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Advertising

Master Thesis

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and that this thesis has not been used to obtain a different or the same degree.

Prague,

Jiri Pokorny

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Abstract

JEL Classification D01, M37

Keywords Microeconomics, Information, Advertising

This thesis defines advertising very broadly - as any information that form consumers such that they change their consumption. Microeconomic models assume that consumers choose their consumption independently, and do not take into account that their wants can be changed due to actions of other market participants, which this thesis criticizes. Advertising is modelled with the Cobb-Douglas function as a good that is complementary to the good that is advertised. The models show that advertising decreases the total welfare only in some cases. If it is profitable for a firm to advertise, its production usually increases the total welfare.

Abstrakt

Klasifikace JEL D01, M37

Klíčová slova Mikroekonomie, Informace, Reklama

Tato práce definuje reklamu velmi široce - jako kteroukoliv informaci, která formuje spotřebitele tak, že tito mění svoji spotřebu. Mikroekonomické modely předpokládají, že si spotřebitelé volí svou spotřebu nezávisle, a neberou v úvahu, že potřeby spotřebitelů se mohou měnit v závislosti na jednání ostatních účastníků trhu, což tato práce kritizuje. Reklama je modelována pomocí Cobb-Douglasovy funkce jako statek, který je komplementární ke statku, k němuž se tato reklama vztahuje. Modely ukazují, že reklama snižuje celkový užitek jen v některých případech. Pokud je reklama pro firmu výhodná, její produkce obvykle celkový užitek zvýší.

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Master Thesis Proposal

Author	Bc. Jiri Pokorny
Supervisor	doc. Ing. Tomas Cahlik, CSc.
Proposed topic	Microeconomic Analysis of Information and Advertising

Topic characteristics The goal of this thesis is to model consumer behavior on the market, where advertising and information play a key role, with the use of microeconomic analysis. In the framework of the model, consumer can be understood as a computer hardware, which advertisements and information in general are taped on, where the source of this information are mostly the media, but in a wide sense also education, culture, etc. . From the microeconomic point of view, each consumer has its utility function, significantly influenced by, or even consisting of, that information of many kind, and he maximizes it under various constraints, given by either her or his own hardware, which is what she or he is given since she or he was born, or by the character of information received or goods consumed. This approach implicitly presumes consumer's imperfect rationality, which is today common in the economic theory.

The thesis wants to answer also the question how from the economic point of view advertising and information are beneficial for community welfare or how they are not.

Methods I will write the thesis in the background of microeconomic theory as it is trained on the bachelor and master level and of the Core Bibliography. The core will be consumer theory and the consumer's optimization problem, which I plan to extend with the possibility of change of consumer's preferences, which will therefore become an endogenous variable.

I will solve the problem analytically as far as it is possible and I want to attain general equilibrium solution. In the case I am not successful in finding this, I will try simulations and multi-agent approach.

Outline

1. Introduction, presentation of the problem and its solutions by other authors
2. Construction of a microeconomic model
3. Static version of the model, optimization and discussion
4. Dynamic version of the model, multi-agent approach (if necessary)
5. Conclusion, finding ideal composition of advertisements and information for a community

Charakteristika tématu Cílem této práce je pomocí mikroekonomické analýzy modelovat chování spotřebitelů na trhu, kde zásadní roli hrají reklama a informace. Spotřebitele lze v rámci modelu chápat jako počítačový hardware, na který je nahráván software v podobě reklamy a jiných informací obecně, kde zdrojem těchto informací jsou především média, ale v širším slova smyslu i vzdělávání, výchova, atd. . Z mikroekonomického pohledu má každý spotřebitel svou užitkovou funkci, kterou do značné míry ovlivňují, či dokonce tvoří, právě informace všeho druhu, a tuto on maximalizuje za různých omezujících podmínek, daných ať už jeho vlastním hardwarem, tedy tím, co je mu dané od narození, nebo charakterem přijímaných informací a konzumovaných statků. Tento přístup implicitně předpokládá nedokonalou racionalitu spotřebitele, což je dnes v ekonomické teorii bráno jako běžné. Práce bude chtít také odpovědět na otázku, jak, z ekonomického pohledu, reklama a informace prospívají či nepospívají blahobytu společnosti.

Metody : V této práci budu vycházet z mikroekonomické teorie tak, jak se učí na bakalářském a magisterském stupni, a z uvedené Základní literatury. Základem bude teorie spotřebitele a jeho optimalizačního problému, kterou plánuji rozšířit o možnost změny spotřebitelových preferencí, které se tak stanou endogenní proměnnou. Úlohu budu řešit analyticky, pokud to jen bude možné, a chci dospět k řešení v podobě globální rovnováhy. V případě, kdy by se mi nepodařilo toto nalézt, přikročil bych k simulacím a multiagentnímu přístupu.

Osnova

1. Úvod, představení problému a jeho řešení u jiných autorů
2. Konstrukce mikroekonomického modelu

3. Statická verze modelu, optimalizace a diskuze
4. Dynamická verze modelu, multiagentní přístup (pokud bude nutné)
5. Závěr, nalezení ideální skladby reklamy a informací pro společnost

Core Bibliography (by the year of publishing) / Základní literatura (podle data vydání):

KALDOR, Nicholas The Economic Aspects of Advertising, *The Review of Economic Studies*, Vol. 18, No. 1 (1950 - 1951).

DORFMAN, Robert and STEINER, Peter O. Optimal Advertising and Optimal Quality, *The American Economic Review*, Vol. 44, No. 5 (Dec., 1954).

DEBREU, Gérard Theory of Value: An Axiomatic Analysis of Economic Equilibrium, Yale University Press, 1959.

STIGLER, George J. The Economics of Information, *The Journal of Political Economy*, Volume 69, Issue 3 (Jun., 1961).

NERLOVE, Marc and ARROW, Kenneth J. Optimal Advertising Policy under Dynamic Conditions, *Economica*, New Series, Vol. 29, No. 114 (May, 1962).

TELSER, Lester G. Advertising and Competition, *The Journal of Political Economy*, Vol. 72, No. 6 (Dec., 1964).

LANCASTER, Kelvin J. A New Approach to Consumer Theory, *The Journal of Political Economy*, Vol. 74, No. 2 (Apr., 1966).

NELSON, Phillip The Economic Consequences of Advertising, *The Journal of Business*, Vol. 48, No. 2 (Apr., 1975).

AULD, D. A. L., Advertising and the Theory of Consumer Choice, *The Quarterly Journal of Economics*, Vol. 88, No. 3 (Aug., 1974).

DIXIT, Avinash and NORMAN, Victor Advertising and Welfare, *The Bell Journal of Economics*, Vol. 9, No. 1 (Spring, 1978).

SPENCE, A. Michael Notes on Advertising, Economies of Scale, and Entry Barriers, *The Quarterly Journal of Economics*, Vol. 95, No. 3 (Nov., 1980).

FRIEDMAN, James W. Advertising and Oligopolistic Equilibrium, *The Bell Journal of Economics*, Vol. 14, No. 2 (Autumn, 1983).

GROSSMAN, Gene M. and SHAPIRO, Carl Informative Advertising with Differentiated Products, *The Review of Economic Studies*, Vol. 51, No. 1 (Jan., 1984).

KIHLSTROM, Richard E. and RIORDAN, Michael H. Advertising as a Signal, *The Journal of Political Economy*, Vol. 92, No. 3 (Jun., 1984).

BECKER, Gary S. and MURPHY, Kevin M. A Simple Theory of Advertising as a Good or Bad, *The Quarterly Journal of Economics*, Vol. 108, No. 4 (Nov.,

1993).

FRANK, Robert H. Mikroekonomie a chování, Svoboda-Libertas 1995.

MULLAINATHAN, Sendhil A Memory-Based Model of Bounded Rationality, The Quarterly Journal of Economics, Vol. 117, No. 3 (Aug., 2002).

KAMENÍČEK, J. Lidský kapitál: úvod do ekonomie chování, Praha: Karolinum, 2003.

KRÄHMER, Daniel Advertising and Consumer Memory, 2004.

LOEWENSTEIN, George and O'Donoghue, Ted Animal Spirits: Affective and Deliberative Processes in Economic Behavior, 2004.

BAGWELL, Kyle The Economic Analysis of Advertising, 2005.

GOEREE, Michelle Sovinsky Limited Information and Advertising in the U.S. Personal Computer Industry, Econometrica, Vol. 76, No. 5 (September, 2008).

MULLAINATHAN, Sendhil and SHLEIFER, Andrei Coarse Thinking and Persuasion, 2006.

CAHLÍK, Tomáš Multiagentní přístupy v ekonomii, Praha: Karolinum, 2006.

SKOŘEPA, Michal Decision Making A Behavioral Economic Approach, Palgrave Macmillan (2010).

Motto

“He who fights with monsters should look to it that he himself does not become a monster...when you gaze long into the abyss the abyss also gazes into you...”

-Friedrich Nietzsche

Chapter 1

Introduction

While the topic of advertising is not a part of the core of economic science, everyone can think over its importance if he or she remembers the decision over which product to buy, which university to choose, or about the topic of the final thesis. What is meant by advertising is the subject of the first chapter.

1.1 Advertising and information

At the beginning, the most important thing to talk about is the topic itself, because its actual field is not very straightforward to see. The thesis has as a background the techniques of microeconomics as they are taught in undergraduate and graduate courses. The key problem here is how advertising influences consumers' choice and how to incorporate it in the utility maximization model, where no kind of advertising is considered.

In this thesis, advertising should be understood as information. The word “information” in the broad sense can actually mean almost anything, while in the narrow sense with regards to microeconomic analysis it particularly means information about what goods are available, what are their prices, and what are the initial endowments, and for the producers there is also information about production possibilities.

Nor the first, nor the second meaning is true for this thesis. The idea is to model advertising meaning all mechanisms that influence consumers in a way that they change their consumption in favor of the good that is advertised, and not only presentations of various firms in the media.

“Advertising”, from the Latin *ad* (toward) + *vertere* (to turn), is similar to

“adverb” (toward a word). Advertisements are usually turning the consumer’s attention toward a particular word - the name of a brand.

Advertising can be thought about as something that either lets consumers know about products and gives them new information about these, which is the positive way of thinking about it, or to seduce them and persuade them to change their preferences about products, which is the negative way of thinking about it. Also, exceptionally, persuasive advertising can sometimes have effects that one would call positive, and on the other side, advertising that lets us know about a new product can sometimes have effects that one would call negative. Advertising is usually a mixture of both types of effects. In this thesis we will assume that all goods and their properties are known to all consumers and consider only the persuasive effects of advertising.

Obviously, changes in consumption are possible not only because of television and radio shots, billboards, or messages in newspapers, but also due to any other kind of information that is not advertising in the narrow sense, but has the same effect. For example, documentaries also attempt to change consumers’ preferences, which is not advertising in the narrow sense, but in the broad sense it is. Advertising is meant to be information that “form” consumers such that they change their consumption.

