Taxing value added in the financial sector

An input-output approach and effects of the Norwegian FAT

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Master of Economic Theory and Econometrics

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Abstract

In my thesis I illuminate the effects on social welfare created by the introduction of a financial activity tax (FAT) on financial services. Many financial services are exempt from value added tax (VAT). Even though it may be wanted, there are technical difficulties in implementing a VAT on these services. In order to make up for the missing taxation, a FAT was introduced on financial services in Norway January 1 2017. The Norwegian FAT is a 5 % tax on wages and an additional 1 % on corporate income tax rate. Such a tax effects consumer prices and the government tax revenue. Taken together, these two factors are treated as social welfare.

To what degree does FAT make up for missing VAT when comparing to a neutral tax regime? Using a theoretical presentation of an input-output analysis, I highlight the distortionary effects on welfare caused by either regime. A VAT gives a too low consumer price of financial services, but cascading of taxes gives a too high price of commodities produced using financial services as inputs. Alternatively, a FAT increases the price for final consumers of financial services, but it does not solve the problem with tax-cascading.

In the empirical analysis I interpret output from model simulations done by using the MSG6-model to look at effects of a FAT on consumer prices. To incorporate a FAT in the MSG6-model, the user price of capital is increased by the same amount as the loan interest rate has to be increased in order to keep the interest margin constant when the payroll tax increase.

The effects on consumer prices are results of full pass through, and changes in spending are results of price increases and that the additional tax revenue is distributed using lump-sum transfers. Modest increases in consumer prices and reductions in consumption of most goods are observed. The larger the dependence of capital as input in production, the larger is the price increase. Price of food, non-alcoholic beverages, consumption of own means of transport increases with respectively 0.0276 %, 0.0352 % and 0.0322 %, and a reduction in spending is observed. The largest price increase is in consumption of housing, with almost 0.29 %, which may be economically efficient because of a previously rather low taxation compared to other investment opportunities. The effect on social welfare depend on consumers’ valuation of their reallocated consumption bundle compared to the initial spending in the reference scenario. The tax will in addition reduce some of the risk posed on the economy by the financial sector.
Preface

This thesis was written as a completion of the Master of Economic Theory and Econometrics at the Department of Economics at the University of Oslo.

First of all, I have to thank my supervisor Vidar Christiansen for excellent guidance and helpful feedback throughout the writing process. I also want to thank Oslo Fiscal Studies (OFS) for granting me with one of their generous scholarships and for providing me with a workspace. Also, to Geir H. Bjertnæs at Statistics Norway, thank you for producing the MSG6 model simulations I use in my thesis. To my family, thank you for always inspiring and encouraging me. And finally, I have to thank Blend Hussaini, for your endless support and motivation. I truly am grateful.

Any remaining mistakes are my responsibility.

Cathrine Sørensen

May 2017
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1 Introduction

A lot of financial services are VAT-exempt. The main reason for this exemption has been the difficulties in defining a tax base for the value added for these services. Such a VAT-treatment distorts relative prices. Production and private consumption of financial services face a tax-advantage, whereas business-use faces a tax-disadvantage. Many have pointed out that the financial sector has grown too large due to the VAT-exemption (Keen (2011), Finanskriselutvalget). Finanskriselutvalget observed weaknesses concerning the huge amount of risk and unbalances in the financial sector in the aftermath of the financial crisis that broke out in 2008. One contributory factor pointed out was the VAT-exemption of financial services, and the concentration of risk and unbalances argue for a behavior corrective tax treatment. The VAT-exemption and the question of whether the financial services indeed should be taxed are highly discussed subjects in the literature. Some point out that financial services are not objects of utility, and should therefore not be taxed (Grubert and Mackie (2000)). Others try to find an efficient way to tax financial services (Boadway and Keen (2003), Jack (2000), Huizinga (2002)), while some argue that VAT should apply to financial services in the same manner as on other commodities (Auerbach and Gordon (2002)).

The aim of my thesis is to look at the effects the financial activity tax will have on social welfare, where the social welfare is expressed as the sum of indirect utility of prices and the value of government tax revenue. Using a simple theoretical model I compare this result to the case of VAT-exemption, in order to point out the distortionary effects created by the previously tax treatment of financial services. A neutral tax regime is used as illustration of a desired tax treatment in order to highlight the distortionary effects.

A financial activity tax was introduced by the Norwegian Parliament January 1 2017. Using wages and corporate income as proxies for the value added in the financial sector, the purpose of the tax is to correct for the missing VAT and to counteract distortions caused by the VAT-exemption of financial services.

I use the framework of an input-output analysis presented by Tore Thonstad in his book Krysslopsanalyse (Thonstad, 1975). Using an input-output analysis, the interaction of businesses across sectors is taken into account. The framework shows the spillover of taxes

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1 NOU 2011: 1, ch. 1.2.4.
into commodity prices through the demand for intermediate-inputs between sectors, making it possible to observe the final prices faced by consumers after a tax reform. I use this framework to highlight the effects of welfare created by the two different tax regimes when moving from a neutral regime, in order to illuminate the differences between the tax treatments, and to further look at to what degree the FAT solves the distortionary effects created by a VAT-exemption.

The input-output structure is important in the MSG6-model used in the empirical analysis. The MSG6-model with changed parameters is used to simulate consumer effects of a new tax reform. Adding a proxy for the FAT into the model, model simulations give results on the change in consumer prices. To incorporate the FAT into the model, the user price of capital is increased with the same amount that the loan interest rate have to increase to keep the interest margin constant when the payroll tax in the financial sector increases with 5 %-age points. I interpret and discuss results obtained from MSG6 model simulations.

I start the thesis by looking at the tax system, how taxes are used, and the tradeoffs the government faces when trying to implement an optimal tax system. Then I explain the structure of the value added tax system, before further pointing at the problems that arise when a commodity or a service is exempt from VAT. This works as an introduction to the discussion regarding taxation of financial services, before the framework of the financial activity tax is described. Chapter 3 describes the structure and strengths of the input-output method, including the use of this method in the national account. The chapter is round of by an example showing the distortionary effects created by a both a VAT-exemption of financial services and a FAT on financial services. Moreover, we can see the effects of a tax reform on consumer prices and the value of government tax revenue. Chapter 4 introduces the framework of the empirical analysis of the introduction of a FAT on financial services. I describe the MSG6-model and give a brief explanation of the reference scenario, before the reform scenario is explained. Chapter 5 gives an analysis and discussion of the results from the model simulations, in addition to a discussion of possible effects outside the model. Chapter 6 summarizes and concludes.
2 Taxes and the tax system

In this chapter I briefly mention different purposes of taxes, what is meant by efficiency of taxes and problems that arise when trying to design an efficient tax system. In chapter 2.2 I explain the design of the VAT before presenting a discussion about an efficient VAT-system and an example of this. Since the purpose of this thesis is to address the problems related to taxation of financial services, I use a simple example to point out the inefficiencies that led to the introduction of a new tax system. I do so, as well as presenting some conflicting opinions from the literature regarding taxation of financial services. Chapter 2.3 describes the design of the FAT introduced in Norway.

2.1 Taxes

The tax system consists of direct- and indirect taxes that are set by the government for one year at a time. Direct taxes include tax on labor and capital income and payroll taxes, while indirect taxes consist of value added tax and excise duties. Direct taxes are meant to be paid by the person it is levied on, whereas the indirect taxes make a producer raise the price of some product, creating a spillover effect making the consumer pay the tax. The main purposes of taxation are i) to finance public spending, investments and transfers ii) redistribute income, and iii) correct for market failures.

The government wishes to raise tax revenue in a way that minimizes the efficiency loss created after a tax is introduced. A tax raises the price of some good, which may result in changed behavior for consumers and producers. These changes may not be optimal from an efficiency point of view. Because of possible adverse effects of taxes, the tax system is designed to first of all try to implement an optimal allocation through an efficient use of resources. Thereafter, taxes should be neutral, meaning that the government is able to raise tax revenue without distorting production and consumption composition.

A lump-sum tax is an example of a neutral tax, since it does not affect the effectivity in the market. Lump-sum taxes affect the purchasing power, but the marginal tradeoffs are unchanged. The optimal allocation of resources is therefore undistorted. Since it is not always
possible to secure the neutrality of taxes, the government can use distortionary taxes in order to collect the amount of tax revenue needed.²

**Efficiency of taxes**

Most taxes are distortionary. Taxes create a tax wedge between the price faced by producers and the price paid by consumers. When marginal cost does not equal marginal willingness to pay, the price a consumer has to pay is higher than the real cost of producing this unit when a tax is introduced. The tax wedge implies that labor-, investment-, and resource use decisions are affected by the taxes and not only by economical profitability. When so, an efficiency loss is created because the resource allocation is distorted.

According to economic theory, the efficiency loss is larger than a proportional increase due to the tax. It is therefore more preferable to have a large tax base with relatively lower tax rates than a small tax base that is taxed at a higher level. For instance, the introduction of a commodity tax will first increase the price of the commodity. Moreover, the price increase results in a lower demand, which in turn reduces the quantity produced. Price elasticities determine how large the effects of a tax are.

Taxes should be levied on activities where the quantity reactions are the smallest, meaning that commodities that are least sensitive to price changes can be taxed at a higher level. How the tax system is designed and how different parts of the economy are taxed, is therefore important to minimize tax wedges.

The government has two concerns when implementing a tax: efficiency and distribution. The government has to look at how a tax affects both the total value added and the distribution of the value added. An economically efficient use of resources requires efficiency in production and consumption, and efficiency in the composition between these. If these assumptions hold, it is not possible to redistribute in a way that will increase production or make consumers more satisfied without negatively affecting other agents in the economy. Efficiency therefore implies that all resources are used where they yield the largest return to the society. In the same way that the tax revenue should be used to distribute income, the tax system should be designed so that the welfare of resources is evenly distributed. Hence, after-tax inequality

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² NOU 2008: 7, ch. 4
should be smaller than before-tax inequality. This is not only affected by the true after-tax income, but also by the share of income needed for different expenditures.

Duties are difficult to implement based on distribution only, since they are not established based on persons’ personal income. A differentiation of taxes based on classification of low income and high income commodities is a possible solution, or else the use of direct taxes or transfers.

Another task for the tax system is to correct for externalities. An externality is a market failure, since the use or the production of some good imposes an extra cost on society, a cost that is not taken account for in the price. A tax can therefore be used to internalize the cost, or reduce the production or consumption of that good. Environmental taxes and tax on tobacco and alcohol are examples of excise duties used to change people’s behavior.

2.2 Value added tax

A value added tax is an indirect tax levied on domestic consumption of goods and services. The system was introduced in Norway in 1970, and had a reform in 2001 when services became part of the system. The tax is levied on VAT-registered companies, but paid by final consumers because of spillovers of tax into commodity prices. In that way, VAT becomes a tax on consumption rather than on production. VAT-registered companies charges VAT for the value of their sold products, but receive a refund for the VAT paid on intermediate inputs. Thus, a company’s tax base is only the value added by the company itself.

The VAT-system is based on the destination principle, meaning that the tax should be paid to the country where the commodity is used, independent of where it is produced. Goods imported and goods produced domestically are thus treated equally. The revenue from VAT accounts for about 20 % of the total tax revenue in Norway, and is therefore the main contributor of the indirect taxes to the tax revenue.3 The purpose of VAT is mainly to collect tax revenue to the government, when both efficiency and distributional concerns are taken into account.

In Norway, as in most other countries, the VAT-system is differentiated. The general VAT in Norway is 25 %, but some goods and services, for instance food and public transport, are

3 NOU 2014: 13, ch. 2.2
subjected to reduced rates. Books, newspapers and electrical cars are examples of goods and services that are subjected to a zero tax rate. Zero-rates implies that no VAT is levied on the price, but VAT-refunds on acquisitions to the production are still given. Other services, like education, health services and financial services are totally VAT-exempt. An exemption implies no VAT on final product, and no refunds of VAT paid on inputs.

Efficiency of the VAT-system

It has been debated whether a general VAT on all goods and services or a differentiated VAT system is the most efficient. A general VAT-rate that includes all goods and services will not affect the composition of production or consumption since relative prices are unchanged, making the neutrality principle hold. In addition, one general VAT-rate would reduce the administrative costs, and no resources will be wasted through rent-seeking. The intertemporal allocation of consumption is undistorted when holding the tax rate constant over time.

