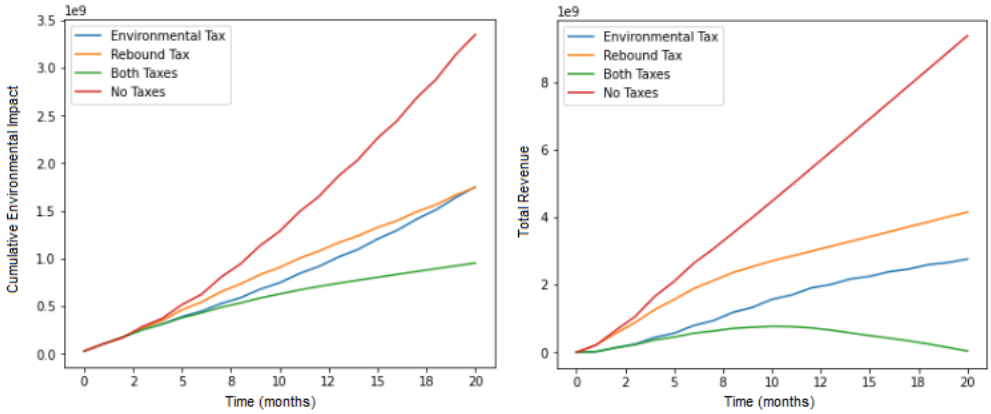

Figure 1: Cumulative Environmental Impact and Revenue generated by a streaming service subject to four different taxation schemes. Units for both magnitudes are arbitrary.

The results portrayed in fig. 1 indicate that, for a very similar reduction of environmental impact at the end of the study period, the amount of revenue generated by the company is higher for the Rebound Tax. Despite confiscating a high percentage (60%) of the economic gains due to efficiency improvements, the Rebound Tax approach has proven to be more beneficial to companies.

In fig. 1, we also see that applying both taxes at the same time has the biggest reduction in environmental impact. However, the economic burden of both taxes may result on some companies not being able to cover their costs and ultimately failing.

Even though this is a novel research line and there is plenty of unexplored territory, our results suggest that there may be alternative solutions for reducing the environmental impact of companies that operate through digital technologies. The simulation tool is still in the development phase, and the code will be made available on request by the corresponding author.

2.1. Relevance and novelty

The three most relevant contributions of this study, according to the authors, are:

- We address the gap in literature on modeling anti-rebound measures, especially when it comes to digital technologies and ICT.
- In contrast to the more common approaches (e.g., Carbon Taxes), we propose a novel way that could prove more beneficial both to businesses and the environment.
- We developed a new simulation procedure for the purpose of this study, different from the more common methods used in the literature, like System Dynamics. This can offer a new perspective on these types of problems.

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