Chapter 2

Role of advertising in the economy

This chapter answers the question why should an economist, and more or less every participant of the economy as well, have advertising in mind, and then it presents an analogy, which helps to understand the effects of advertising on the consumer.

2.1 Key role of advertising for consumer demand

Let us look at the purpose of the markets as such, which is to clear supply and demand in a way that more demanded commodities have higher price than less demanded ones, so that more demanded commodities provide their producers higher profit, so that they are more produced. Firms, instead of adding value to their products and fitting them to consumers' preferences, are wasting their resources to change consumers' preferences, so that their products will fit to them. Galbraith (1967) points on the logic that *"The more a society is rich, the more the wants of this society are created in the process by which they are satisfied"* and *"...wants are becoming dependent on production."* This is to say that in rich societies consumers care about what they eat, and therefore producers have the possibility to influence what the consumers' choose, while in poor societies the wants of consumers are created in their own hungry bodies and advertising does not change much of it, relatively to, for example, the effect of a price change. Persuasive advertising is a market failure, because of wasting of resources to maximize a firm's profit at the cost of other market participants, so it questions the correctness of the profit-maximizing behavior of firms, and even if we believe that markets are led by an invisible hand to a pareto-efficient

allocation and that we have maximized the social welfare, advertising poses also a question whether we actually “want to like what we like” (see 3.2).

This thesis focuses on the demand side, because on the side of firms, advertising can be included just as another product which is sold for zero or negative price, or which is given to the consumer, having a direct effect on consumer’s preferences whether the consumers want it or not. In terms of financial accounting, the role of advertising (in the narrow sense) on the side of firms is not very big: the data from OECD show that advertising expenditures in the Czech republic (the turnover in ISIC3 advertising industry) are about 83 000 million CZK, which is less than 2% of the turnover in the total services excluding financial intermediation. This is comparable to, for example, the turnover in “restaurants, bars and canteens industry”. However, the effect of advertisements on people’s consumption intuitively must be higher than 2% of total effect of all services. Even the other sectors that provide information are not different in this respect: in the United States, the turnover in advertising accounts for less than 1% of total services, which is comparable with the turnover in education. Even though this is a small share, nobody would deny the importance of education in the economy, and so it is for advertising (these statistics moreover consider it only in the narrow sense).

The equilibrium level of prices depends on preferences, which are assumed to be known and constant in basic models working with preferences, but experience shows that consumers’ choices are not *ceteris paribus* constant, and therefore adding advertising in the model of supply and demand will make the model more realistic.

2.2 Consumer as a computer

A consumer can be described as a computer hardware, on which information is taped, where the source of this information are mostly the media, education, culture, etc. This analogy is particularly convenient because of the current trend of computers’ utilization, which we see everywhere. Consumers are often working with, and sometimes even consuming, computers, especially in childhood, and computer often serves as a complement or as a substitute to the human brain. While the computer is based on programming language, consumers’ behavior is also strongly determined by different kinds of languages. This is not only an analogy, but it also points to the fact that consumers are often doing things that should be rather done by computers: for example,

computers are working on a binary basis, and consumers who work with them are performing binary operations (even consumers who are not working with computers have to compute at least when they are using money).

Effects of advertising can be analysed and better understood if we imagine consumers as computers, rather than as representative agents pursuing their private interests with stable choices and stable behavior. In microeconomics, consumers' private interests are computable anyway, so in our case it is not a restriction.

Chapter 3

Advertising and consumer demand

When having agreed on the importance of advertising for the economy, there is still a question how to analyze it. Firstly, is it actually a question to be analyzed by economists? Is it not rather a question for sociologists, marketing analysts, or medial analysts? The microeconomic models used in this thesis might seem quite far from what advertising is, and as there are moreover no real data, it could be confusing. However, advertising often is confusing - there are not exact statistics, there are not clear advices and manuals of how to make it or how to resist it. If it was not confusing, it would not be persuasive advertising. This thesis is an attempt to analyze and clarify advertising from the microeconomic point of view, and this chapter discusses how it can be done. It must be emphasized that mathematical techniques are a proper way of analyzing this topic, but only there, where there are people concerned with mathematics, which we saw in 2.2 that it is today in many places.

3.1 Advertising and complementarity

One way of modelling behavior of consumers whose wants are dependable on what firms do is adding some kind of exogenous parameter, but in our case this would not suffice, because advertising is not independent of actions of players in the economy, but is also initiated by the players themselves. More likely, in a supply and demand model of an economy, one should not have advertising in exogenous variables, but in utility and production functions that are maximized (for example, if one is doing sport, he or she knows that food will taste him or her better, so he or she maximizes these two activities jointly, and this joint

maximization should be also done for any kind of advertising and the good that is advertised).

To achieve it, and at the same time have a stable utility function, one might suggest that preferences of each particular consumer are constant, and what is changing when consumers change their behavior are prices of commodities that are complements of those that the consumer's preferences seem to be changing of. Let's say, for example, that consumers have preferences over bread and butter, which are complements, and that price of bread grows suddenly very high. Demand for butter decrease, but rather than thinking that preferences for butter decreased relatively to other goods, everybody will understand the complementarity together with the price change to be the cause of the change in demand. Indeed, advertising has been already considered as a complementary good in, for example, Kaldor (1950). Becker & Murphy (1993) claim that advertising does not change consumers' tastes, and their model with advertising as a complementary good is very close to the model of this thesis: *"In consumer theory, goods that favorably affect the demand for other goods are usually treated as complements to those other goods, not as shifters of utility functions. There is no reason to claim that advertisements change tastes just because they affect the demand for other goods."* This approach allows for many kinds of advertising to be added to a standard model of consumer behavior, without having to rearrange the model, and therefore it is chosen as the most convenient one.

A particularly interesting causes of what is wanted are a lecture in school or a story of a book (or movie, or some performance). It is a kind of intangible good that a consumer keeps and that is often complementary to repeating the lecture or the story by the consumer himself or herself. Television advertisements work this way, too, and if we take it even more generally, everything that a consumer does can actually be a complement to doing it again, like in the "model of addiction" in Becker & Murphy (1988). A nice example of that is listening to music, mentioned by Marshall (1890): *"There is however an implicit condition in this law [meaning the law of diminishing marginal utility] which should be made clear. It is that we do not suppose time to be allowed for any alteration in the character or tastes of the man himself. It is therefore no exception to the law that the more good music a man hears, the stronger is his taste for it likely to become..."*

3.2 Consumer's wants

Model of advertising might show us and clarify one more feature of consumers' behavior, which basic models do not show: whether a change of preferences is motivated by the consumer himself or not. In other words, whether a consumer should be understood as a sovereign subject in the economy, like the microeconomic theory understands him or her. For example, in Mas-Colell, Whinston, & Green (2005): "*A distinctive feature of microeconomic theory is that it aims to model economic activity as an interaction of individual economic agents pursuing their private interests.*" When private interests are defined as a utility maximization problem, then under the existence of advertising private interests are not private, but formed by forces in the economy. If we then speak about choice, it is not something subjective, but a result of those forces, which are in this thesis called advertising. Nevertheless, even if consumer's private interests are formed by the forces in the economy, it does not mean that the consumer cannot be one of those forces himself. In an economy with production, the consumer could buy that complementary good or shares of a firm producing it. The model of advertising can tell us analytically, to what extent the consumer pursues his or her own interest, and to what extent his or her behavior is determined by other forces in the economy.

Here I recall Karel Engliš (Engliš 1992), who distinguishes ontological ("what is the cause?") and teleological ("what is wanted?") "orders of thinking". Now we have advertising, which is precisely "the cause of what is wanted", so the model of advertising puts these two "orders of thinking" together. In the model actually, the pure ontological thinking includes the teleological thinking, because consumers' wants are modelled by pure ontological theory (mathematics). However, still there are two teleological statements in microeconomics: firstly, the construction of utility functions, which represent what is potentially (not effectively) wanted by each particular consumer, and secondly, the assumption of maximization of utility, which represents (in microeconomics) the highest purpose, which has not any higher purpose, as in that case the consumer is "on the top of the mountain" (We can question these assumptions by asking, for example, on which mountain the consumer actually is, and whether he or she is there alone or not.). If we admit these two assumptions we can continue with an analysis that is purely ontological. This approach allows for analysing the consumer objectively and to infinitely small pieces, while it is able to explain *why* something is wanted by him or her, which the standard

microeconomic model is not taking into account.

Is it really so important to analyze consumers' wants in the space of real numbers? Consider a function defined on \mathbb{R} which has a single maximum. The probability that this maximum is in \mathbb{N} (the set of natural numbers) is zero: for a consumer living in the real world we will not find the optimal solution in the natural-numbers space. For example, the whole world of finance cannot explain what is incorporated in a single indifference curve of that consumer. Neither with microeconomic techniques we will find the optimal solution, because we are restricted by the necessity of an analytical interpretation of that indifference curve, but we are able to get close to that solution and depict it on a simple graph. The consumers' evolution into computers makes it easier to analyze their behavior (and thus to find their optimums and influence them by advertisements), but also reducing the "richness" of the world (the word "richness" a little ironic here since it also means having a great amount of money).

3.3 Cognitive dissonance

As a computer's hardware has some fixed capacities, superfluous commands decelerate the computer's running, like some undesirable information obstruct the consumer's productive, educative, or entertaining activity by turning his or her attention to superfluous words. This can be called an "informational opportunity cost". Even if we assume that the consumer has a great capacity for conscious and active processing of information that flow to him or her from the outside world and therefore is able to prevent himself or herself from "subliminal stimuli", there is also the so called "cognitive dissonance" phenomenon (Festinger 1957). Mere watching of something pushes a consumer to have a good opinion on it, similarly to when someone who is eating a roll is likely to think that the roll is good. The consumer just wants to be in accord with his or her own thoughts. In musical theory, the opposite to dissonance is consonance, and we can understand an advertisement in terms of musical theory as something which puts the consumer in tune with the good, and complementarity of any two goods as their consonance. With respect to that, it is assumed that every advertisement does have an effect on consumers.

3.4 Models used by other authors

Economic articles that consider advertising usually analyze the market as a whole and do not consider individual players. The demand side of the economy is then represented by an aggregate demand function, which comprises all consumers at once (for example Nerlove & Arrow (1962)).

In his book *Accounting for tastes* (Becker 1996), Becker says that preferences are influenced by childhood, social interactions and culture. He includes these in the utility function as *personal capital* and *social capital*. There is a so called *extended* utility function, which he considers stable in time and identical between consumers. Models in this thesis resemble the Becker's one in the stability of the utility function in time while keeping the effects of advertisement goods and services on consumers. The utility of consumption goods depends on the amount of advertisement goods that a consumer has consumed.

In Becker & Murphy (1993), a firm decides on the amount of optimal advertising and optimal amount of the good sold, and the consumer compares the marginal utility of advertising with its price, which is greater than zero. The utility function of a consumer is $U = U(x, y, A)$, where x, y are goods and A is an advertisement good for x . An advertisement is a good that is either given away or sold to the consumer and is a complement to the advertised good. A very important remark in this article is about the symmetry of complementarity, which implies that consumers like to consume advertisements once they have consumed the advertised goods, which is not a very rational behavior for some kinds of advertisements, but can be considered normal for advertising as defined in section 1.1.