On the other hand, a VAT distorts the labor decision. VAT makes it more attractive to consume leisure, since the tax makes leisure relatively cheaper than consumption of goods. A differentiation of VAT may be used to counteract the distortion of labor supply. Since a consumption tax distorts the labor decision by making leisure relatively cheaper than consumption of goods, taxing commodities that is associated with leisure at a higher rate than other goods internalizes these distortions. If it is the case that people with high income consume more commodities complementary with leisure than others, a higher VAT on such commodities would in addition to alleviate the labor supply distortion have a distributional effect.

Economic theory says that when commodities are close substitutes, the differentiation of taxes should be low. The reason for this is that a differentiation of the tax rates causes substitution effects that distort the consumption bundle. Substitution effects are larger when there exist close substitutes that become relatively cheaper after the introduction of a tax. A different tax treatment of close substitutes make consumers demand the good subjected to the lowest tax rate. Taxes change the relative price level, making the good taxed at the higher level

4 A general VAT on all goods and services removes the possibility of trying to obtain exemptions or exceptions from VAT.
relatively, maybe also absolutely, more expensive. Hence, the consumption bundle is distorted.

This reasoning also counts for a higher tax on commodities without close substitutes. Taxing commodities with inelastic demand at a high level, will to a smaller extent affect the demand for those commodities than for commodities with a relatively more elastic demand. The tax will be levied on consumers rather than split between consumers and producers.5

It has been argued that the differentiation of the VAT-system is not reasonable when it comes to distributional concerns, since direct taxes give larger opportunities to redistribute income. Even though there might exist other ways to implement a tax system that secures redistribution to a larger extent, it would cause large practical problems. A differentiation would for instance require high administrative costs, and it is not sure that the gain will be noticeable.

A simple example of value added tax

VAT-registered companies charge VAT on the goods they sell, and receive refunds for the VAT paid on their inputs. When buying inputs to use in production, the price a company pays contains VAT. Thereafter, when the company sells its final product, it charges VAT on top of the price. The VAT liability of the company is the difference, since the VAT-charge on inputs is deducted.

Even though it is the companies who have the VAT-liability, final users of a good or a service end up paying the tax. Companies transfers the VAT into the price of their sold products. This can be shown using a simple example. Suppose we have three companies that produce some good that is sold as input or to final consumers. Company 1 sells to consumers and input to company 2, and company 2 sells to consumers and input to company 3. Company 3 only sells to final consumers. The VAT rate is 25%.

5 When a tax is levied on goods with elastic demand, consumers will reduce their demand. Producers are therefore also affected by the tax. Quantity is unaffected when demand is inelastic, so consumers pay the tax.
**Figure 1:** Illustration of the value added tax system

<table>
<thead>
<tr>
<th>Company 1</th>
<th>Company 2</th>
<th>Company 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer price: 200 NOK</td>
<td>Value added: 100</td>
<td>Value added: 100</td>
</tr>
<tr>
<td>Selling price: 200x1.25 = 250 NOK</td>
<td>Selling price: 300x1.25 = 375 NOK</td>
<td>Selling price: 400x1.25 = 500 NOK</td>
</tr>
<tr>
<td>VAT payment: 50 NOK</td>
<td>VAT charge: 75 NOK</td>
<td>VAT charge: 100</td>
</tr>
<tr>
<td>Refund: 50 NOK</td>
<td>Refund: 75 NOK</td>
<td></td>
</tr>
<tr>
<td>VAT payment: 25 NOK</td>
<td>VAT payment: 25 NOK</td>
<td></td>
</tr>
</tbody>
</table>

The value added tax is a consumption tax that is levied on the value added to a commodity in each stage of the production or trade in the supply of goods. Each producer is obliged to pay a VAT on their value added, but the final consumer ends up paying the VAT on the total value of the commodity. As seen in figure 1, each company have a VAT-payment they have to pay to the authorities, but this payment is transferred into the selling price. Total VAT paid to the government is 100 NOK. Relative prices are undistorted.

**Problems with missing VAT on financial services**

Most financial services are in Norway exempt from VAT, and were left untaxed until 2017. After the financial crisis broke out in 2008, a selection of professionals, *Finanskriseutvalget*, were selected to prepare an examination of the Norwegian financial market. Weaknesses concerning the huge amount of risk and unbalances in the financial sector were observed. Among other factors, the VAT-exemption of financial services was mentioned as a problem. The exemption concerns insurance, payment methods, currency transactions, turnover of company holdings, money transfers, etc. The VAT-exemption allowed the financial sector to grow larger than what is optimal, and the risk each agent put on the society was not reflected through the prices they paid.

\[
\frac{P_i}{P_j} = \frac{(1+\tau)P_i}{(1+\tau)P_j}
\]
A problem with the VAT-exemption of financial services is that the production and the private consumption of financial services enjoy a tax-advantage, at the same time as productive uses face a tax-disadvantage. According to economic theory, exemption of one sector results in an inefficiently high use of these goods and services because relative prices are distorted. The tax-disadvantage for productive uses stems from the missing VAT-deductions when no VAT is received. This leads to cascading of taxes, resulting in a double taxation of commodities produced by companies using inputs that are exempt from VAT in their production. We can look at the same example as above, but now sector 2 is exempt from VAT.

**Figure 2:** Illustration of the value added tax system if one company is VAT-exempt

<table>
<thead>
<tr>
<th>Company 1</th>
<th>Company 2</th>
<th>Company 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer price: 200 NOK</td>
<td>Value added: 100</td>
<td>Value added: 100</td>
</tr>
<tr>
<td>Selling price: 200x1.25 = 250</td>
<td>Selling price: 350 NOK</td>
<td>Selling price: 450x1.25 = 562.50 NOK</td>
</tr>
<tr>
<td>Pays: 50 NOK in VAT</td>
<td>VAT-charge: 0</td>
<td>VAT-charge: 162.50</td>
</tr>
<tr>
<td>Refund: 0 NOK</td>
<td>Refund: 0 NOK</td>
<td>Refund: 0 NOK</td>
</tr>
<tr>
<td>Pays: 0 NOK in VAT</td>
<td>Pays: 162.50 NOK in VAT</td>
<td></td>
</tr>
</tbody>
</table>

When company 2 is VAT-exempt, the missing VAT gives a lower price for final consumers compared to the previous case. On the other hand, company 3 ends up having a larger VAT-liability because of missing refunds. This results in a higher price of that good. Company 2 is VAT-exempt, meaning that no VAT is levied on the price of final products and the company does not receive deductions for VAT on inputs bought from company 1. When no deductions for VAT are given, VAT from sector 1 is transferred through company 2 to company 3, where it becomes part of the tax base. Cascading of taxes causes a double taxation of company 3 in a way that makes the VAT a tax on production rather than on consumption. The price of company 3 goods increase by more than the VAT on the value added in production, leading to a distortion of relative prices. VAT-revenue to the government amounts to 162,50 NOK.
This example shows how a VAT-exemption of one sector causes inefficiencies. Even though the exemption follows the financial activity and not a company in itself, it has created distortions in both production and consumption. First, it encourages both production and consumption of these services. A relatively lower price for these goods and services implies that the use is larger than optimal. In addition, the lack of refunds for the financial sector make inputs more costly than self-production. This encourages more within-company production that in turn makes the sector grow larger than optimal. Second, missing VAT-refund imposes a higher price of financial services used as inputs, encouraging companies to reduce the use of these services, or substituting financial services by other inputs. These distortions violate the neutrality principle of the VAT-system, since the VAT-exemption distorts relative prices.

The fact that companies producing financial services might have incentives for self-production of otherwise bought inputs, and that financial services sold as inputs to other production might be reduced, creates efficiency costs for the economy as a whole. In 2014, the missing tax revenue because of the VAT-exemption of financial services was estimated to be 8.1 billion NOK, and 8.85 billion NOK in 2016. Calculation of these estimates are on unsure basis.

**Should financial services be taxed?**

The problem with missing VAT on financial services is a complex issue with conflicting results in the literature. Many point out that there should be introduced some regulatory taxes on the financial sector, but that there are issues connected to how such taxes should be designed. What is the value added in the financial sector, and what is the tax base? There are both technical- and administrative difficulties of levying a VAT on the value added by financial institutions. For many financial services there are no explicit price, and it is therefore difficult to define a tax base. For instance, the value added in a business is the value created minus the value of inputs used. When the input is capital that is raised by taking in deposits or by assessing the capital market, it is difficult to define a price. Deposit interest rate differs from the loan interest rate, where the latter includes a risk premium. A risk premium is a cost,

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7 NOU 2014: 13, ch. 9.4. 1.
8 Inst. 4 L (2016-2017), ch. 6.
and should consequentially not be taxed. The difficulty lies in the tax authorities’ ability to determine whether a high interest on a loan reflects a large profit or a large risk premium.

Keen (2011) points out the challenges posed by financial activities, and that in the light of the financial crisis the need for some regulation of the financial sector is crucial. He mentions the missing VAT on financial services as one of the main tax issues public economists would bring up as a problem. Further, the VAT-imperfections give reason to suppose that the financial sector is growing too large. Thus, it is time to rethink the way the financial sector is taxed, and find a way to correct for these inefficiencies. He also asks the question whether one should put neutrality aside to specially target the problems posed by the financial sector.

In Buettner and Erbe (2013) they look at the welfare effects of repealing the VAT-exemption of financial services is Germany. Using an input-output analysis, they look at the effects of repealing the VAT-exemption on consumer demand, intermediate input demand and labor supply. The effects they find turn out to be rather limited, but their results shows a modest welfare gain provided that these tax revenues were used to reduce the VAT-rate or other distortive labor taxes.\(^9\)

When leaving aside the discussion of whether financial services should indeed be taxed, the discussion of how to tax emerges. Financial services differ from each other, and hence the markets for the various services have different properties. Should the taxation of each individual service also differ, or are there ways to implement a uniform VAT that do not create further distortions?

In Auerbach and Gordon (2002), they argue that VAT should apply to resources devoted to financial transactions in the same manner that it does in other sectors. “… all primary inputs that enter into the production of a good should be taxed, is correct even for financial services.” (Auerbach and Gordon, 2002, p. 412).

On the contrary, Grubert and Mackie (2000) rely on the fundamental guiding principle of tax policy design when they state that financial services should be exempt from tax. They stress that only final consumption should be subjected to taxes, whereas intermediate goods should be exempt. Further, they say that many financial services used by consumers are not consumption goods, and should therefore not be taxed under a consumption tax. Investment

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\(^9\) To determine the value added in the financial sector, they use the difference between the deposit- and loan interest rate compared to a benchmark interest rate.
services, loan services and insurance services are intermediate goods that in themselves do not generate any utility, and should therefore be exempt from VAT. Taxing non-consumption goods under a consumption tax distorts the neutrality principle of the tax. What gives utility when e.g. receiving investment advice, is the potential increase in income and not the advices in themselves. Taxation of the investment service leads to a tax on the potential increase in income. Therefore, taxing these kinds of services will distort the intertemporal savings decision, because future consumption is overtaxed.

According to Boadway and Keen (2003) this conclusion is a fallacy. Many taxed goods are not commodities of final utility but still recommended to be taxed. Still, the authors state that it is a half-truth to say that financial services is as any other commodity. A bank, for instance, gives a lower interest to a lender than what the bank itself pays in interests for their loans. According to their model, taxing consumption of financial services and the fee but not the interest rate spread, will make the tax lump-sum. Jack (2000) reaches the same conclusion. He states that the intertemporal decision is undistorted and neutrality achieved if taxing identifiable fixed fees, while leaving the spread-based charges untaxed. The administrative practicability, on the other hand, is another issue.

Huizinga (2002) studies the possibility of repealing the VAT-exemption in the EU, and looks at possible options of doing so and the effects these reforms would have on demand for financial services, VAT-revenue and total welfare. In the light of the distortions created by a VAT-exemption, the author discusses two possible methods to use. These are known as ‘cash-flow method’ and the ‘zero-rating business-use of financial services.’ These methods are two ways of implementing standard VAT on financial services. Even though the methods have different implementation they give basically the same economically result. The aim is to impose a VAT-payment on households and leaving business-users untaxed, while providers of financial services are allowed VAT-credits on their purchased inputs.10 The paper finds that a reform would increase VAT-revenue, eliminate distortions of prices faced by businesses and households, and have a small effect on overall welfare.

VAT is calculated for each individual transaction when using the cash-flow method. It therefore follows the same layout as a standard VAT. The method requires more

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10 Financial institutions need to identify their customers in order to differentiate between business buyers and households. Given the OECD fight against tax evasion and terrorism, the information is to a large extent already available to the providers of financial services.
administration than the zero-rating method that subjects financial institutions to a zero VAT-rate while following the standard VAT-practice. Looking at each individual transaction requires large resources of accounting and information systems, and will consequentially require large costs. Zero-rating violates the standard VAT practice since different buyers are faced with different prices. It may also leave some providers of financial services with a net VAT payment. Taking into account the distortions of a VAT-exemption, the author conclude that zero-rating business-use of financial services while applying regular VAT on services delivered to households would be the method best able to correct for distortions.

Another issue when deciding on how to indirectly tax (VAT) financial services is the presence of direct taxes. Ideally, a lump-sum tax should be used, since we know that such a tax is non-distortitive regarding the consumption bundle. We want to introduce indirect taxes that alone or together with direct taxes behave like lump-sum taxes. I will briefly introduce two cases discussed by Vidar Christiansen in *Indirect Taxation of Financial Services* (Christiansen, 2017) that yield different results regarding the efficiency of a VAT on financial services.

When a consumer, for instance, decides how much to borrow or save, she is faced with a fixed administrative cost and an interest rate. The interest rate she faces includes a spread showing a fixed transaction cost in the banking sector per unit borrowed. Introducing a VAT on fixed costs and interests of financial intermediation saving and borrowing in addition to having an income tax, would yield different effects on the borrowing and saving decision. With deductible interest payments, a VAT on interests will in the borrowing case result in a lower tax payment through the income tax. In case of saving, VAT makes the distortionary effects of an income tax larger.

In the market for insurance, there are two cases I want to address. First, the loss of purchasing power when introducing a VAT on the payment for insurance. Second, a VAT on the insurance premium when a specific good is insured. About the first case, the lack of information regarding which agents end up in the respective states makes it difficult to achieve efficiency in taxes, which would require state contingent taxes. With the aim of not making consumers worse off in either state (not reducing expected utility), exempting insurance from VAT is efficient. A VAT on the payment for insurance distorts relative prices since the consumer gives up more consumption in the good state than what she get back in the bad state. Instead, a VAT on the consumption in the respective states will be efficient. When instead considering a full insurance on a particular good that may be lost, the transaction cost
may be seen as the value added. Taxing this transaction cost with the same rate as the consumption tax is necessary to achieve full neutrality when there is a consumption tax present. The transaction cost is part of the full cost of the good if it is lost, and should therefore be subjected to a VAT.

These two examples show how efficiency may not be achieved when using a general VAT on financial activities. In the case regarding insurance, the different insurance schemes need different consideration in order to achieve neutrality. At the same time, the use of distortionary taxes is accepted to a large degree. As just discussed, whether policy makers think that financial services should be taxed or not, issues regarding how to make an optimal policy design give rise to further considerations.

The main point is that financial services is a heterogenic category, which account for a different tax treatment of various services. I will not further discuss how this may be done. The focus of my thesis will be on the effects of a change in tax treatment of one sector, when taking into account the sequential structure of the VAT-system. Using an input-output model we can see the effect on final prices faced by consumers. This general framework could be used to analyze numerous sectors. In the light of the ongoing discussion and the newly introduced reform in Norway, I have chosen to analyze the effects of introducing a FAT on the production of financial services.

2.3 Financial activity tax

Most direct and indirect taxes cause distortions, but it is in the government’s intentions to collect taxes without affecting the efficiency in the economy in a too great extent. The Norwegian government decided in 2016 to introduce a FAT on financial services from January 1 2017. The purpose of this tax is to correct for the missing VAT from financial services, and to reduce the distortions in production and consumption of these services. Even though the new tax treatment might not be neutral, the changes in the tax system is considered to cause less distortion than the VAT-exemption. The government has decided to introduce taxes on two components that contributes to the value added in the financial sector.

A tax on the activities in the financial sector is ideally a tax on the value added in the financial sector, but without the characteristics of a VAT. I use this definition later, when I in chapter 3.3 introduce a model to accentuate effects caused when introducing a new tax reform.
Because of difficulties in defining value added in the financial sector, different proxies for the value added are used. Consequentially, the design of a FAT takes various forms.

In Norway, the FAT will be an additional tax on wages (5 % in 2017) that is related to production of financial activities. Companies subjected to FAT have to pay a corporate income tax of 25 %. The financial activities are defined in section K “Finansierings- og forsikringsvirksomhet” in the Statistics Norway standard industrial classification. The activity level is defined by the share of wages related to financial activity relative to the total wage costs. Companies with wage costs to employees working (partly or fully) with activities within sector K that exceeds 30 % of the total wage costs, are obliged to pay a tax defined on the whole payroll tax basis. Employers with wage costs related to production of financial services that are subjected to VAT that exceeds 70 %, are exempt from FAT. Companies without any wage costs will consequently be exempt. Many companies are involved in non-economic activities that are seen as economically valuable. In order to not distort such activities, only the wage cost linked to economic activity is part of the tax base.

The tax on wages is calculated in percent based on the basis of the payroll tax basis for the previous year, and it will follow the same rules for calculation, proceedings and collection. In addition, for the companies that are subjected to FAT on wages, the tax on corporate income will be continued on the 2016-level of 25 %, whereas other companies is faced with a reduced tax on 24 %. From 2017 and for businesses registered after January 31 2017, the wage costs will be calculated on the basis of the first calendar month the business has duty to provide information. Estimates show that the FAT will give an incurred proceed of 2250 million NOK, and 1790 million NOK recorded.

The FAT will reduce the after-tax corporate income in the financial sector. It is in the governments intentions that the tax will be shifted over to consumers and wages of employees. To what degree this happens, depend on the competition in the markets for financial services.

Increased prices reduce the demand for financial services, which in turn reduces the employment. A problem with the VAT-exemption was that the missing VAT-credits on inputs made self-production more appealing for the financial institutions instead of

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11 SN2007, p. 27
12 Prop. 1 LS (2016-2017) ch. 6.1
demanding services from other providers. A tax on wages will make financial institutions reduce their employment in order to reduce the tax burden. This may have a negative effect on the self-production, making financial institutions demand more services from external providers. Even though the financial institutions may reduce their employment, the increased demand from external providers can result in an unaffected total labor demand.

The international aspect

According to economic theory, the introduction of a tax leads to a higher price and a reduced quantity. Introducing a tax in one country distorts relative prices when comparing to other countries. Domestic services become relatively more expensive, which may result in a higher demand for financial services from abroad.

These distortions of relative prices do not arise when using an ideal VAT. As earlier mentioned, a VAT follows the destination principle. VAT is paid in the country where a commodity or service is used. When deciding whether to buy a good or a service at home or abroad, a VAT does not affect the relative prices a consumer is faced with.

The FAT motivates consumers to buy services from abroad. Domestic suppliers of financial services may want to change their behavior to stay on the same competitive level as earlier. Producers of financial services might try to avoid FAT by moving their production, or parts of it, to other countries. A FAT can only be levied on producers registered in Norway. Moving whole or parts of the production to lower-cost countries can result in unchanged prices.

Huizinga (2002) points out that domestic suppliers of financial services in countries where these services are VAT-exempt face a competitive disadvantage towards banks based in countries where there is no VAT (like in the US). Banks in countries where financial services are VAT-except pay VAT on their inputs, whereas banks based in the US do not. This leads to higher prices of the services provided by the former bank compared to the latter.

A FAT will not solve the problem with over-taxation of business-use of financial services. A FAT on the value added in the financial sector will result in a higher price for both domestic and foreign consumers of the domestically produced services, whereas services produced in other countries are unaffected. The tax distorts relative prices between domestic and foreign

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13 Wage costs and income in the financial sector used as a proxy for the value added.
producers, resulting in a disadvantage for domestic suppliers. This point is defended by the fact that the tax on corporate income has been reduced from 28% in 2013 to 25% in 2017 for financial institutions covered by this FAT. The reduction in corporate income tax accounts for almost the whole part of FAT put on wages, so that the tax burden will not be significantly larger than what it was in 2013.14

In most other countries, the financial sector is taxed as other sectors but exempt from VAT. Many countries saw the necessity of introducing stabilization taxes on the financial sector after the financial crisis. Some countries have an additional tax on those parts of the economy that is exempt from VAT, hereunder the financial sector. For example do Denmark and France have an additional tax on wages, whereas Israel and Iceland tax both wages and revenue in the financial sector. There are also cases of excises on for instance insurance premiums, like in Denmark and Finland. Australia and New-Zealand have included damage insurance in the VAT-system. Tax on financial transactions of various forms are similarly introduced in England, Belgium, Switzerland, and Finland as a regulatory taxes in the financial sector.15

The next chapter introduces the input-output structure, which makes it possible to highlight the welfare effects of exempting one sector from VAT, and which effects arise when introducing a FAT instead. In chapter 2.2 we saw how a VAT is neutral when all sectors have a VAT-liability, but when one sector is exempt the neutrality principle is violated because of distorted relative prices. As discussed in chapter 2.1, when the government introduces a corrective tax as the FAT, it is with the intention to reduce the distortions already present and to solve a problem of inefficiency. I want to show the welfare effects of both a VAT-exemption and the introduction of a FAT. How does a FAT differ from the VAT-exemption of financial services? Does it contribute to restore neutrality to some degree? Consequentially, what effects do the tax treatments have on consumer prices and government tax revenue?

14 Prop 1 LS (2016-2017), ch. 6.4
15 Prop. 1 LS (2013-2014), ch. 23. 4
3 Method

In this chapter I present the input-output model. First, I explain the purpose of the model and why I use it in my thesis. Chapter 3.2 describes the use of this model in the national account, before the structure of the model is explained. In chapter 3.3 I use the input-output structure on a simple model to show the distortionary effects that arise when moving from an efficient tax system to, respectively, a tax system where one sector is exempt from VAT, and a tax system where a FAT is levied on the VAT-exempt sector.

3.1 The input-output structure

I use an input-output model to address the dependence between sectors. The input-output framework makes it possible to see the effect of different measures not only on total sizes, but also on production, investment and consumption within and across sectors. The interaction and dependence between sectors stems from the need of input delivered by other sectors. Sectors demand deliveries from each other, and the growth of one sector implies spillover effect to others. Growth affects the employment, which in turn affects the demand for goods. Sectors compete for the same resources, so prices are affected by the economic condition.

Since the aim of this thesis is to analyze the effects on social welfare of the introduction of a FAT, I look at how prices change and what happens to the level of tax revenue after the introduction of the tax. The social welfare will be expressed by the sum of indirect utility of prices and the value of the government tax revenue. The social welfare will in the end only depend on how well off the consumers are.

A sector may produce both taxed and tax exempt goods, and it might both demand and supply inputs to other sectors and businesses. To address the change in prices and tax revenue when introducing a tax regime, I will start by looking at a simple one-dimensional model. The model is one-dimensional in the sense that it does not include cross deliveries between the different sectors. Usually, sectors have cross deliveries of different amounts to several other productions, and do in that way depend on all other sectors in the economy to a larger degree. Even though the simple model only include deliveries going from one sector to another, without the latter demanding inputs from the first, this framework gives sufficient results of
consumer prices and government revenue to discuss how the changes due to different tax regimes affect social welfare.

3.2 The input-output structure in the national account

The Norwegian national accounts are published for every year with a one year lag with the aim to give a full understanding of the economy, and to look at the development and structure over time. It gives both an overall view and a detailed description of both private and public consumption and investments, employment rates and hours worked, and of the transactions between the different industries in the economy, including import and export. National accounts are designed using international guidelines and standards, since the accounts are used when comparing the economy of different countries.

Since 1954, the Central Bureau of Statistics, now called Statistics Norway (Statistisk Sentralbyrå), has engaged in inter-industry analysis, with the objective of collecting enough information to bring forth an input-output structure of the data to analyze problems in the Norwegian economy. The input-output analysis gives a more detailed description of the production flows than what we find in the national accounts.

Supply- and use-tables and the input-output matrix

Annual supply- and use-tables are product by industry matrices that show the flows of goods and services in the economy for a given year. Together these two matrices give a detailed picture of total uses and total supply of goods and services. Total supply of goods and services for a given period must either be derived from productive services of labor and/or capital, inventory from earlier periods, or imports from other countries. The supply-table breaks down the total domestic production into market output, output for own use and output for other than market use. The table shows the value of production of various products within each industry. Together with the value of imports, this gives the total supply of goods and services in the economy.