3.5 Cobb-Douglas utility function

The most suitable function for us is the Cobb-Douglas function:

$$y = c \prod_i x_i^{a_i}, \quad c, a_i \geq 0 \quad (3.1)$$

See the graph of a Cobb-Douglas utility function for two goods in section 4.4.

With this function, goods are imperfect complements and each of them can be considered as an advertisement for all the others. If we choose one of the goods to be an advertisement, the marginal utility of consumption of the other

goods is positive even if the amount of the advertisement good stays constant, with the exception of the amount of this good being zero, but in that case we can say that the consumer does not know about the existence of the other goods, so that he or she does not consume them.

An interesting property of such utility function is that a consumer might consume some good for a long time without even knowing that it is an advertisement:

If A and C is complementary to B (so the utility function is a sum of two Cobb-Douglas functions),

then consumption of A, which itself has a positive marginal utility, is an advertisement for consumption of B, increasing its potential utility,

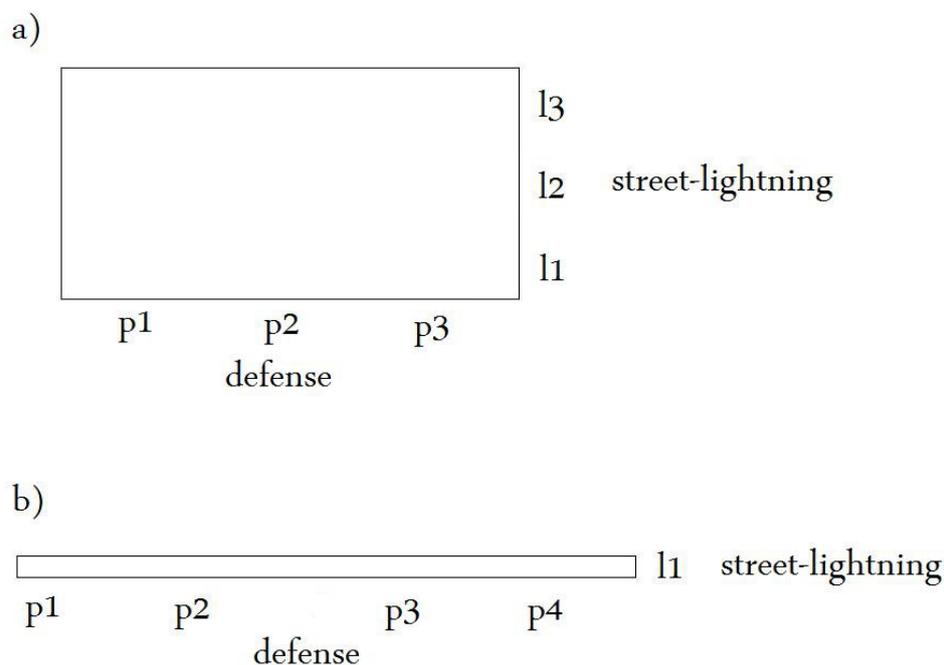
and consumption of B, depleting the potential created by consumption of A, is an advertisement for consumption of C, increasing its potential utility.

So not only A is an advertisement for B, but it is also indirectly an advertisement for C. If we imagine a longer chain with more goods, it might become almost impossible for the consumer to realize that he or she is consuming an advertisement.

3.6 Public good as a complement

Kaldor (1950) characterizes advertising as a particular case of subsidized commodities (commodities sold below cost) and explains four reasons why those commodities exist: non-excludability (security, defence, street-lightning, etc.), external economies (education, research, etc.), policies attempted to change the distribution of goods (for example subsidization of healthy food), and profit maximization of “many-product firms”. He considers advertising to belong to the fourth category, but from the point of view of this thesis it would be advertising in the narrow sense. If we take the broader definition, there is no reason why not to understand the remaining categories also as advertising. This section provides an example that in this thesis the idea of advertising has a very general meaning.

Figure 3.1: Defense and street-lightning as complements



In all four categories from the previous paragraph, we can see some complementary relation:

The fourth one is about advertising as it is mostly understood. Firms sell advertisements under cost to increase the demand for goods, which are complements to those advertisements.

The third category are policies attempted to change the distribution of goods, which is what advertising often does. Good health increases the utility of many activities, so it can be considered as their complement.

Goods of the first two categories also increase the utility of many activities, and they are moreover complementary to each other. Why not consider defence as a complement to street-lightning? Figure 3.1 illustrates the complementarity:

On picture a) there are three policemen on the defense line and three lamps on the street-lightning line, so the area, which can represent, for example, a park, is safe for visitors and at the same time lit in the evening.

On picture b) there is only one lamp, and even though the policemen enforce

themselves with one more man (or women), the area they effectively guard is much smaller than on picture a), and the available (lit and safe) space is enough just for a narrow path.

Now suppose that at the end of the park there is a shop. Defense and street-lightning are then advertisements for every good of that shop, because customers who go shopping in it have to go through the park, and if they are in the park, they have a possibility to go shopping. In the context of this thesis, defense and street-lightning are also advertisements to each other.

The example above can be generalized to more dimensions (as well as the Cobb-Douglas function can be). In three-dimensional space, a similar example of complementarity is construction of something:

Imagine that three people are building an object of three dimensions. It has to be enough large so that they can fit in (some firms might have rather used advertising to change the three people's constitution to them being able to fit into any object, but let us assume here that it is not possible). Figure 3.2 illustrates the problem:

There are person A who builds part A, person B who builds part B, and person C who builds part C. On picture a), they all fit in without any problems, but on picture b), C is not working properly, so the building is much lower, in spite of increased effort of A and B. What's more, if C is really able to lower his constitution, he or she is the only one who fits into the building: a clear example of inefficiency, C being a free-rider-with-a-free-lunch person.

Let us go away from inefficiencies and suppose that all the three persons want to maximize the volume of the building, because it is part of the utility function of each of them. The three dimensions (axes denoted as A, B, and C) represent three public goods (or services).

Expressed formally:

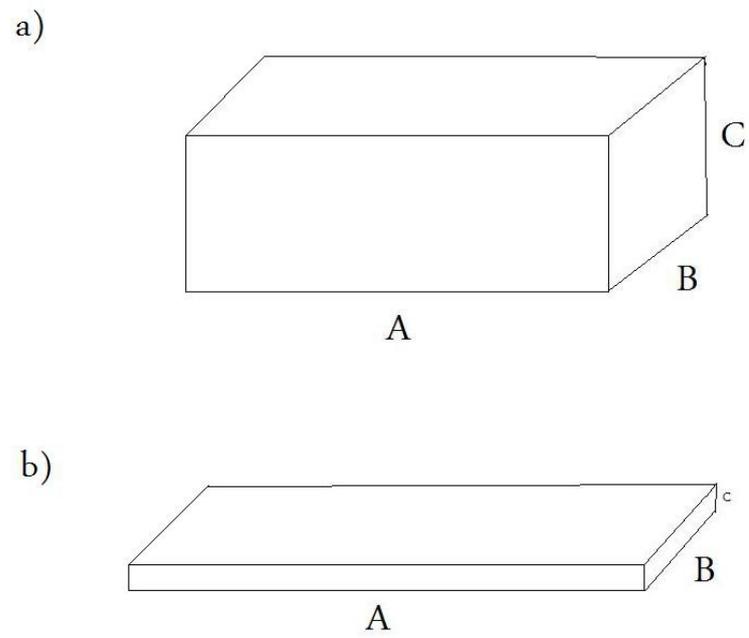
$$u_A(\alpha, A, B, C) = \alpha + ABC \quad (3.2)$$

$$u_B(\beta, A, B, C) = \beta + ABC \quad (3.3)$$

$$u_C(\gamma, A, B, C) = \gamma + ABC, \quad (3.4)$$

where α , β , and γ are the persons' utilities that do not depend on the public goods.

Figure 3.2: Building a three-dimensional object



Why are those public goods complements to each other? It is not always, but usually if one public good (or service) is completely missing (let us take as an example some important service such as security), living in the respective community is not a good choice, even if there is street-lightning etc.

The example above is also about cooperation. Cooperative persons are also complementary to each other: we see that if person C does not cooperate with persons A and B, the result will be as in Figure 3.2 b). In fact, public goods are practically a case of cooperation with many goods - much more than three as in the example of construction, the consequence of which is that communication has to be more complex to be able to cooperate. The community cannot cooperate simply by talking to each other as the three persons in the example. The upper part of Figure 3.3 represents a community with more than three public goods and with advertisements. In each of parts a), b), c), and d), we can again imagine three persons-builders, who are able to directly communicate within these groups (so they can also evaluate the work of others and adjust their work accordingly). If they are not able to do this between the groups, it can result in several inefficiencies:

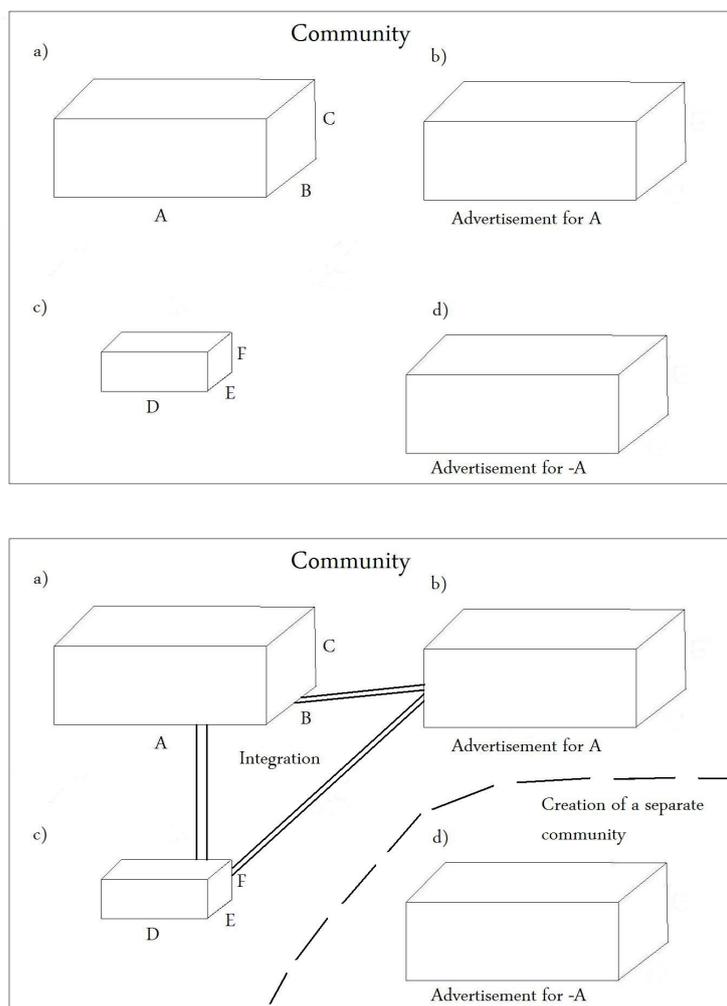
Suppose that A, B, C, D, E, and F are all complements to each other. A, B, and C do not know that D, E, and F are slower, so the marginal utility of A, B, and C's work is lower than they think, because their assessment is based only on the work of themselves and their colleagues. On the other side, D, E, and F are not motivated to work harder because they do not think that the marginal utility of their work is as high as it is.

If a), b), and c) are three private companies, then they should merge together (or make some kind of integration or at least create communication channels), because of the reason in the previous paragraph and also because the advertisement for A produced by b) makes it more efficient to produce B and C in a).

On the other hand, d) should create a separate community, because its production of advertisement for -A is anti-complementary to A, and thus also for everything produced by a), b), and c).

A solution is shown on the lower part of Figure 3.3.

Figure 3.3: Public goods as complements - a community



Chapter 4

Model 2x2

4.1 Assumptions about consumers

Rationality

Consumers take into account everything that they know, and among all possible choices choose the alternative that lies highest in their preference relation. Their preference relation is complete and transitive. The assumption of modern behavioral economics that consumers' rationality is bounded is not assumed, because of the following reasons: a persuaded consumer is still a rational consumer, because the persuasion results from the complementarity relations in the consumer's utility function, which he or she follows rationally. Also, as Becker (1996) says: . . . *“childhood and other experiences, and the attitudes and behavior of others, frequently place more far-reaching constraints on choices than do mistakes and distortions in cognitive perceptions.”*

Boundedness of the budget set

So that consumers are not (because of the monotonicity assumption) consuming infinite amounts of some goods.

Monotonicity

There are no evil goods. This is not restrictive for the sphere of goods to be possibly modelled, since consumption of an evil good can be replaced by minus-consumption of its opposite.

Continuity of preferences

This assumption is restrictive, but it becomes less restrictive when goods are assumed to be continuously differentiable and, more importantly, when there are more consumers with the same preferences, such that their preferences can be aggregated.

Strict convexity of preferences

We can observe that a consumer might prefer some good that he or she has already consumed in the past, which would not lead us to convexity of preferences. Nevertheless, at a moment in time, preference of variety is a natural characteristic.

Differentiability of the utility function

Although the model is based on complementarity of goods, the complementarity does not have to be perfect with a breaking point on the indifference curve, such as the Leontief technology has.

Some other classical properties of the utility function follow from the assumptions about preferences.

Wealth

For each consumer there is an initial endowment of wealth and sometimes there are revenues from shares, both spent fully.

No Labour

There is no explicit labour in the model, but one of the goods can be interpreted as free time.

4.2 Assumptions about firms

Production set

The production set of a firm is bounded above.

Production factors

A firm can be seen as a black box that just transforms inputs into outputs: *“Man cannot create material things. In the mental and moral world indeed he may produce new ideas, but when he is said to produce material things,*

he really only produces utilities; or in other words, his efforts and sacrifices result in changing the form of arrangement of matter to adapt it better for the satisfaction of wants." (Marshall 1890).

Thus the production factors in the economy are identical with the consumption goods.

Depending on the interpretation of the goods, there might be some additional assumptions on their production.

Production function

The production function of a firm is continuous, differentiable, monotonous in at least one production factor, and quasiconcave.

Homogeneity of products

A product produced by a firm is a perfect substitute of the same product produced by another firm in the market.

4.3 Assumptions about the markets

Exogenous variables

Number of consumers and number of firms is given exogenously and fixed. Utility functions and production functions are also exogenous and fixed, as well as available goods (production factors) and their initial distribution among consumers. The distribution of shares is also given exogenously.

Endogenous variables

Consumers choose their consumption, and firms decide on production factors and on production. It does not have to be necessarily in this order. The solution of a model is an equilibrium price.

Market structure

Because there are two firms and it is impossible for a new firm to enter the market, the market is oligopolistic, which allows the firms to make profits.

Time dimension

From the point of view of altering the production factors, the model assumes a long term, i.e. there are no fixed costs of production.

Market players' knowledge and timing of the players' actions

The resulting equilibrium depends on what each market player knows about the economy when he or she is deciding on possible actions, and on the sequencing of the players' actions. When advertising is concerned, consumers usually know about advertisement goods sold to them prior to their (consumers') decision about the consumption of other goods.

No externalities

There are no externalities in the economy. Firm 1's production of a good that is a complement to another good produced by firm 2 is not seen as an externality, but as a kind of cooperation between the two firms.

4.4 Equations

- Consumers**
- n ... number of consumers
 - m ... number of producers
 - x_i ... consumption of good i
 - ω ... initial endowment of wealth
 - p_i ... price of good i
 - θ_k ... share in firm k
 - π_k ... profit of firm k

 - $n = 2$
 - $m = 2$

Consumer A – the optimization problem:

$$\max_{x_1, x_2, x_3, x_4, x_5} u_A(x_1, x_2, x_3, x_4, x_5) \quad (4.1)$$

s. t.

$$\sum_{i=1}^5 p_i x_{Ai} \leq \sum_{i=1}^5 p_i \omega_{Ai} + \sum_{k=1}^m \theta_{Ak} \pi_k. \quad (4.2)$$

Consumer B – the optimization problem:

$$\max_{x_1, x_2, x_3, x_4, x_5} u_B(x_1, x_2, x_3, x_4, x_5) \quad (4.3)$$

s.t.

$$\sum_{i=1}^5 p_i x_{Bi} \leq \sum_{i=1}^5 p_i \omega_{Bi} + \sum_{k=1}^m \theta_{Bk} \pi_k \quad (4.4)$$

$$x_i \geq 0 \quad \forall i. \quad (4.5)$$

I.e.: Expenditures on consumption are less or equal to initial wealth endowment plus dividends from shares. Consumption is non-negative.

- Firms**
- z ... the employment of production factors, z_1, \dots, z_5
 - $f_i(z)$... the production function of good i , $i = 1, \dots, 5$
 - y_i ... the production of good i , $i = 1, \dots, 5$
 - the production equation: $y_i = f_i(z)$
 - $p_{z_i} = p_{x_i} = p_i \quad \forall i$

Firm I – the optimization problem:

$$\max_{y_{Ii}, z_I} \pi_I(y_{Ii}(z_I), z_I, p), \quad (4.6)$$

where

$$\pi_I = \sum_{i=1}^5 p_i y_{Ii} - \sum_{i=1}^5 p_i z_{Ii}. \quad (4.7)$$

Firm II – the optimization problem:

$$\max_{y_{IIi}, z_{II}} \pi_{II}(y_{IIi}(z_{II}), z_{II}, p), \quad (4.8)$$

where

$$\pi_{II} = \sum_{i=1}^5 p_i y(z_{IIi}) - \sum_{i=1}^5 p_i z_{IIi}. \quad (4.9)$$

I.e.: Profit of a firm equals to what is produced and sold minus the costs of production.

Equilibrium conditions

– the supply and demand equality:

$$\sum_{j=1}^n x_{ji} = \sum_{j=1}^n \omega_{ji} + \sum_{k=1}^m y_{ki}, \quad i = 1, \dots, 5. \quad (4.10)$$

– shares:

$$\theta_{AI} + \theta_{BI} = 1. \quad (4.11)$$

$$\theta_{AII} + \theta_{BII} = 1. \quad (4.12)$$

Exogenous variables and functions

– θ_{jk}, ω_{ji}

– functions: $f_{ki}(z), u_j(x)$

Endogenous variables

– $x_j, y_k(z), z_k, p_i$

Utility functions

– The mere consumption of a good is at the same moment inducing the consumer to consume the complement of the good. The utility from this complementary good increases, as we can see in Figure 4.2.

Figure 4.1

Graphical representation

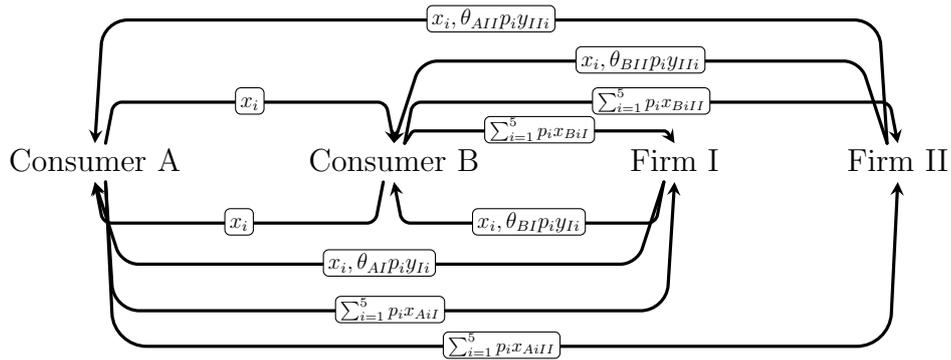
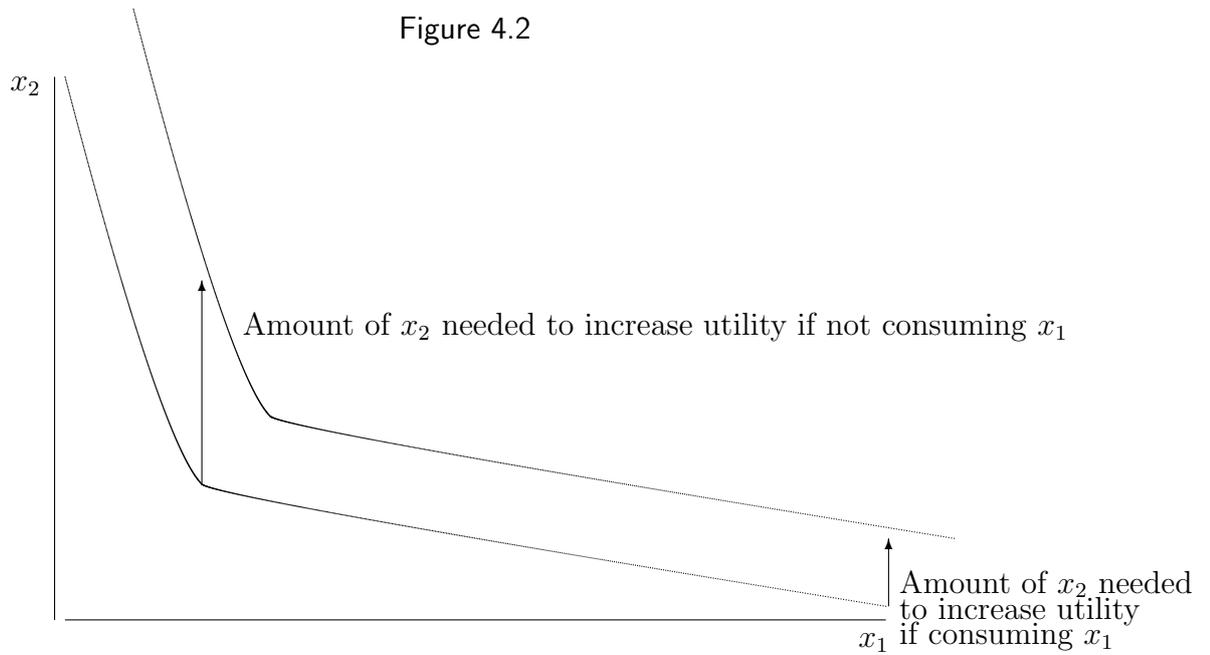


Figure 4.2



- In this setting, consumption of a firm's product can be thought of as advertising.