The use-table shows to which purposes the total production from different industries are used in the given period. Whether it is as input in other industries, sold as final delivery in the form of consumption or real investment to households or the government, inventory, or if it is exported.
Trade and transport margins and taxes less subsidies paid on products from each sector is shown in the supply-table in order to attain identities between supply and use. The reason for this is that in the supply-table, the values are given in basic prices, meaning the price the producer receive for a purchased good after transport-, VAT and tax charges are paid, and eventual subsidies are subtracted. In the use-table, the values are given in purchasers’ prices, i.e. the prices faced by consumers. These prices are less any deductible VAT.

The value added is recorded at basic prices. Value added is the net result of output valued at basic prices, less the value of inputs valued in consumer prices. We can find the value added in each industry in the use-table.

The input-output matrix combines the supply- and the use-table into a symmetric matrix. This structure can be used to analyze the mutual dependence between sectors and industries, since it combines the total supply and the total uses of all the goods and services in the economy. The input-output matrix concerning prices for industry to industry shows the value of goods flowing between sectors, and to final uses. It is based on the assumption that the production sales structure is fixed.

The input-output matrix

I will now introduce some basic features of the input-output model for a closed economy that I partly use when introducing the simple model. These are all based on the structure presented by Tore Thonstad in his book Kryssløpsanalyse (Thonstad, 1975).

The input-output model includes sectors that deliver goods to each other (cross-deliveries), and to consumption and investments (final delivery). $X_{ij}$ stands for the delivery from sector $i$ to sector $j$. $X_{ii}$ is assumed to be 0. $S_i$ is the amount of final delivery from sector $i$, consisting of $C_i$ (consumption) and $J_i$ (gross investments, including stock increase for sector $i$). $X_i$ is the total production (gross production) in sector $i$, so that $X_i = \sum_{j=1}^{n} X_{ij} + S_i = \sum_{j=1}^{n} X_{ij} + C_i + J_i$. These variables are considered as values in given prices. When introducing the input-output coefficient it is possible to look at the delivery needed from one sector when a sector increases its production. This structure assumes that one industry needs a given delivery for each NOK of its product. $\alpha_{ij}$ means the delivery going from sector $i$ to sector $j$ for each additional NOK gross production, where $0 < \alpha_{ij} < 1$. We can write $X_{ij} = \alpha_{ij} X_j$, so that
\[ X_i = \sum_{j=1}^{n} \alpha_{ij} X_j + S_i. \] 

\( E_i \) stands for the gross product in sector \( i \), meaning sector \( i \)’s contribution to the gross domestic product. The gross product is the gross production minus received intermediate goods. Using this information, we can put up the input-output matrix.

**Figure 3: Input-output matrix**

<table>
<thead>
<tr>
<th>Receiving sector</th>
<th>Sector 1</th>
<th>Sector 2</th>
<th>Sector 3</th>
<th>Final delivery</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector 1</td>
<td>-</td>
<td>( \alpha_{12} X_2 )</td>
<td>( \alpha_{13} X_3 )</td>
<td>( C_1 + J_1 = S_1 )</td>
<td>( X_1 )</td>
</tr>
<tr>
<td>Sector 2</td>
<td>( \alpha_{21} X_1 )</td>
<td>-</td>
<td>( \alpha_{23} X_3 )</td>
<td>( C_2 + J_2 = S_2 )</td>
<td>( X_2 )</td>
</tr>
<tr>
<td>Sector 3</td>
<td>( \alpha_{31} X_1 )</td>
<td>( \alpha_{32} X_2 )</td>
<td>-</td>
<td>( C_3 + J_3 = S_3 )</td>
<td>( X_3 )</td>
</tr>
<tr>
<td>Gross product</td>
<td>( E_1 )</td>
<td>( E_2 )</td>
<td>( E_3 )</td>
<td>-</td>
<td>( E )</td>
</tr>
<tr>
<td>Total</td>
<td>( X_1 )</td>
<td>( X_2 )</td>
<td>( X_3 )</td>
<td>( C + J = S )</td>
<td>( X_1 + X_2 + X_3 + E )</td>
</tr>
</tbody>
</table>

As we can see in this table, sectors both receive and supply intermediate goods for each other. An input-output matrix shows the flow of intermediate goods, as well as the value of final uses.

**The input-output structure with prices as variables**

To analyze the price structure in the economy, we can introduce prices as variables. Instead of analyzing the flows of values in given prices, this structure considers the cross-deliveries as units. The coefficient \( \alpha_{ij} \) denotes the technical units needed from sector \( i \) for each produced technical unit in sector \( j \). An input-output structure using prices as variables shows how final prices within industries are connected to the prices of the intermediate goods needed in the
industries’ production. The final price for a good is therefore given by the costs of producing that good, i.e. the price of inputs needed. For example, $P_j = a_{ij}P_i$. The price of the good produced in sector $j$ depends on the technical units needed as inputs from sector $i$, and the price of these.

Income has to equal expenditures in this model, so the production value in one sector equals the expenses to, for instance, intermediate goods, wages and own income. A relation of this kind requires that every increase in costs are fully transferred into the prices.

Assume we have two goods, 1 and 2, that are produced in each sector. The goods are produced using inputs form the other sector and by using labor. $N$ denotes total labor supply, which is divided between the two sectors so that $N = N_1 + N_2$. $w$ denotes wage per unit labor, and it is assumed to be the same in either sector. For sector 1 the wage amount is $wN_1$, and similarly for sector 2, $wN_2$.

We then have that the price for each good 1($P_1$) is determined by the price of good 2 ($P_2$), the amount necessary of good 2 to produce one unit of good 1 ($\alpha_{21}$) and the number of labor units: $P_1 = P_2 \alpha_{21} + wN_1$. For sector 2: $P_2 = P_1 \alpha_{12} + wN_2$.

Rewriting these two expressions gives:

$$P_1 = \frac{w}{1-\alpha_{12}\alpha_{21}}(\alpha_{21}N_2 + N_1)$$
$$P_2 = \frac{w}{1-\alpha_{12}\alpha_{21}}(\alpha_{12}N_1 + N_2)$$

The unit prices of the two goods are determined by the costs, i.e. wages and the costs of intermediate goods. All cost increases are fully transferred into the prices. If the price of one of the goods increases, the price of the other also increases because of increased factor price. Wage level does not affect relative prices.\(^{16}\)

I use the input-output structure with prices as variables in chapter 3.3, where I put up a model to illustrate how different tax regimes affects prices faced by consumers in a closed economy. Production value equals expenses to intermediate goods. The effects on labor demand is not directly observable since it is included in the value added in each sector. Possible effects on the employment will be discussed. The next example is meant as an illustration of how

\(^{16}\) If one of the sectors were a competitive industry, wages would be determined by prices on the world market, and the input-output coefficients. The price in the other sector would depend on the price in the competitive industry, productivity of labor and the input-output coefficients.
commodity prices are affected by changes in other parts of the production cycle. Producers may depend on each other to various degrees through demand and supply of intermediates in different amounts. In my framework I do not show this to a large degree. I assume that one sector only delivers intermediates to one other sector, and that a sector does not both demand and supply intermediates from another sector. Even though a production cycle may consist of even more deliveries of intermediate inputs across sectors, the model is able to give an illustration of the dependence between sectors, as well as how the structure works.

### 3.3 A simple model using the input-output structure

I use a regime where all sectors are subjected to VAT as a base to show how other regimes create tax wedges. This VAT-regime is therefore used as an illustration of an efficient tax regime, since relative prices are undistorted. Afterwards I compare the efficient regime to two other regimes to address the tax wedges and inefficiencies created by these. The first comparison is to a regime where one sector is exempt from VAT. This regime is meant as an illustration of the previous tax treatment of the financial sector, and to further highlight the inefficiencies created by such a tax treatment. The second regime is the main focus. It levies a tax on the value added in one of the sectors, but the tax does not follow the same principles of deductions as a VAT-regime. The latter is therefore an illustration of the newly introduced tax, where a sector (the financial sector) is subjected to a FAT.\(^\text{17}\)

I consider three sectors:

- **Sector 1**: sells to sector 2 and consumers
- **Sector 2**: sells to sector 3 and consumers
- **Sector 3**: sells to consumers only

Sector 1 produces good \(X_1\) that is sold to consumers and as input to sector 2. The production does not require any inputs from the other sectors. \(X_1 = \alpha_{12}X_2 + S_1\), where \(\alpha_{12}\) is the input-output coefficient denoting the given value of input from sector 1 needed for each additional NOK of \(X_2\) produced. \(S_1\) is sold to final consumers. The production of goods in sector 2 requires input from sector 1, and the goods are sold to both consumers and as input in sector 3. \(X_2 = \alpha_{23}X_3 + S_2\). As in the case of sector 1, \(\alpha_{23}\) is here the given value of input from sector 2 needed for each additional NOK of \(X_3\) produced, and \(S_2\) is sold to final consumers.

\(^\text{17}\) The general definition of a FAT as described on p. 14.
Sector 3 produces good \( X_3 \) that is sold to consumers only, so \( X_3 = S_3 \). \( X_1 \), \( X_2 \) and \( X_3 \) are values in given prices.

As described above, the input-output model usually considers values in given quantities. In order to analyze what happens to the price in a sector when the prices of inputs from other sectors change, I will now introduce the price structure. Production quantities are measured in technical units when using prices as variables.

The prices of inputs used in production in the different sectors will affect the prices of the final product. Let \( P_i \), where \( i = 1, 2, 3 \), denote the price of the products from the three sectors. The input-output coefficient \( \alpha_{ij} \), where \( i, j = 1, 2, 3; i \neq j \) denotes the input used in sector \( j \) delivered by sector \( i \), measured in technical units. \( V_i \), where \( i = 1, 2, 3 \), denotes the value added per unit output in each sector. Sector 1 does not demand any input from the other sectors. The price of sector 1 goods is therefore not affected by prices of inputs. For simplicity, all pre-tax prices are set to unity. For sector 2, the price of the good will also depend on the price of the input bought from sector 1, and the value added to the production of the good: \( P_2 = \alpha_{12} P_1 + V_2 \). The same yields for sector 3, when buying input from sector 2: \( P_3 = \alpha_{23} P_2 + V_3 = \alpha_{23}(\alpha_{12} P_1 + V_2) + V_3 \). We see that the dependence sector 2 has to sector 1 is transferred to sector 3 through sector 3s’ dependence of sector 2.

The VAT-regimes

I consider three different tax regimes:

a) All three sectors VAT-registered.

b) Sector 2 is VAT-exempted.

c) FAT on the activities of sector 2.\(^\text{18}\)

We are interested in the welfare effects of moving from a neutral tax regime, regime a), to regimes where relative prices are distorted, regime b) and c). Consumers’ utility is affected by the prices they face and the amount of tax revenue collected by the government. The welfare

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\(^{18}\) The tax presented in this context is a tax on the value added in sector 2, without sector 2 being able to deduct VAT on inputs or demand VAT on goods sold. Even though this result is true in general, and not only for a financial activity tax, I will for simplicity call it a FAT.
will therefore be the sum of indirect utility of prices and a valuation of the governments’ tax revenue.

When all three sectors are VAT-registered, the relative prices between sectors are equal to the case if neither of the sectors were VAT-registered. The prices of the goods produced in each sector equals the after-tax production cost of the goods, so there will be no distortionary effects on the consumption bundle due to tax differences.

\[
P_1 = 1(1 + \tau)
\]

\[
P_2 = (\alpha_{12} + V_2)(1 + \tau)
\]

\[
P_3 = ((\alpha_{12} + V_2)\alpha_{23} + V_3)(1 + \tau)
\]

All pre-tax prices normalized to unity. The price of sector 1 goods is the after-tax production cost. The price of goods produced in sector 2 consists of the after-tax price of the input-output factor from sector 1 used in sector 2, and the after-tax price of the value added in sector 2. The price of goods produced in sector 3 consists of the after-tax price of the input-output factor from sector 2 used in production in sector 3, and the after-tax price of the value added by sector 3. I will start by looking at how the introduction of the various regimes change the prices consumers face.¹⁹

**Price changes when moving from regime a) to regime b)**

\(\beta\) denotes the integration of sector 2 into a VAT system. \(\beta = 1\) is full integration, and, \(\beta = 0\) indicates that sector 2 is VAT exempt. \(\tau\) denotes the tax rate. The consumer prices of the three sectors will look like:

\[
(1) \quad P_1 = 1 + \tau
\]

\[
(2) \quad P_2 = (1 + \tau - \tau \beta)\alpha_{12} (1 + \tau \beta) + (1 + \tau \beta) V_2
\]

\[
(3) \quad P_3 = ((1 + \tau - \tau \beta)\alpha_{12} + V_2)\alpha_{23}(1 + \tau) + V_3(1 + \tau)
\]

¹⁹ The model assumes a full pass through of costs into the prices of commodities. This implies that the supply curve of the various commodities is flat. In reality, this may not be the case. Producers and consumers may divide the additional cost between them, and the degree of pass through may be different between different goods.
Sector 1 does not buy any inputs from other sectors, so the introduction of a new VAT-regime does not affect the price of sector 1 goods. $P_1$ depends on the production cost and the VAT-rate, independent of VAT-regime.