Goods

There are five goods in the economy. They are complements - an increase in the amount of one of the goods increases the utility of consumption of each of the other goods, thus each good is potentially an advertisement for the other goods. This is represented by a Cobb-Douglas utility function.

- **d** - wood

Wood is consumed by consumers and also used for the production of fire.

- **w** - water

Water is used for the production of wood.

- **i** - iron

Iron is used for the production of wood and fire.

- **e** - earth

Earth is used for the production of fire.

- **f** - fire

Fire is consumed by consumers and can be used as an advertisement.

4.5 Production with constant returns to scale

In this section, firms have production functions with constant returns to scale. Firm I has an additional possibility of advertising (in the model represented by \hat{i}), with a strictly concave production function. The firm can decide to use some resources on advertising instead of on production of its normal product, which can be inefficient for the economy as a whole.

Additional assumptions

Consumers are forced to consume fixed amount of earth, water, and iron ($w_A = w_B = i_A = i_B = 1 = e_A = e_B$), and decide only on the consumption of wood and fire.

Consumer A initially owns iron and water, consumer B owns wood and earth.

Price of iron, price of water, and price of earth are exogenous and fixed (they can be traded on the world market), and price of fire and price of wood are determined endogenously (there cannot be more of them than are the initial endowments + production).

Firm I is the only producer of wood, but it does not behave as a monopolist - it optimizes its production, but not the price of wood (the firm is owned by consumers, who decided about that). For example, if firm I would represent some aggregate of identical firms, it would be difficult (or even impossible) to perfectly collude on prices.

Setting of parameters

Default values are:

$$\begin{aligned}\bar{d} &= \bar{e} = \bar{w} = \bar{i} = 1 \\ p_e &= p_w = p_i = \frac{1}{10} \\ \theta_{AI} &= \theta_{BI} = \theta_{AII} = \theta_{BII} = \frac{1}{2}\end{aligned}$$

Consumer A's utility function

$$u_A(d_A, w_A, i_A, e_A, f_A) = (d_A w_A i_A e_A f_A)^{\frac{1}{5}} \quad (4.13)$$

Consumer B's utility function

$$u_B(d_B, w_B, i_B, e_B, f_B) = (d_B w_B i_B e_B f_B)^{\frac{1}{5}} \quad (4.14)$$

Firm I's production functions

$$y_{Id} = (\hat{w}\hat{i})^{\frac{1}{2}} \quad (4.15)$$

$$y_{If} = (\hat{i})^{\frac{1}{2}} \quad (4.16)$$

Where “hat” denotes the amount of the good used in production, and “double-hat” denotes the amount of i used in the production of f (and not in the production of d).

Firm I's cost function

$$C_I = p_w\hat{w} + p_i\hat{i} + p_{\hat{i}}\hat{\hat{i}} \quad (4.17)$$

Firm II's production function

$$y_{II}f = (\hat{d}\hat{e})^{\frac{1}{2}} \quad (4.18)$$

Firm II's cost function

$$C_{II} = p_d\hat{d} + p_e\hat{e} \quad (4.19)$$

4.5.1 Firm I produces both d and f

Optimization problem of consumer A

$$\max_{d_A, f_A} (d_A f_A)^{\frac{1}{5}} \quad (4.20)$$

s.t.

$$p_d d_A + p_f f_A = p_i \bar{i} + p_w \bar{w} + \theta_I \pi_I + \theta_{II} \pi_{II}. \quad (4.21)$$

The corresponding Lagrangian is differentiated with respect to d_A, f_A, λ_A .

Optimization problem of consumer B

$$\max_{d_B, f_B} (d_B f_B)^{\frac{1}{5}} \quad (4.22)$$

s.t.

$$p_d d_A + p_f f_A = p_d \bar{d} + p_e \bar{e} + (1 - \theta_I) \pi_I + (1 - \theta_{II}) \pi_{II}. \quad (4.23)$$

The corresponding Lagrangian is differentiated with respect to d_B, f_B, λ_B .

Optimization problem of firm I

$$\max_{\hat{w}, \hat{i}, \hat{i}} p_d (\hat{w} \hat{i})^{\frac{1}{2}} + p_f \hat{i}^{\frac{1}{2}} - p_w \hat{w} - p_i \hat{i} - p_i \hat{i}. \quad (4.24)$$

The equation is differentiated with respect to $\hat{w}, \hat{i}, \hat{i}$.

Optimization problem of firm II

$$\max_{\hat{d}, \hat{e}} p_f (\hat{d} \hat{e})^{\frac{1}{2}} - p_d \hat{d} - p_e \hat{e}. \quad (4.25)$$

The equation is differentiated with respect to \hat{d}, \hat{e} .

Market clearing conditions

$$d_A + d_B = y_{Id} + \bar{d} - \hat{d} \quad (4.26)$$

$$f_A + f_B = y_{If} + y_{II f} \quad (4.27)$$

Solution:

Because

$$\lim_{[\hat{w}, \hat{i}] \text{ or } [\hat{i}, \hat{w}] \rightarrow [0, +\infty]} p_d (\hat{w} \hat{i})^{\frac{1}{2}} - p_w \hat{w} - p_i \hat{i} + p_f \hat{i}^{\frac{1}{2}} - p_i \hat{i} = -\infty \quad (4.28)$$

and

$$\lim_{[\hat{w}, \hat{i}] \rightarrow [+\infty, +\infty]} p_d (\hat{w} \hat{i})^{\frac{1}{2}} - p_w \hat{w} - p_i \hat{i} + p_f \hat{i}^{\frac{1}{2}} - p_i \hat{i} = \text{sgn}(p_d \sqrt{c} - p_w c - p_i) \infty, \quad (4.29)$$

where $w = ci, \hat{i}, p_d, p_f, p_w, p_i, c \in \mathbf{R}_+$,

and the same for the profit of firm II (expression 4.25), there are no global maximums or minimums of those functions with respect to $\hat{w}, \hat{i}, \hat{d}$, or \hat{e} (as in Figure 4.3). Therefore, the more goods firms would produce, the better for them, and since consumers receive the firms' profits, they are also better off. This is not realistic because it is like a perpetuum mobile and would lead to infinite profits or losses and violate the boundedness assumption. Nevertheless, there is a stationary point, in which the profits of the firms are zero with the exception of profit from the production of fire by firm I ($p_f \hat{i}^{\frac{1}{2}} - p_i \hat{i}$). Supposing that the firms are motivated to stay at that stationary point (e.g. because the firms do not know what will be the prices p_d and p_f before they decide on production, so they are eliminating risk when staying there), we can examine whether advertising increases or decreases the utility of the consumers.

Note: This model also shows the importance of financial markets, with which the firms could have eliminated the price risk and could have taken advantage of production with constant returns to scale.

Consumers choose for consumption the following amounts of wood and fire:

$$d_A = \frac{p_i \bar{i} + p_w \bar{w} + \theta_I \pi_I + \theta_{II} \pi_{II}}{2p_d}, \quad (4.30)$$

$$f_A = \frac{p_d}{p_f} d_A, \quad (4.31)$$

$$d_B = \frac{p_d \bar{d} + p_e \bar{e} + (1 - \theta_I) \pi_I + (1 - \theta_{II}) \pi_{II}}{2p_d}, \quad (4.32)$$

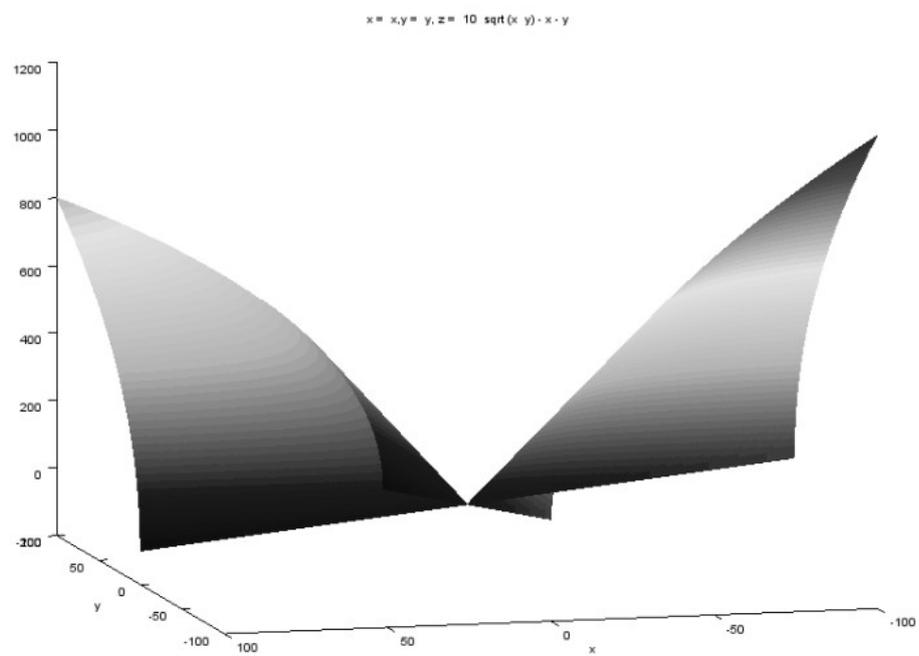
$$f_B = \frac{p_d}{p_f} d_B. \quad (4.33)$$

And the optimal amount of wood (\hat{d}) used as input by firm II and the optimal amount of iron (\hat{i}) used as an input by firm I are:

$$\hat{d} = \frac{\frac{p_d}{2p_w} \hat{i} + \bar{d} - \frac{2p_e}{p_i}}{3}, \quad (4.34)$$

$$\hat{i} = 3p_w \frac{d_A + d_B - \frac{2}{3} \bar{d} - \frac{2}{3} \frac{p_e}{p_i}}{p_d}. \quad (4.35)$$

Figure 4.3: Profit with constant returns to scale



The equilibrium prices are:

$$p_d = 2\sqrt{p_i p_w}, \quad (4.36)$$

$$p_d = 2\sqrt{p_e p_d}. \quad (4.37)$$

4.5.2 Firm I does not produce f

Optimization problems of consumers and of firm II are the same as in 4.5.1.

Optimization problem of firm I

$$\max_{\hat{w}, \hat{i}} p_d (\hat{w} \hat{i})^{\frac{1}{2}} - p_w \hat{w} - p_i \hat{i}. \quad (4.38)$$

The equation is differentiated with respect to \hat{w} , \hat{i} .

Market clearing conditions

$$d_A + d_B = y_{Id} + \bar{d} - \hat{d} \quad (4.39)$$

$$f_A + f_B = y_{If} \quad (4.40)$$

Solution:

In equilibrium, the optimal amount of water (\hat{w}) used as input by firm II is:

$$\hat{w} = \frac{3}{8p_w} (p_i \hat{i} + p_w \hat{w} + p_d \hat{d} + p_e \hat{e}) - \frac{\bar{d} p_d}{2p_w}. \quad (4.41)$$

Prices are the same as in 4.5.1.

4.5.3 Results

Because for some values of parameters, \hat{w} , \hat{i} , \hat{d} , and \hat{e} have negative values, the model is solved in these cases setting the values of those variables to zero.

The firms usually stop using inputs when \bar{d} (initial endowment of wood) is large enough. If it is greater than 7, firm I does not produce wood in all situations.

Preferred alternative is always the one with higher sum of utilities $u_A + u_B$ (consumers can always agree on redistribution that is better for both than any alternative with lower sum of utilities).

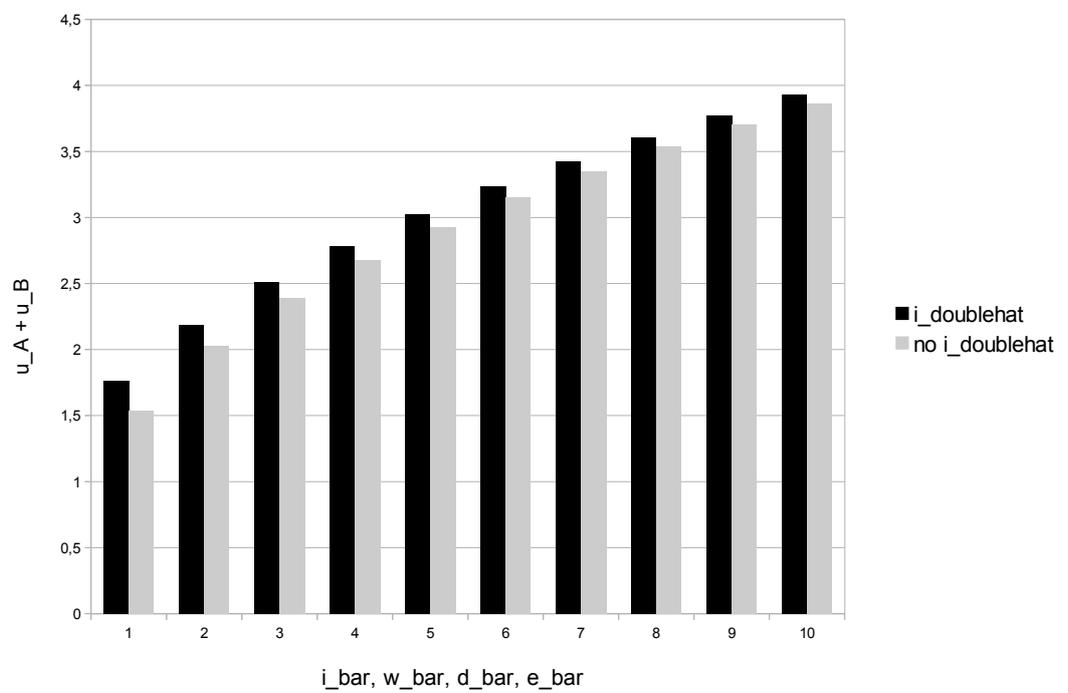
Figure 4.4 shows the sum of utilities when all initial endowments (\bar{d} , \bar{e} , \bar{w} , and \bar{i}) increase. The sum of utilities increases while it is always higher for the case when firm I produces the advertising good (\hat{i}). The difference is decreasing. The advertising good is f -fire, which is produced also by firm II, so it might be seen as wasting of resources by firm I, which should rather produce wood, which is not produced by firm II. The production of wood really decreases, but both consumers consume in equilibrium more wood and more fire, because the concave production function for advertising is an advantageous means of producing fire. Even though firm I stays at the stationary point, it makes a profit from advertising, which goes to the consumers, so that they pay only for the cost of production.

The results are similar no matter how the parameters are changed, so this model provides no argument against advertising, because either there exists some small amount of it that increases the overall utility, or firm II does not produce it.

4.6 Production with a convex-concave production function

Here, we have the more realistic case, where up to some amount of production, firms are more productive if they produce more, but at the same time cannot produce infinite amounts of goods as in the previous section. We might expect that advertising will crowd out fire produced by firm II, which then will not produce enough of it to be at least at the inflex point of its production function (which is always more optimal than any lower amount of production).

Figure 4.4: Total welfare - initial endowments increase



Additional assumptions, default values of parameters, and optimization problems of consumers are the same as in 4.5. There is a new parameter α in the fixed part of the production function of firm I.

4.6.1 Firm I produces both d and f

Firm I's production functions

$$y_{Id} = (7\hat{i}^2 + 3\alpha)^{\frac{1}{3}} \quad (4.42)$$

$$y_{If} = (\hat{i})^{\frac{1}{2}} \quad (4.43)$$

Firm I's cost function

$$C_I = p_i\hat{i} + p_i\hat{i} \quad (4.44)$$

Firm II's production function

$$y_{II}f = (3\hat{e}^2 + 0.007)^{\frac{1}{3}} \quad (4.45)$$

Firm II's cost function

$$C_{II} = p_e\hat{e} \quad (4.46)$$

Market clearing conditions

$$d_A + d_B = y_{Id} + \bar{d} \quad (4.47)$$

$$f_A + f_B = y_{If} + y_{II}f \quad (4.48)$$

Solution:

With consumers maximizing utility and firms maximizing profits we get a system of nonlinear equations, which is solved numerically for different values of parameter α .

4.6.2 Firm I does not produce f

Firm I's production function

$$y_{Id} = (7\hat{i}^2 + 3\alpha)^{\frac{1}{3}} \quad (4.49)$$

Firm I's cost function

$$C_I = p_i \hat{i} \quad (4.50)$$

Firm II's production function

$$y_{II_f} = (3\hat{e}^2 + 0.007)^{\frac{1}{3}} \quad (4.51)$$

Firm II's cost function

$$C_{II} = p_e \hat{e} \quad (4.52)$$

Market clearing conditions

$$d_A + d_B = y_{Id} + \bar{d} \quad (4.53)$$

$$f_A + f_B = y_{II_f} \quad (4.54)$$

Solution:

The same as in 4.6.1.

4.6.3 Results

In Figure 4.5 we can see that for some values of α the total welfare is lower if firm I is allowed to produce fire (f). More generally, it shows that there can exist a situation where it is better for consumers (and thus for the economy, because in the models, the consumers are the only owners of the firms) if some firm has less opportunities, which is quite surprising and raises doubts whether the numerical results are correct. But still, even if there were imprecisions and the resulting equilibrium did not satisfy the system of equations, it could be argued that neither in reality an economy exactly satisfies any system of equations and if the results are close to an equilibrium, the economy might well stay in it, or will not move much far from it, and the same argument is in case there are more equilibrium points. It is interesting to realize that there are also equilibrium points in the complex space, which can be seen as equilibriums with some additional imaginary variable, which is zero for the equilibriums in the real space and represents some important factor not included in the system of equations (Perhaps another kind of advertising!).

The supposed explanation of lower total welfare when firm I uses \hat{i} was that firm II then produces too little fire from its input \hat{e} . However, Figure 4.6 shows that \hat{e} is actually higher for that case. An explanation is that low value of parameter α discourages firm I from using \hat{i} (see Figure 4.7).

Figure 4.7 also shows that there are probably more equilibrium points, because the gray point for $\alpha = 0.5$ is elsewhere than would be expected, which, however, does not mean that some of the points are not equilibrium points.

If instead of having the parameter α in the production function of firm I (eq. 4.49) the same is examined for firm II (eq. 4.6.2), results show only a small difference between the situation with \hat{i} and the situation without \hat{i} .