The price of sector 2 goods depends on whether the sector is subjected to VAT or not.

\[ P_2(\beta = 1) = (1 + \tau)\alpha_{12} + (1 + \tau)V_2 = (1 + \tau)(\alpha_{12} + V_2) \]

\[ P_2(\beta = 0) = (1 + \tau)\alpha_{12} + V_2 \]

Price change when moving from regime a) to regime b): $dP_2 = -\tau V_2$

Sector 2 buys input from sector 1, so the price of goods from this sector will, in addition to the VAT-rate and the VAT-regime, also depend on the cost of inputs. This term is given by the input-output coefficient. Being VAT-exempt implies that sector 2 neither charges VAT on its output nor receive any deductions for VAT on inputs. Removing the tax liability of sector 2 reduces the price of sector 2 goods because the value added in the sector is not subjected to VAT.

Removing the VAT-liability of sector 2 has implications for the price of sector 3 goods.

\[ P_3(\beta = 1) = (\alpha_{12} + V_2)\alpha_{23}(1 + \tau) + V_3(1 + \tau) \]

\[ P_3(\beta = 0) = ((1 + \tau)\alpha_{12} + V_2)\alpha_{23}(1 + \tau) + V_3(1 + \tau) \]

Price change when moving from regime a) to regime b): $dP_3 = \alpha_{12}\alpha_{23}\tau (1 + \tau)$

When VAT exempt, sector 2 passes the VAT on inputs from sector 1 onto sector 3 through the price of inputs. The missing refund leads to a cascading of tax, since the VAT from sector 1 becomes part of the tax base of sector 3. In addition, sector 3 in unable to receive any deductions for VAT on intermediates from sector 2, since there is no VAT-charge. Missing tax refunds both in sector 2 and in sector 3 leads to a cascading of taxes, increasing the tax base of sector 3 leading to a double taxation of the sector. This, in turn, leads to a higher price of goods sold from sector 3. These effects can be shown by the term $\alpha_{12}\alpha_{23}\tau (1 + \tau)$, where we can see that both inputs going from sector 1 to sector 2 and from sector 2 to sector 3 is taxed twice.
Price changes when moving from regime a) to regime c)

\( \varphi \) denote sector 2s’ integration into a tax system. \( \varphi = 0 \) means that sector 2 is subjected to VAT (regime a), whereas \( \varphi = 1 \) means that there is a FAT on sector 2 goods. The FAT acts like a tax on the value added, but it does not have the same characteristics as the VAT-system. Where a VAT-liability give deductions for incoming VAT, the FAT does not.

\[
(8) \quad P_1 = 1 + \tau \\
(9) \quad P_2 = (1 + \tau)\alpha_{12} + (1 + \tau)V_2 \\
(10) \quad P_3 = ((1 + \varphi \tau)(\alpha_{12} + V_2))\alpha_{23}(1 + \tau) + V_3(1 + \tau)
\]

Both \( P_1 \) and \( P_2 \) are unaffected by the introduction of a FAT on sector 2 goods. The FAT works in these two sectors in the same way as a VAT-liability on sector 2.

The price in sector 3 is affected by the introduction of a new tax regime in sector 2.

\[
(11) \quad P_3(\varphi = 1) = ((1 + \tau)(\alpha_{12} + V_2))\alpha_{23}(1 + \tau) + V_3(1 + \tau) \\
(12) \quad P_3(\varphi = 0) = (\alpha_{12} + V_2)\alpha_{23}(1 + \tau) + V_3(1 + \tau)
\]

Price change when moving from regime a) to regime c): \( dP_3 = (\alpha_{12} + V_2)\alpha_{23}\tau(1 + \tau) \)

When introducing a FAT, consumers face a larger price than in the case of VAT-exemption of sector 2. As in the previous case, sector 3 does not receive any VAT-credits, so the price of purchased inputs become part of the tax base. However, there will be an additional increase in price since sector 2 goods are subjected to a FAT. With the missing VAT-refunds on inputs, both the FAT and the price of inputs become a part of the tax base for sector 3. The cascading of taxes leads to a tax base where sector 3 is faces with a double taxation due to the missing refund when sector 2 is VAT-exempt and an additional VAT-payment of the FAT transferred through the price of inputs from sector 2.
**Tax revenues**

In addition to prices, the welfare also depends on the tax revenue collected by the government. When all sectors are VAT-registered, we can see that the government collects $\tau$ in taxes for each $X_1$ sold. Tax revenue for each $X_2$ sold is $\tau(\alpha_{12} + V_2)$, and each $X_3$ gives $\tau((\alpha_{12} + V_2)\alpha_{23} + V_3)$.

We can write the total revenue as: $R = \tau X_1 + \tau(\alpha_{12} + V_2)X_2 + \tau((\alpha_{12} + V_2)\alpha_{23} + V_3)X_3$

**Tax revenue when sector 2 is VAT-exempt:**

$R = \tau X_1 + (\tau\alpha_{12} + \beta\tau V_2)X_2 + (2\tau\alpha_{12}\alpha_{23} + \tau^2\alpha_{12}\alpha_{23} - \beta\tau\alpha_{12}\alpha_{23} - \tau^2\beta\alpha_{12}\alpha_{23} + \tau V_2\alpha_{23} + \tau V_3)X_3$.

Each unit sold from sector 1 gives $\tau$. For each unit $X_2$ the government collects $\tau\alpha_{12}$ if sector 2 is VAT-exempt, but if sector 2 is VAT registered the value added is also taxed, thereof the term $\beta\tau V_2$. Tax revenue for each $X_3$ also depend on the tax system in sector 2. $\tau\alpha_{23}((\alpha_{12} + V_2) + V_3$ is collected in either case, whereas a VAT-exemption of sector 2 results in an additional $\tau(1 + \tau)\alpha_{12}\alpha_{23}$.

Each sectors’ contribution to the tax revenue can be denoted:

(13) $\tau_1 = \tau$

(14) $\tau_2 = \tau\alpha_{12} + \beta\tau V_2$

(15) $\tau_3 = \alpha_{12}\alpha_{23}(2\tau + \tau^2 - \beta\tau - \beta \tau^2) + \tau V_2\alpha_{23} + \tau V_3$

**Total tax revenue when sector 2 is subjected to FAT:**

$R = \tau X_1 + \tau(\alpha_{12} + V_2)X_2 + (\tau\alpha_{12}\alpha_{23} + \psi\tau\alpha_{12}\alpha_{23} + \phi\tau^2\alpha_{12}\alpha_{23} + \tau V_2\alpha_{23} + \phi\tau V_2\alpha_{23} + \phi\tau^2 V_2\alpha_{23} + \tau V_3)X_3$

VAT collected for each unit sold from sector 1 is still $\tau$. For each $X_2$ sold, the government collects $\tau(\alpha_{12} + V_2)$, and for each $X_3$ $\tau\alpha_{12}\alpha_{23} + \tau\alpha_{23}\alpha_{12} + \tau^2\alpha_{12}\alpha_{23} + \tau V_2\alpha_{23} + \tau V_2\alpha_{23} + \tau^2 V_2\alpha_{23} + \tau V_3 = (2\tau + \tau^2)\alpha_{12}\alpha_{23} + (2\tau + \tau^2)\alpha_{23}V_2 + \tau V_3$ is collected. Sector 3 is faced with their normal VAT-payment: $((\alpha_{12} + V_2)\alpha_{23} + V_3)\tau$, a double VAT-payment due to the missing refund when sector 2 is VAT exempt: $\alpha_{23}\alpha_{12}(1 + \tau)$, and an additional VAT-
payment on the FAT transferred through the price of inputs from sector 2: \( \alpha_{23} V_2 \tau (1 + \tau) \).

Each sector's contribution to the tax revenue can be denoted:

\begin{align*}
(16) \tau_1 &= \tau \\
(17) \tau_2 &= \tau (\alpha_{12} + V_2) \\
(18) \tau_3 &= (\alpha_{12} \alpha_{23} + V_2 \alpha_{23}) (\tau + \varphi \tau + \varphi \tau^2) + \tau V_3.
\end{align*}

**Price effects of introducing a new tax regime**

To address the effects on welfare of introducing a new tax regime, I will compare the tax-wedges created when changing from regime a) to regime b) and from regime a) to regime c). The introduction of a new tax regime will affect the welfare of consumers through changed prices. To look at the welfare effects we therefore need expressions for both the price effects of introducing a new regime and the relative price changes. The relative prices are given by the price effect of introducing a new tax regime relative to the price obtained in the new regime.

In regime b) \( \beta = 0 \) means that sector 2 is VAT-exempt. Differentiating the prices with respect to \( \beta \) will therefore imply that we move from a regime where sector 2 is VAT-exempt to a regime where sector 2 is VAT-registered. To get the price effects we are looking for, when moving from regime a) to regime b), the derivatives are multiplied with \(-1\). \( P_1, P_2 \) and \( P_3 \) are, respectively, given by equations (1), (2) and (3).

\begin{align*}
P'_1 &= \frac{dP_1}{d \beta} = 0 \\
P'_2 &= \frac{dP_2}{d \beta} = -\tau V_2 \\
P'_3 &= \frac{dP_3}{d \beta} = \tau (1 + \tau) \alpha_{12} \alpha_{23}
\end{align*}

The relative price changes are given by the price changes in terms of the price the consumer would face had sector 2 been VAT exempt. \( P_1, P_2 \) and \( P_3 \) are, respectively, given by equations (1), (5) and (7). Relative price changes:
\[ P_1' = \frac{dP_1}{d\varphi} = 0 \]

\[ P_2' = \frac{dP_2}{d\varphi} = 0 \]

\[ P_3' = \frac{dP_3}{d\varphi} = \tau (1 + \tau) \alpha_{12} \alpha_{23} \]

The relative price changes are given by the price changes in terms of the price the consumer would face had sector 2 is subjected to FAT. \( P_1, P_2 \) and \( P_3 \) are, respectively, given by equations (8), (9) and (10). Relative price changes:

\[ P_1' = \frac{dP_1}{d\varphi} = 0 \]

\[ P_2' = \frac{dP_2}{d\varphi} = 0 \]

\[ P_3' = \frac{dP_3}{d\varphi} = \tau (1 + \tau) \alpha_{12} \alpha_{23} \]

Introducing a new tax regime will make the prices of the various goods change. A change in prices will in turn affect the optimal composition of consumption goods, since the consumers’ consumption possibilities are changed. Holding utility constant when looking at how a change in price affects the demand of some good, will give us the compensated price derivative. The compensated price derivative of \( X_i \) with respect to \( P_i \) we denote by \( S_{ij} \), where \( i, j = 1,2,3; i \neq j \).
To what extent the demand for the various goods are affected depends on the elasticity of demand. The compensated elasticity is denoted by \( \sigma_{ij} = \frac{\partial X_i}{\partial P_j} \frac{P_j}{X_i} \), where \( i, j = 1, 2, 3; i \neq j \). This tells us what happens to the demand for good \( i \) when the price of good \( j \) changes.

Consumers faces a different set of market tradeoff when the prices of the goods are changed. How the demand for a good changes therefore depends on the change in income of the consumers. Income derivative of \( X_i \): \( \frac{\partial X_i}{\partial I} \).

Consumers get utility through consumption. Since the level of consumption is determined through commodity prices and income, consumers will have an indirect utility of prices. Optimal demand for a good depends on the prices and the income of a consumer.

\[ X_i^* = D_i(P_1, P_2, P_3, I) \]

The indirect utility function is obtained when inserting the demand functions into the utility function, so that:

\[ U(X_1, X_2, X_3, I) = U(\sum_{i=1}^{3} D_i(P_1, P_2, P_3, I)) = V(P_1, P_2, P_3, I) = V(P_1, P_2, P_3, E(P_1, P_2, P_3, u)) \]

We assume that consumers maximize their utility by consuming their total income given the prices they face, meaning that income equals expenditure in optimum. The expenditure function is given by:

\[ E(P_1, P_2, P_3, u) = P_1X_1 + P_2X_2 + P_3X_3 = \sum_{i=1}^{3} P_i H_i(P_1, P_2, P_3, u) \]

Where:

\[ H_i(P_1, P_2, P_3, u) = H_i(P_1, P_2, P_3, E(P_1, P_2, P_3, u)) = X_i(P_1, P_2, P_3, I) \]

---

20 The Marshallian demand function. This function gives the optimal consumption of goods by maximizing the agents utility given income and the commodity prices. The function is also called the uncompensated demand function.