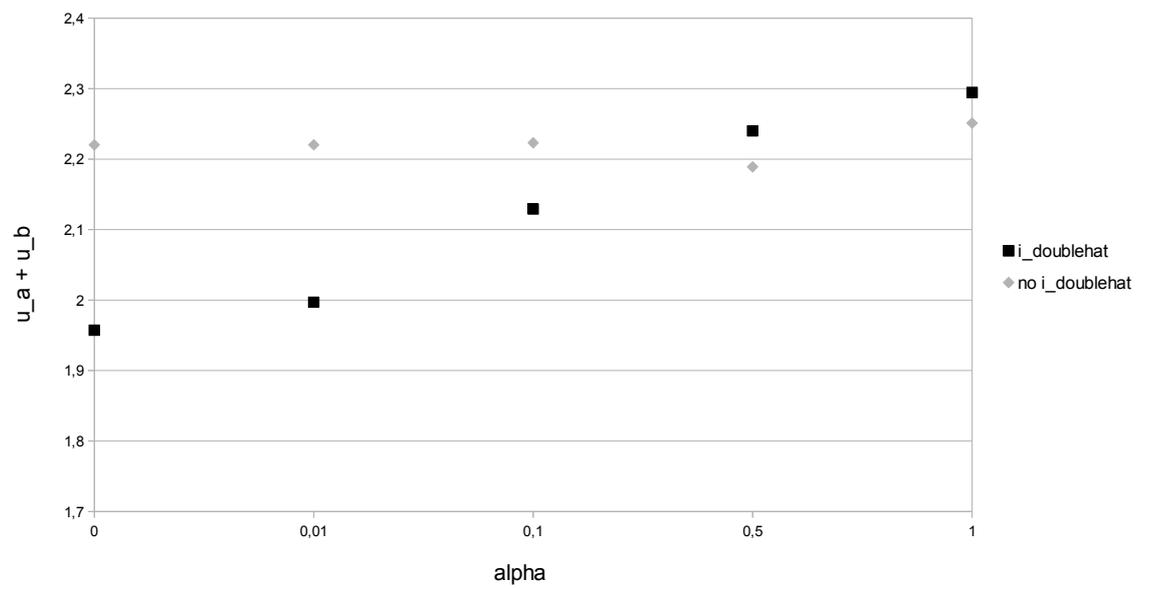
Figure 4.5: Total welfare - change of α 

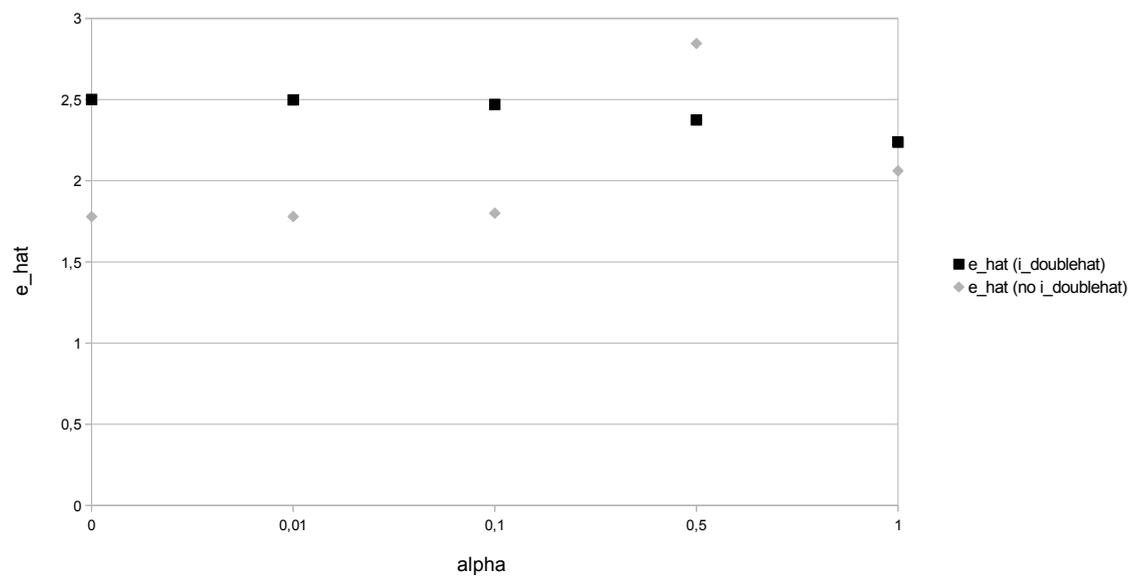
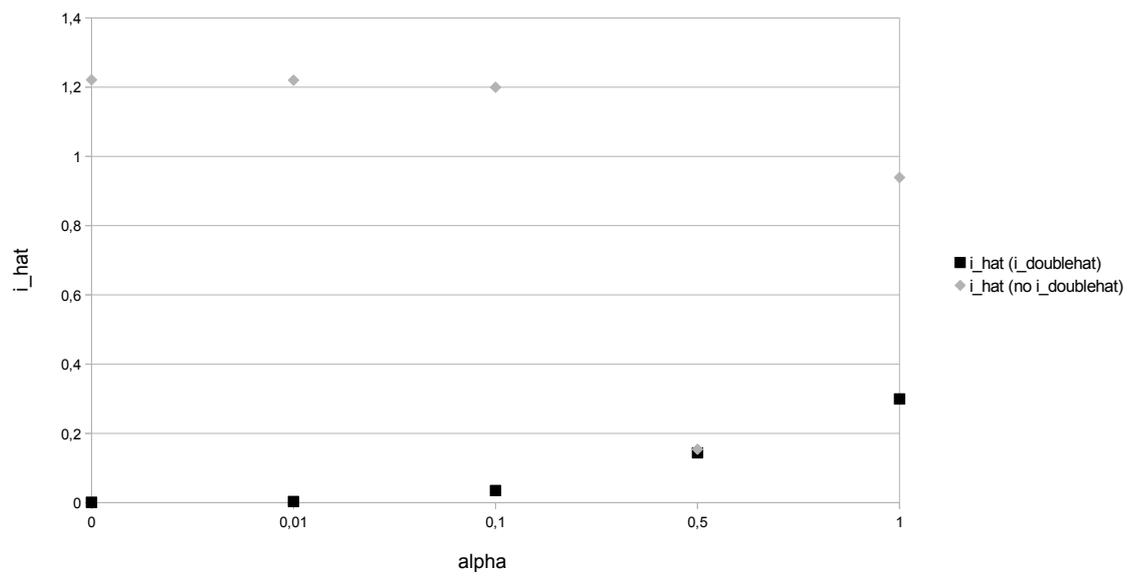
Figure 4.6: \hat{e} - change of α 

Figure 4.7: \hat{i} - change of α 

Chapter 5

Model 2x1

The previous models can be thought of as models of advertising, but they are more general because the goods of those models can be any two goods that are complements. They also do not capture some important properties of advertising such as: consumers do not pay for advertising, they do not choose between an advertisement and a common good as if they were of the same type of good, and they usually receive the advertisement before they receive the other good. This is taken into consideration in the following model.

Compared to the previous models, there is instead of two consumers only one (whose utility function can be understood also as the aggregate demand), the utility and production functions are different, and profits are not gained by the consumer (for example, it can be when the consumer represents those consumers that are not owners of any firms, or when the firms of the model are foreign-owned firms). Firm II has in this case a possibility to advertise, but in a different way than firm I did in chapter 4. An advertisement is produced (so it appears in the market clearing equation for f -fire), but firm II does not receive any profit from it (it appears in its profit function only as a cost). Why then would firm II want to produce the advertisement? Because it is able to influence the price of d -wood, which in equilibrium depends on the level of the advertisement. It is the same situation as with the Stackelberg leader: other players in the market are not able to negotiate about the amount of an advertisement once it is seen (consumed) by consumers. Firm II takes the reaction function of the other firm and the reaction function of the consumer as given, and tries to increase the price of d , which is its primary product, by production of the advertisement f .

Other assumptions and values of parameters are the same as in the previous models.

5.1 Equations

Consumer's (or the aggregate) utility function

$$u(d, w, i, e, f) = (d)(wie + f) \quad (5.1)$$

Note: As in chapter 4, $w = i = e = 1$.

Firm I's production function

$$y_{If} = 7\hat{d} \quad (5.2)$$

Firm I's cost function

$$C_I = p_d \hat{d}^2 \quad (5.3)$$

Firm II's production functions

$$y_{II d} = 7\sqrt{\hat{w}} \quad (5.4)$$

$$y_{II f} = \hat{i}^{\frac{1}{4}} \quad (5.5)$$

Firm II's cost function

$$C_{II} = \frac{1}{2}\hat{w} + p_i \hat{i} \quad (5.6)$$

5.1.1 Firm II advertises

Optimization problem for the consumer

$$\max_{d,e} d(1+f). \quad (5.7)$$

Optimization problem for firm I

$$\max_{\hat{d}} p_f 7\hat{d} - p_d \hat{d}^2. \quad (5.8)$$

Optimization problem for firm II

$$\max_{\hat{w}, \hat{i}} 7\sqrt{\hat{w}}pd - \frac{1}{2}\hat{w} - p_i \hat{i}, \quad (5.9)$$

where

$$p_d = \frac{-8\hat{i}^{\frac{1}{4}} + 4\sqrt{4\sqrt{\hat{i}} + 4\hat{i}^{\frac{1}{4}} + 196\bar{d} + 1 - 49\bar{d} - 4}}{4802} \quad (5.10)$$

This equation incorporates all equilibrium conditions except for the one for firm II's production of f from \hat{i} , and it also incorporates the market clearing conditions. Firm II has the advantage of being a leader and maximizes its profit with respect to \hat{i} given all other conditions, including the condition of its own production of d , for which it has not the leader-advantage.

Market clearing conditions

$$d = \bar{d} + y_{II}d \quad (5.11)$$

$$f = y_{If} + \hat{i}^{\frac{1}{4}} \quad (5.12)$$

5.1.2 Firm II does not advertise

Optimization problem for the consumer is the same as in 5.1.1.

Optimization problem for firm I

$$\max_{\hat{d}} p_f 7\hat{d} - p_d \hat{d}^2. \quad (5.13)$$

Optimization problem for firm II

$$\max_{\hat{w}} p d 7\sqrt{\hat{w}} - \frac{1}{2}\hat{w}, \quad (5.14)$$

Market clearing conditions

$$d = \bar{d} + y_{II} d \quad (5.15)$$

$$f = y_{If}. \quad (5.16)$$

Solution:

The system of equations is solved numerically for different values of \hat{i} with parameters set to:

$$\bar{d} = \frac{1}{10}$$

and

$$p_i = \frac{1}{1000}.$$

5.1.3 Results

The result of this analysis is completely opposite than expected: as Figure 5.1 shows, p_d is actually a declining function of \hat{i} , with the limit

$$\lim_{\hat{i} \rightarrow +\infty} p_d(\hat{i}) = -\frac{\bar{d}}{98}. \quad (5.17)$$

A profit-maximizing firm is therefore not motivated to produce the kind of advertising described at the beginning of this chapter. Figure 5.2 shows, how its profit declines if it advertises. The consumer, on the other hand, benefits from the increased advertising, as can be seen in Figure 5.3.

This model does not take into account opportunity costs that arise for consumers when they consume the advertisements, and that advertisements for two competitive products often overlap, so the result should not be understood as in favor of advertising. The primary interest was whether firms find it profitable to change consumers' tastes instead of producing its main product and the impact of this on the total welfare, and here we see that firm II does not find changing of the consumer's tastes profitable and that the change increases the total welfare, but only slightly, by less percent than is the decrease of profit of firm II (absolute comparison is impossible because the model does not use any real data). The model suggests that advertising, excluding any of its side effects that the model does not take into account, should not be used by firms, because it is not profitable for them, and that consumers can only gain from it.

We also asked the question to what extent is consumers' behavior determined by advertising (3.2). The answer is:

It can be seen on the utility function that if there is no advertising ($\hat{i} = 0$) or if good f is not produced at all, the consumer will less prefer good d . So production of good f , which is an advertisement for good d (even if produced by firm II as a standard good), is a force in the economy, which changes the consumer's tastes, and it would be the same for any good that is a complement and at the same time brings some positive utility to the consumer. It does not make sense to mathematically analyze the extent to which it does, because there are so many factors that influence it, and it is more a question for a sociologist or for a medial analyst.