21 The \( H(\cdot) \) function denotes the Hicksian demand function. The Hicksian demand function is used to find the combination of goods that keeps the agent on a given utility level, when minimizing the expenditures.
$H_i$ denotes the optimal consumption of good $i$ for utility level $u$. The value of the government revenue is denoted by $\mu$.

**Change in social welfare**

The social welfare in case b) can be expressed as:

$$W = V(P_1, P_2, P_3, I)$$

$$+ \mu[\tau X_1 + (\tau \alpha_{12} + \beta \tau V_2)X_2 + (2\tau \alpha_{12} \alpha_{23} + \tau^2 \alpha_{12} \alpha_{23} - \beta \tau \alpha_{12} \alpha_{23})$$

$$- \beta \tau^2 \alpha_{12} \alpha_{23} + \tau V_2 \alpha_{23} + \tau V_3)X_3]$$

In case c)

$$W = V(P_1, P_2, P_3, I)$$

$$+ \mu[\tau X_1 + \tau (\alpha_{12} + V_2)X_2 + ((\alpha_{12} \alpha_{23} + V_2 \alpha_{23})(\tau + \varphi \tau + \varphi \tau^2) + \tau V_3)X_3]$$

Social welfare is the sum of indirect utility of prices and the welfare weighted tax revenue of the government (weighted with weight $\mu$). To see how the welfare of consumers are affected by the introduction of a tax regime, I differentiate the two welfare expressions with respect to the integration parameters $\beta$ and $\varphi$. Consumers’ welfare is reduced because they are faced with a new set or commodity prices that in turn distorts the optimal composition of goods. This is called the uncompensated demand response to a price change. It comes in as a negative effect on consumers’ indirect utility, whereas the tax revenue part consists of two parts. First, the substitution effect shows how consumers may change their behavior into buying those goods that become relatively cheaper, substituting away from the relatively more expensive goods. Second, higher prices makes consumers poorer, making them want to reduce their consumption. The second effect is a negative income effect. Taken together, the income- and substitution effect determine the level of tax revenue.

The welfare is given as: $W = V(P_1, P_2, P_3, I) + \mu[\tau_1 X_1 + \tau_2 X_2 + \tau_2 X_2]$}

We want to find how the utility varies with prices and income. The indirect utility function shows optimal utility for given prices. When prices change, the optimal allocation changes. Using Roy’s identity, we find the direct expressions for how price changes affect individual welfare. We have that:
\[
\frac{\partial V(P_1, P_2, P_3, E(P_1, P_2, P_3, u))}{\partial P_i} = -\lambda X_i \quad \text{and} \quad \frac{\partial V(P_1, P_2, P_3, E(P_1, P_2, P_3, u))}{\partial \lambda} \frac{\partial E(P_1, P_2, P_3, u)}{\partial P_i} = \lambda
\]

Where \( \lambda \) can be interpreted as marginal utility of income. Marginal utility is increasing in income, and decreasing in prices.

\[
\frac{\partial V}{\partial P_i} + \frac{\partial V}{\partial \lambda} \frac{\partial \lambda}{\partial P_i} = 0.
\]

Rearranging gives:
\[
-\frac{\partial V}{\partial P_i} = \frac{\partial \lambda}{\partial P_i} = -\frac{\lambda X_i}{\lambda} = -X_i
\]

Differentiating the welfare function with respect to the parameter implying the introduction of a new tax regime gives (\( \beta \) used as illustration):

\[
\frac{\partial W}{\partial \beta} = -\lambda X_1 \frac{\partial P_1}{\partial \beta} - \lambda X_2 \frac{\partial P_2}{\partial \beta} - \lambda X_3 \frac{\partial P_3}{\partial \beta} + \mu \left( X_1 \frac{\partial \tau_1}{\partial \beta} + X_2 \frac{\partial \tau_2}{\partial \beta} + X_3 \frac{\partial \tau_3}{\partial \beta} + \tau_1 \left[ \frac{\partial X_1}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_1}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_1}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] + \tau_2 \left[ \frac{\partial X_2}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_2}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_2}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] + \tau_3 \left[ \frac{\partial X_3}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_3}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_3}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] \right)
\]

Using micro theory, we have that:
\[
\frac{\partial X_i}{\partial \beta} = S_{ij} - X_j \frac{\partial X_i}{\partial I}.
\]

Inserting this into the expression and applying Roy’s identity:

\[
\frac{\partial W}{\partial \beta} = -X_1 \frac{\partial P_1}{\partial \beta} - X_2 \frac{\partial P_2}{\partial \beta} - X_3 \frac{\partial P_3}{\partial \beta} + \mu \left( X_1 \frac{\partial \tau_1}{\partial \beta} + X_2 \frac{\partial \tau_2}{\partial \beta} + X_3 \frac{\partial \tau_3}{\partial \beta} + \tau_1 \left[ \frac{\partial X_1}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_1}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_1}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] + \tau_2 \left[ \frac{\partial X_2}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_2}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_2}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] + \tau_3 \left[ \frac{\partial X_3}{\partial \beta} \frac{\partial P_1}{\partial \beta} + \frac{\partial X_3}{\partial \beta} \frac{\partial P_2}{\partial \beta} + \frac{\partial X_3}{\partial \beta} \frac{\partial P_3}{\partial \beta} \right] \right)
\]

Rewriting this expression gives:

\[
\frac{\partial W}{\partial \beta} = (\mu - 1) \left[ X_1 \frac{\partial P_1}{\partial \beta} + X_2 \frac{\partial P_2}{\partial \beta} + X_3 \frac{\partial P_3}{\partial \beta} \right] - \mu \left[ X_1 \frac{\partial P_1}{\partial \beta} + X_2 \frac{\partial P_2}{\partial \beta} + X_3 \frac{\partial P_3}{\partial \beta} \right]
\]

\[
+ \tau_1 S_{11} P_1 + \mu \tau_1 S_{12} P_2 + \mu \tau_1 S_{13} P_3
\]

\[\text{This is the derivative of the Slutsky equation, showing the effect on demand for a good when the price of some other good changes. } S_{ij}\] is the price derivative of the Hicksian demand function, and denotes the substitution effect. \(-X_j \frac{\partial X_i}{\partial I}\) is the price derivative of the expenditure function, and denotes the income effect.
\[ + \mu \tau_2 S_{21} P_1' + \mu \tau_2 S_{22} P_2' + \mu \tau_2 S_{23} P_3' \]
\[ + \mu \tau_3 S_{31} P_1' + \mu \tau_3 S_{32} P_2' + \mu \tau_3 S_{33} P_3' \]

Inserting the expressions for each sector's contribution to the tax revenue, equation (13), (14) and (15). Welfare effect of moving from a regime where sector 2 is VAT-registered to a regime where sector 2 is VAT-exempt:\textsuperscript{23}

\[
\frac{\partial W}{\partial \beta} = (1 - \mu)[-\tau V_2 X_2 + \alpha_{12} \alpha_{23} \tau (1 + \tau) X_3] + \mu[-\tau V_2 X_2 + \alpha_{12} \alpha_{23} \tau (1 + \tau) X_3]
\]
\[
\cdot \left\{ \tau \frac{\partial X_1}{\partial I} + (\tau \alpha_{12} + \beta \tau V_2) \frac{\partial X_2}{\partial I} \right. \\
\left. + (\alpha_{12} \alpha_{23} (2\tau + \tau^2 - \beta \tau - \tau^2 \beta) + \tau V_2 \alpha_{23} + \tau V_3) \frac{\partial X_3}{\partial I} \right\} \\
+ \mu \tau_1 S_{12} P_2' + \mu \tau_1 S_{13} P_3' + \mu \tau_2 S_{22} P_2' + \mu \tau_2 S_{23} P_3' + \mu \tau_3 S_{32} P_2' + \mu \tau_3 S_{33} P_3'
\]

Which we can write as:

\[
\frac{\partial W}{\partial \beta} = (1 - \mu)M + \mu M m \\
+ \mu \tau_1 X_1 \sigma_{12} \frac{P_2'}{P_2} + \mu \tau_1 X_1 \sigma_{13} \frac{P_3'}{P_3} + \mu \tau_2 X_2 \sigma_{22} \frac{P_2'}{P_2} + \mu \tau_2 X_2 \sigma_{23} \frac{P_3'}{P_3} + \mu \tau_3 X_3 \sigma_{32} \frac{P_2'}{P_2} + \mu \tau_3 X_3 \sigma_{33} \frac{P_3'}{P_3}
\]

Where \(M\) is the effect on tax revenue and the income change of a consumer when introducing the tax regime. When removing the tax, the consumption possibilities of the consumers change, giving them a higher income because of a smaller tax burden. At the same time, the tax will give a reduction in revenue, leading to a reduced positive effect of the tax removal, therefore the term \((1 - \mu)\) in front of the \(M\). \(m\) can be interpreted as the marginal propensity to pay taxes when there is a raise in income, meaning how the consumption level of each taxed good changes when income changes. The effect \(m\) has on overall welfare will depend on the size of \(\tau\), since there already is an under-consumption due to tax distortions. The overall welfare loss due to a reduction in income is greater the larger the propensity to reduce consumption of heavily taxed commodities.

\textsuperscript{23} We are moving from the case of \(\beta = 1\) to \(\beta = 0\), so the derivatives with respect to \(\beta\) are multiplied with -1. For the price changes this has already been done.
Inserting the price effects from equations (19), (20) and (21), we get:

\[
\frac{\partial W}{\partial \beta} = (1 - \mu)M + \mu mM
\]

\[
+ \mu \tau_1 X_1 \left\{ \frac{-\tau V_2}{(1 + \tau)\alpha_{12} + V_2} + \frac{\tau \alpha_{12}\alpha_{23}}{(1 + \tau)\alpha_{12} + V_2\alpha_{23} + V_3} \right\}
\]

\[
+ \mu \tau_2 X_2 \left\{ \frac{-\tau V_2}{(1 + \tau)\alpha_{12} + V_2} + \frac{\tau \alpha_{12}\alpha_{23}}{(1 + \tau)\alpha_{12} + V_2\alpha_{23} + V_3} \right\}
\]

\[
+ \mu \tau_3 X_3 \left\{ \frac{-\tau V_2}{(1 + \tau)\alpha_{12} + V_2} + \frac{\tau \alpha_{12}\alpha_{23}}{(1 + \tau)\alpha_{12} + V_2\alpha_{23} + V_3} \right\}
\]

Line 2-4 presents the distortionary effects that are due to missing taxation in the VAT exempt sector. \(-\tau V_2/((1+\tau)\alpha_{12}+V_2)\) shows the missing tax revenue from sector 2, while \(\alpha_{12}\alpha_{23}\tau/((1+\tau)\alpha_{12}+V_2\alpha_{23}+V_3)\) shows the effect the VAT-exemption of sector 2 has on sector 3. The VAT exempt creates a cascading effect, leading to an over-taxation of consumer goods from sector 3. Consumers buying consumption goods from sector 2 benefits through a lower relative price of those goods, but the tax revenue is lower than it would be, had sector 2 been VAT-registered. The opposite is true for sector 3. The dead-weight losses created by the tax wedges are determined by the compensated price elasticities between the goods.