Figure 5.1: Model 2x1 - advertising and price

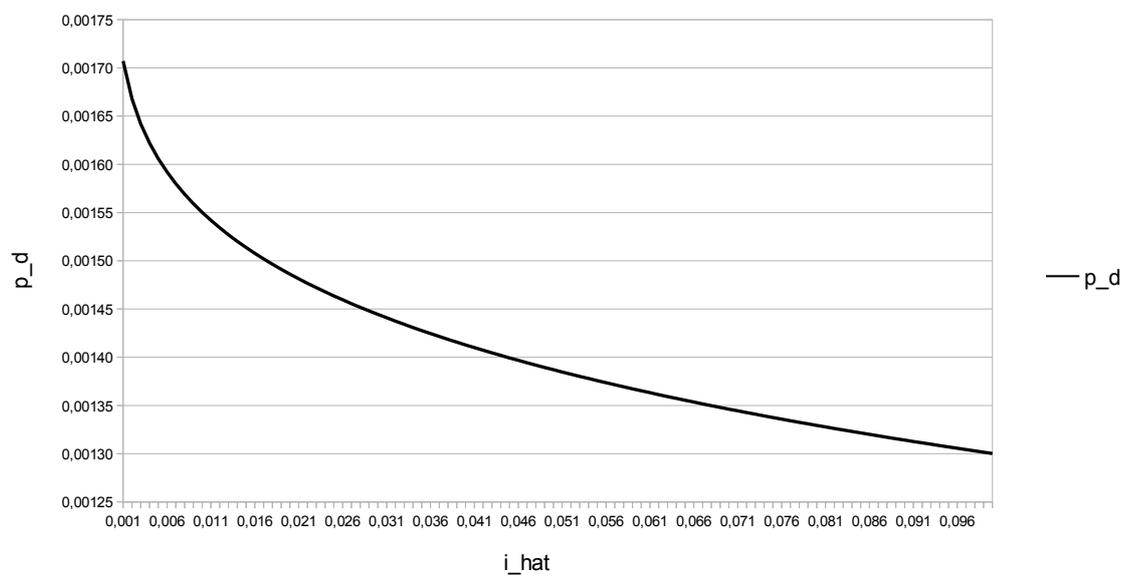


Figure 5.2: Model 2x1 - advertising and total welfare

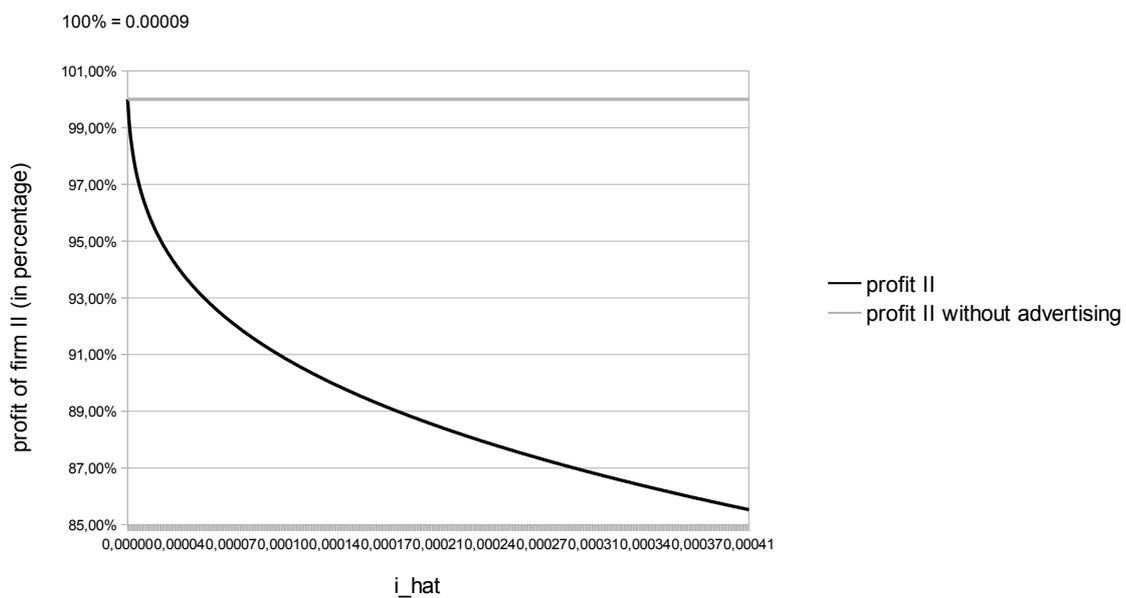
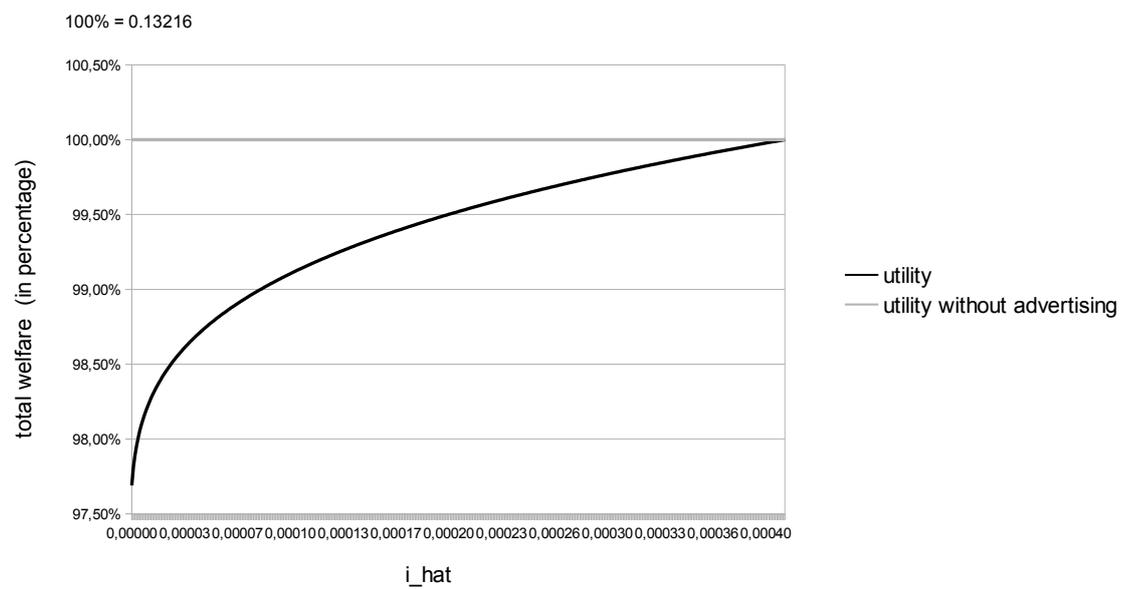


Figure 5.3: Model 2x1 - advertising and total welfare



Chapter 6

Conclusion

The last chapter summarizes findings of the first three chapters and results of the mathematical analysis.

6.1 Summary of chapters 1, 2, and 3

The first chapter (1) defined what is meant by advertising and that the topic of the thesis is persuasive advertising in a broad sense (that is, including all information that change consumers' tastes).

The second chapter states that persuasive advertising is a market failure, because it changes consumers' tastes, which means firstly a needless use of resources and secondly it disrupts the consumers' sovereignty, particularly the freedom of choice. Even though statistically advertising creates a small part of the economy, its impact on the demand side of the economy is much bigger, especially in a rich society (2.1).

Section 2.2 explains an analogy between a consumer and a computer, which is useful to understand how advertising affects consumers. This analogy is particularly convenient today, when people use computers very often.

The third chapter (3) is concerned with putting advertising in the context of microeconomics and with justification of the approach taken by the thesis. It argues that advertising should be added to utility and profit functions so that it is taken into account that preferences of consumers can change and that this change is initiated by firms and by consumers themselves. For this it is convenient to regard advertising as a good complementary to the good that is advertised (see 3.1). It is discussed whether consumption of a good is an advertisement for its consumption in the future.

Section 3.2 explains why the microeconomic assumption that individual agents pursue their private interests may not be realistic. A microeconomic model can be improved by considering the cause of what is wanted by a consumer, and the cause is advertising. A consumer who is living in a space of real numbers can attain higher utility and is less easily influenced by an advertisement than a consumer who lives in a space of natural numbers (see also 2.2).

Advertising always has an effect, because of the “cognitive dissonance” phenomenon (see 3.3).

Models of this thesis are close to models of Becker (1996) and Becker & Murphy (1993), where the utility of consumption goods depends on the amount of advertisement goods that a consumer has consumed (see 3.4).

Section 3.5 describes the Cobb-Douglas function, which is the most suitable function for a model of advertising (see also the graph in section 4.4).

6.2 Results of chapters 4 and 5

In chapter four, there are two models that, however meant to be models of advertising, can be understood as models of any goods that are complementary to each other. Vice versa, advertising can be defined as a good complementary to the good that it advertises. Advertising in the narrow sense (how it is usually understood) does not have to be complementary in the opposite direction - a good is not an advertisement for its advertisement, which is taken into consideration in chapter five.

If there are two consumers in the model, the evaluation of the total welfare is always done simply by adding their utilities together, which is justified by the possibility of redistribution that is preferred by both.

In each model there are two firms, one of which can advertise. In chapter four they are owned by consumers, and in chapter five they are not (they are foreign or owned by some other consumers).

There are five goods in the economy. To emphasize the universal meaning of the word “advertising”, the five goods are: wood, water, iron, earth, and fire. It is not so important how the goods are called, the only important thing is that each of them is complementary to the other four.

The first model of chapter four, where firms produce with constant returns

to scale, provides no argument against advertising, because if the firm produces it, then it increases the total welfare of the consumers (see 4.5.3). However, the model suggests that there might be forces that push the firms to a stationary point, where they produce inefficient amount of goods, because due to the uncertainty of future prices, the firms do not know whether each unit they produce will be a profit or a loss (see 4.5.1). Because there are no financial markets in the model, the firms can eliminate risk only by staying at the stationary point. In a model with financial markets, the firms would hedge against the risk and produce efficiently.

The second model of chapter four, where firms produce with a convex-concave production function, supposes that advertising of firm I will crowd out fire (a good, which is produced by firm II and at the same time is an advertisement produced by firm I) produced by firm II, which then will not attain the point, where its production is the most efficient. For some values of parameters, it is really the case that the total welfare (sum of utilities of consumers A and B) is lower if firm I is allowed to produce an advertisement good (eq. 4.43), which proves that there can exist a situation where it is better for consumers if some firm has less opportunities (Figure 4.5). Because the consumers are the only owners of the firms, it is better for the whole economy. However, the explanation is different than supposed: firm II's production of fire is not crowded out, it is actually higher (Figure 4.6), but what becomes lower is firm I's production of its own primary good (Figure 4.7).

The model of chapter five is closer to how advertising is understood in the narrow sense: consumers do not pay for advertising in this model, and they receive it before markets for goods are cleared. Firm II, which advertises, is in a position similar to that of a Stackelberg leader: it takes reaction functions of the other firm and of the consumer as given and tries to increase the price of its primary product by production of an advertisement. The advantage showed up to be uninteresting for firm II (Figure 5.2), and a representative consumer can only gain if the firm will use it anyway. If there is no redistribution of wealth between the firm and the consumer, the firm does not find it profitable to advertise, and there are moreover some factors against advertising that the model does not take into account (opportunity costs for consumers when watching an advertisement, advertisements for two competitive products often overlap). The utility function of this model also shows that the mere existence of a complementary good (of which an advertisement is a typical case) changes the consumer's tastes, if the good brings some positive utility to the consumer.

Bibliography

BECKER, G. S. (1996): *Accounting for Tastes*. Harvard University Press. ISBN: 9780674543577.

BECKER, G. S. & K. M. MURPHY (1988): "A theory of rational addiction." *Journal of Political Economy*, Vol. 96, No. 4, pp. 675-700.

BECKER, G. S. & K. M. MURPHY (1993): "Simple theory of advertising as a good or bad." *The Quarterly Journal of Economics*, Vol. 108, No.4, 941-964.

ENGLIŠ, K. (1992): *Věčné ideály lidstva*. Vyšehrad. ISBN: 9788070211137.

FESTINGER, L. (1957): *A Theory of Cognitive Dissonance*. Stanford University Press. ISBN: 9780804709118.

GALBRAITH, J. K. (1967): *Společnost hojnosti*. Svoboda.

KALDOR, N. (1950): "The economic aspects of advertising." *The Review of Economic Studies*, Vol. 18, No. 1, pp. 1-27.

MARSHALL, A. (1890): "Principles of economics: An introductory volume." Published later in London: Macmillan & Co., Ltd., 1920.

MAS-COLELL, WHINSTON, & GREEN (2005): *Microeconomic Theory*. Oxford University Press. ISBN: 9780195073409.

NERLOVE, M. & K. J. ARROW (1962): "Optimal advertising policy under dynamic conditions." *Economica*, New Series, Vol. 29, No. 114, pp. 129-142.