Inserting the expressions for each sectors contribution to the tax revenue, equation (16), (17) and (18). Welfare effects of moving from a regime where sector 2 is VAT-registered to a regime where sector 2 is subjected to FAT:

\[
\frac{\partial W}{\partial \varphi} = (\mu - 1) \left[ X_3 \tau (1 + \tau) \alpha_{12}\alpha_{23} \right] - \mu \left[ X_3 \tau (1 + \tau) \alpha_{12}\alpha_{23} \right] \frac{\alpha_{12}\alpha_{23}\tau}{(1+\tau)\alpha_{12}+V_2\alpha_{23}+V_3}
\]

\[
+ \mu \tau_1 S_1 \frac{\partial P_3'}{\partial I} + \mu \tau_2 S_2 \frac{\partial P_3'}{\partial I} + \mu \tau_3 S_3 \frac{\partial P_3'}{\partial I}
\]

Where \(N\) is the effect on tax revenue and income change of a consumer when introducing a FAT. In this case, the tax increases the prices paid by consumers, leading to a reduced welfare. The increased government tax revenue gives a damping effect, expressed with
(μ − 1). n can be interpreted as the marginal propensity to pay taxes when there is a raise in income. Rewriting and inserting for the price effects from equations (22), (23) and (24) gives:

\[
\frac{\partial W}{\partial \varphi} = (\mu - 1)N - \mu N n
\]

\[
+ \mu \tau_1 X_1 \left\{ \tau \frac{\alpha_{12} \alpha_{23}}{(\alpha_{12} + V_2)\alpha_{23} + V_3} \right\}
\]

\[
+ \mu \tau_2 X_2 \left\{ \tau \frac{\alpha_{12} \alpha_{23}}{(\alpha_{12} + V_2)\alpha_{23} + V_3} \right\}
\]

\[
+ \mu \tau_3 X_3 \left\{ \tau \frac{\alpha_{12} \alpha_{23}}{(\alpha_{12} + V_2)\alpha_{23} + V_3} \right\}
\]

The tax wedges in this case show that the tax increases the price of the consumption goods from sector 3 only. Subjecting sector 2 to a FAT solves the problem with missing taxation of that sector, but the cascading of taxes into the price of sector 3 goods still remain, resulting in a too high relative price of sector 3 goods. The inefficiency, or the size of the dead-weight losses created by the tax regime, depend on the compensated elasticities.

The compensated elasticities tells how much a consumer changes her consumption of a good when the price of some other good changes. If the goods are normal goods the σ_ii’s are negative, implying that the demand for goods from sector 2 increases in the VAT-exemption case, whereas demand for sector 3 goods is reduced in both the VAT-exemption and the FAT case. σ_{ij} tells us how much the demand for good i is affected by a change in price j. How large the increase or reduction is depends on the elasticity.

**Discussion**

The example above has shown how the dependence between sectors results in price changes after the introduction of two different distortionary tax regimes. The general equilibrium approach finds the effects on consumer demand and the demand for intermediate inputs after the introduction of new tax regimes.

The structure of the model assumes that all changes in costs cause total spillover into commodity prices. In the end, the effect on welfare depends on the consumers’ valuation of the reduced private consumption compared to the increase in tax revenue, in addition to the
tax wedges. These tax wedges shows the substitution effect. The substitution effect indicates to what degree consumers want to substitute away from relatively more expensive goods in order to buy goods that have become relatively cheaper. Consumers have to adjust their consumption bundle in order to stay on the same utility level as before the introduction of a tax. Not only does the tax regimes make the consumers have to reduce their consumption, but the optimal composition of goods is distorted. The demand for the various goods depend on the consumers’ elasticity of demand towards each individual good.

Another important discussion regarding the distortions of consumers’ consumption bundle is the value of the tax rate. The value of the tax rate in each regime determines how large the distortions are. The optimal tax rate in each regime is the one which minimizes the distortions created by the tax. Since the distortionary effects are related to how a tax is implemented, different values of the tax rates may affect the welfare in different ways within each regime.

Only consumption goods are objects of utility, and the results do only show how consumers change their consumption behavior when prices change. But consumers may also raise utility from increased leisure. When commodity prices increase, consumption of leisure becomes relatively cheaper, so consumers may want to substitute away from the consumption of goods. The effect on welfare depend on consumers’ valuation of their new settlement compared to the initial consumption bundle.

The effect on employment depends on the behavior of both consumers and producers. Increased prices of consumption goods reduce the demand for goods, which in turn reduces the production. A reduction in goods produced leads to a lower demand for factor inputs, so employment decrease. Consumers’ valuation of their consumption bundle determine whether they would reduce their hours worked in order to consume more leisure, or increase their hours worked in order to achieve the same consumption bundle as before. The latter may be the case if the consumption bundle consists of necessities without any close substitutes that are cheaper.

In the case where sector 2 is VAT-exempt, the relative prices are distorted because sector 2 goods become relatively cheaper while the price of sector 3 goods increase. If we assume that all goods are normal, the price changes will lead to a higher private demand for sector 2 goods, and a lower private demand for sector 3 goods. These effects are highlighted as the distortionary effects of a VAT-exemption of financial services. Relative prices of the goods
are distorted, so consumers are faced with a too low price of sector 2 goods, and a too high price of sector 3 goods because of cascading of taxes into the consumer price.

The same effects are present in the case where sector 2 is subjected to a FAT. The FAT gives a too high consumer price on good 3 because of cascading of taxes into the consumer price. On the other hand, the FAT solves the problem of a too low price of sector 2 goods.

In either case, production is affected when consumers change their consumption bundle when relative prices are distorted. In the end, the social welfare only depend on how well of consumers are regarding the prices they face. Whether consumers choose to substitute away from the goods that have become relatively more expensive, depends on the compensated elasticity of demand. Consumers’ valuation of their new consumption bundle compared to the initial settling, in addition to consumers’ valuation of the increased government tax revenue, determine the effects on social welfare.

In the next chapter I start the empirical analysis of the welfare effects of the introduction of a FAT on financial services.
4 The MSG6-model

In this chapter I introduce the method used for the empirical analysis. To study the effects on social welfare of the introduction of a FAT, I interpret results from model simulations done by using the MSG6-model. MSG6 is an intertemporal, disaggregated general equilibrium model of the Norwegian economy developed at Statistics Norway. I present a description of the model in chapter 4.1. The reference scenario in the model is briefly described in chapter 4.2, before the reform scenario is presented in chapter 4.3. The reform scenario represents the policy change. I add to it a discussion regarding which parameters are changed to reflect the introduction of a FAT.

4.1 The MSG6 model description

A simplified version of the MSG6-model will be used. The description of the model is translated and copied from the report from Statistics Norway Velferdseffekter av redusert selskapsbeskatning i Norge (Bjertnæs, 2015, p. 11-12). All references from the article are kept.

Main features of the MSG6-model

“The model is a version of the empirical, macroeconomic model MSG6 of the Norwegian economy (Heide, Holmøy, Lerskau and Solli (2004)). It gives a detailed description of production and consumption in the Norwegian economy. It is a general equilibrium in the sense that market prices are determined so that markets for goods, services and production factors clear. Products and factors can move between different usages without costs. The model gives a relatively thorough representation of the authorities’ economic instruments and how these affects behavior and welfare in private sector. It is assumed in the reference path that the public sector saves financially to make the pension fund grow. In reform scenarios it is assumed that the financial saving is kept constant for all future generations. Therefore, the standard of the public services is kept as in the reference path, which is an extrapolation of the Norwegian economy with today’s tax system, see Perspektivmeldingen (2013) and appendix for more details.
Consumers are represented by one representative consumer, who’s utility in each period is dependent of consumption of leisure and 26 different consumption goods, see Skjerpen (2010) and figure A1 in appendix. The representative consumer determine her consumption of leisure and the other goods to maximize welfare (economic efficiency), defined as the present value of the utility of consumption. Households can borrow and save in the international financial market where they are faced with a given constant interest rate. In the reference path is it assumed that the financial saving is negative the first decades, while the intertemporal budget constraint gives financial saving equal zero from 2050.

The model has 40 industries, see table A1 in appendix, where each industry consists of more businesses with different productivity and size. Each business produce their own products that are different, but can substitute each other in consumption and intermediate goods. It is therefore not perfect competition, and the companies receive a higher price than indicated by the production costs (markup-pricing). An entry/exit constraint determine the number of businesses in each industry. The businesses maximize the present value of the cash-flow when they decide production level and the composition of intermediate goods, including labor, different capital, goods, services and energy, see figure A2 in appendix. An increase in production increases costs per produced unit (decreasing returns to scale). Production within an industry can increase by new establishments. In the MSG6-model an increase will give a raise in all variants. This generates a welfare gain since the utility of the representative consumer is assumed to increase when the number of consumption goods increase.

Norwegian businesses compete with foreign suppliers both at home and abroad. They compete with the prices given on the world market. For most goods in the domestic market it is possible that the price on Norwegian produced goods and foreign produced goods differ (Armington-hypothesis). Prices in the domestic market can also develop differently that prices of exports, modelled with a cost reflecting the costs of companies ability to wriggle between domestic and the export markets. Terms of trade gains for different goods does not become endogenous if export quantity is varied. A detailed description of the production side of the model is given in Holmøy and Hægeland (1997)."
4.2 The reference scenario

Parameters estimated on behavioral and technological effects are mainly obtained from the Norwegian national accounts, but the MSG6 framework is more aggregated than the national accounts.

The reference scenario in the model is based projections of the Norwegian economy with today’s politics, based on the reference scenario in Perspektivmeldingen (2013). The reference scenario is an extrapolation of the Norwegian economy from 2009 to 2050. In Perspektivmeldingen, the projections covers the period 2009-2060, and includes assumptions regarding growth per year, built on a continuation of today’s behavioral patterns. Projections about future development in value creation and income in the Norwegian economy are based on assumptions on changes in productivity, employment, immigration, revenues from petroleum and returns in the financial markets. The dependence to the world economy is taken into account. There are large uncertainties regarding future development in different parameters, so the preconditions behind the projections are rather unsure.

The projections are based on observations of historical patterns and average yearly growth in total factor productivity in private sector. Exogenous parameters are included in the model using today’s policy, so that taxes, consumption in public sector, and oil- and gas production are included with today’s level. There are large uncertainties in the development in the price of oil in the long run, so the price of oil is in the reference scenario set to 525 NOK per barrel from 2014, in given 2013 prices. The uncertainties regarding the returns to financial markets are also large, and the projections of long term returns are based on the assumptions of returns in a normal situation. The government uses 4 % of the value of the oil fund each period. The increase in disposable real income per capita is expected to double within 2060, where assumptions about the growth in productivity in mainland Norway is the main contributor.

Changes in productivity are based on an average yearly growth in factor productivity in the private sector in the mainland economy, where assumptions regarding technological change and changes in the work force (like total employment and hours worked), institutions and markets, and education and qualifications are made. Total work participation is dependent of hours worked, which is expected to stay unchanged, the employment is expected to decrease, whereas the share of population in working age is reduced in the long run. In the reference
scenario it is expected an equal work participation as today regarding population groups divided into age, sex and country of origin.

### 4.3 The reform scenario

The reform scenario shows the deviations from the reference scenario when changing exogenous parameters. Therefore, the reform scenario incorporates the FAT on financial services into the MSG6-model. As mentioned earlier, the FAT will be an additional tax on wages and a 25% tax on corporate income in the financial sector. When changing parameters, only the additional tax on wages is considered. The tax on corporate income is expected to only reduce the profit within the financial sector and not account for any price changes. Using economic theory, a tax on pure profits does not distort a company’s production behavior.24

In the reform scenario, the financial sector is not divided into groups defining whether a company has a FAT liability or not. Such a classification would require information about the wage costs of each company producing financial services in order to determine the share of each financial service that is subjected to a FAT. Therefore, an additional tax is levied on the whole group of financial services in the model.

MSG6 includes 40 industries, where bank- and insurance business is includes with code 63. This industry represents the financial sector. In order to introduce a FAT, the wage costs and the associated payroll tax has to be known. An additional increase in the payroll tax increases the costs, which creates a spillover into the price of some product. Regarding the insurance sector, the spillover of tax results in an increase in the insurance premium.

In the banking sector, on the other hand, an increase in the wage costs due to the introduction of a FAT will lead to an increase in the loan interest rate. A bank’s profit is determined by the interest margin, which is the difference between loan and deposit interest rate. A bank’s costs are due to the need for capital and where the bank gets its capital from, which is essentially from deposits and market funding, through for instance bonds. Therefore, risk premiums, costs of acquiring capital, and other costs linked to the banking services results in different interest rates for deposits and loans. One of these costs are wages. I expect that the spillover of taxes will be in such a way that the interest margin is kept constant. There is free entry and

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24 This require certain qualifications. Taxing only pure profits require that deductions are given so that a corporate tax is neutral.
exit in the model, which results in no economic rent for the firms. Therefore, there will be a direct spillover into the loan interest rate, and consumers end up paying the entire tax. The spillover into the loan interest rate I assume is more reasonable than a bank lowering its deposit rate. The deposit rate is to a large degree determined by the world market.

To implement the effects of a FAT into the MSG6-model, the user price (return) of capital is increased. The loan interest rate increases when the additional tax on labor is introduced, which in turn increases the user price of capital with the same amount. Cost of capital refers to the opportunity cost of making a specific investment. The expected return from an investment has to be larger than the cost of capital for an investment to be worthwhile, so an increase in the user price of capital therefore require a larger return from the investment in order to be undertaken. Regarding insurance, this reasoning is supported by the fact that insurance premiums to a large degree are related to real capital being insured. The user price of capital is the price of using and owning capital for one period, and is given by the nominal interest rate, depreciation rate and change in price. To illustrate:

The user price of capital before the introduction of tax is $r_{\text{real}} + \delta$, where $r_{\text{real}}$ is the return to real capital and $\delta$ denotes capital depreciation.\textsuperscript{25} Assume a bank gives loans for real investments and that there is implemented a tax on each NOK loaned. No profit for a bank gives an loan interest rate of $r_{u} = r^{*} + c + tf$, where $r^{*}$ is the deposit rate determined on the world market, $c$ is costs (wages etc.) for each NOK loaned and $tf$ denotes the tax. The return to real capital, when there are no profits on loan funded real investments, is then: $r_{\text{real}} = r_{u}$.\textsuperscript{26} The return to loan funded real investments equals the loan interest rate. Therefore, required return to capital increases when the interest rate in the user price increases. Assuming no after-tax pure rents, the user price increases with the same amount as the interest rate so that it equals the required return to capital. The required return to capital is $r_{\text{real}} = r^{*} + c + tf$, so the user price of capital becomes $r^{*} + c + tf + \delta$.

The user price of capital is in the model 0.1, which it also is for most other industries in the model. For financial services, which is included in the model as bank- and insurance services, the payroll tax in the reference year (2009) was 13.929246 %. Increasing this by 5 %-age points gives us the new tax rate of the financial sector.

\textsuperscript{25} Given as a real interest rate.
\textsuperscript{26} Standard arbitrage equation: marginal return of investing equals marginal return of investing in bank deposits, which is equal to the interest rate and the tax in this example. Normally, a risk premium would also be included.
The changes in the user price of capital is calculated in the following way:

Gross debt of households (K2) amounted to 5164 billion NOK in January 2017\textsuperscript{27}. According to model simulations, the increase in tax proceeds from the payroll tax amounted to about 2,384 billion NOK in 2017. That means that the increase in the interest rate for each NOK loaned (K2) amounted to $2.384 \text{ billion}/5164 \text{ billion} = 0.0004616 \text{ NOK}$. It is therefore assumed that the user price for each NOK invested increases with an additional 0.0004616 NOK as a result of the increase in the payroll tax in the financial sector. The user price of capital was initially 0.1, so the increase in the user price is of 0.004616 %. It is assumed that the increased costs for the insurance industry increases the insurance premium that in turn leads to an increased user price of capital. The increase in the user price of capital therefore includes both increased loan interest rate and increased insurance premiums.

In chapter 5 I interpret the results given by the model. The model simulations show effects on social welfare after the introduction of FAT (increased user price of capital). The effects of the exogenous shift are measured as percentage and absolute deviations from the reference scenario. Wages are given in the model, while demand for labor is endogenously determined. Effects on the labor demand is therefore not included in a fortunate way in the model, but will be discussed as in the theoretical presentation in chapter 3.3. On the other hand, keeping wages constant makes the effects that appear on consumer prices direct effects caused by spillover of costs. In addition, the government have to balance its budget on an annual basis. Deviations in the government tax revenue are transferred to consumers using lump-sum transfers. The reallocation of consumer spending are effects on consumption after the introduction of FAT and after consumers have received lump-sum transfers.

\textsuperscript{27} Statistics Norway: Statistikkbanken kildetabell 06716, Innenlandsk kreditt til publikum. Beholninger. Millioner kroner.
5 Effects of the reform scenario

The effects of the reform scenario show to which extent the introduction of FAT affect consumer prices and spending. The government wishes to raise revenue in a way that minimizes the efficiency loss created after a tax is introduced. FAT serves as a corrective tax since it is implemented in order to reduce distortions already present due to the VAT-exemption of financial services.

A FAT is not a VAT, so while some distortions are counteracted, others are not. The FAT does therefore not substitute for the missing VAT to such a degree that we end up in the neutral tax regime discussed in chapter 2.2. As seen in the example in chapter 3.3, the FAT solves the problem of a too low consumer price of financial services, but not the problem of tax cascading for businesses using financial services as inputs in production. No VAT-deductions are given when a sector is exempt from VAT. The introduction of a FAT on one industry in the economy therefore affects consumer prices not only on these services, but also consumer prices of other commodities. The FAT is not neutral, and will therefore create substitution effects because of distorted relative prices. Cross-deliveries of capital and other inputs ties the industries together. First, we can expect the consumer prices of financial services to increase. Further, an increase in a price somewhere in the production cycle causes spillover effects that propagate through the whole business structure. Therefore, increased price of financial services affect the commodity prices in other industries through higher input prices.

The FAT changes social welfare through spillover of costs that lead to higher consumer prices. Consumers have to pay a higher price to obtain the same level of consumption, and are consequently faced with a negative income effect. In addition, prices change differently because of different use of financial services in the production of various goods. Consumers adjust their consumption bundle by substituting away from relatively more expensive consumption goods. To what degree they do so, depend on their valuation of the different goods. As an opposing effect, the additional tax revenue collected by the government is in the model redistributed using lump-sum transfers. These transfers give a counteractive income effect, making it possible for consumers to increase their consumption of all goods. The lump-sum transfers can potentially compensate consumers for their reduced consumption possibilities caused by higher prices, but the substitution effects are still present.
In the model simulations of the reform scenario these price effects stems from an increased loan interest rate, which in turn increases the user price of capital. The effects on consumer prices therefore represent the input-output effects of this price increase.

The effect tables from the MSG6-model show the percentage deviation from the reference scenario when the initial user price of capital of 0.1 is increased by 0.0004616 NOK for each NOK loaned. The economy experiences an unexpected shock in the user price of capital starting in the basis year 2009, where prices are calibrated to unity. It is the increase in user price of capital that leads to price changes in the other sectors. The effect of this price increase on other industries is shown in table B1 in appendix B. In 2017, the user price of construction capital increases with 0.446 %. Further, the costs in other sectors increase relative to the amount of capital they use. In turn, consumption is reallocated because consumer prices are affected.

**Social welfare**

We are interested in the welfare of consumers, which is expressed through the commodity prices they face and their valuation of government revenue. Table B2 in appendix B shows the absolute changes in consumer prices multiplied by 100 (price indexes multiplies by 100). The table shows the prices in the basis year 2009. Price indexes shows the change in price compared to a basis year. These changes stems from the increase in the user price of capital, and includes both direct and indirect effects through the need for inputs in production.

To see the change in prices in 2017 prices, I have calculated the percentwise changes for some of the consumption goods. Price levels in the reference scenario for 2017 have been used, and the percentwise price changes for 2017 are given in table 1 below. How demand for the various goods changes after prices have changes, depends on the expenditure elasticities and compensated price elasticities, which respectively determine the income and substitution effect. First, price changes change consumers’ behavior through an income effect because the consumption possibilities are changed. Second, since prices change with different rates, the compensated elasticity of demand shows to what degree consumers substitute away from the more expensive goods, as discussed in chapter 3.3 regarding the tax wedges. These two effects depend on consumers’ valuation of different goods, and determine to what degree they are affected by the tax.
**Table 1: Percentage change in consumer prices in 2017**

<table>
<thead>
<tr>
<th>Consumption good</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-Food</td>
<td>0.027642276</td>
</tr>
<tr>
<td>02-Non-alcoholic beverages</td>
<td>0.0352</td>
</tr>
<tr>
<td>03C-Liquor and spirits</td>
<td>0.044262295</td>
</tr>
<tr>
<td>03D-Wine</td>
<td>0.03442623</td>
</tr>
<tr>
<td>03E-Beer</td>
<td>0.056097561</td>
</tr>
<tr>
<td>04-Tobacco</td>
<td>0.045081967</td>
</tr>
<tr>
<td>12-Electricity</td>
<td>0.007142857</td>
</tr>
<tr>
<td>13A-Fossil fuels</td>
<td>0.020588235</td>
</tr>
<tr>
<td>13B-Gasoline og autodiesel</td>
<td>0.017886179</td>
</tr>
<tr>
<td>14C-Workshop repair etc.</td>
<td>0.034677419</td>
</tr>
<tr>
<td>21-Clotes and shoes</td>
<td>0.012295082</td>
</tr>
<tr>
<td>24-Other goods</td>
<td>0.02295082</td>
</tr>
<tr>
<td>25-Equipment for leisure activities</td>
<td>0.015833333</td>
</tr>
<tr>
<td>30-Consumption of own means of transport</td>
<td>0.032231405</td>
</tr>
<tr>
<td>42-Electric household items</td>
<td>0.010169492</td>
</tr>
<tr>
<td>50-Housing</td>
<td>0.28974359</td>
</tr>
<tr>
<td>62G-Health services, with fees</td>
<td>0.005925926</td>
</tr>
<tr>
<td>62P-Health service, except fees</td>
<td>0.044029851</td>
</tr>
<tr>
<td>64G-Education, with fees</td>
<td>0.003731343</td>
</tr>
<tr>
<td>64P-Education, except fees</td>
<td>0.04796748</td>
</tr>
<tr>
<td>65-Other services</td>
<td>0.049193548</td>
</tr>
<tr>
<td>66-Norwegians consumption abroad</td>
<td>0</td>
</tr>
<tr>
<td>70-Foreigners consumption in Norway</td>
<td>0.051219512</td>
</tr>
<tr>
<td>75-Road transport</td>
<td>0.043442623</td>
</tr>
<tr>
<td>76-Air transport</td>
<td>0.021774194</td>
</tr>
<tr>
<td>77- Rail- and tram transport</td>
<td>0.080327869</td>
</tr>
<tr>
<td>78-Maritim transport, local traffic</td>
<td>0.037037037</td>
</tr>
<tr>
<td>79- Postal- and telecommunications services</td>
<td>0.076422764</td>
</tr>
</tbody>
</table>
The price changes for each commodity group depend on the use of real capital as input in production, or the use of other intermediates where real capital is used in production. For instance, it becomes more expensive to replace worn out machinery and tools, which is a reason for why rail- and tram transport (77) and postal- and telecommunications services (79) have large price changes relative to other consumption- and service goods. It becomes more expensive to increase storage space because of higher prices of buildings, and maybe even rental prices on office spaces or store rooms increase. Companies want to circumvent such costs, and do so by incorporating them into the prices of their products or by changing their production behavior. As we saw in chapter 3.3 regarding tax wedges created by the introduction of a FAT, the cascading effects caused by a VAT-exemption are worsened for producers using goods with a FAT liability as input in production. So, the higher the need for financial services in production of some good, the higher the price change due to spillover of costs into consumer prices. Thus, pre-existing distortions of relative prices are amplified.

Looking at the most necessary consumption goods and services, the price on food (00) has a percentage change of 0.0276 % in 2017, while health services with and without fees (respectively 62G and 62P) have percentage price changes of 0.0059 % and 0.0440 %. The price increase on clothes and shoes (21) is almost 0.0123 %. Purchase of own means of transport (30) has a percentage price change of 0.0322 %. These price changes are moderate, but indicate a dependence of real capital. For example, food and beverages with and without alcohol (02, 03C, 03D, 03E) require large storage spaces, machinery and transport, which may explain the changes in price of these goods.

Table 1 shows that the price on loan funded housing (50) increases the most, by almost 0.29 % in 2017. An important assumption in the model is that real investments in housing is financed with loans only. Consequently, this finding has to be seen as one extreme case. Another extreme would be that real investment in housing is financed using equity or funding from foreign banks only, where an example is the existence of multinational firms. Therefore, we should expect the effect to lie somewhere in between these two extremes.

I interpret these price changes as price increases. This interpretation is supported by the findings in table 2 below, where we can see that consumers reduce their consumption of the majority of goods. Consumers have to spend more in order to obtain the same level of consumption. An increase in consumer prices is associated with a welfare loss. An income effect indicate a reduction in all consumption goods with increased price. At the same time, a
substitution effect emerges because of distorted relative prices due to different percentage changes. The substitution effect and the consumers’ elasticity of demand towards each individual good determines the effect on spending.

Table 2: MSG6 effect table: change in consumer spending in absolute value (million NOK) in the reference scenario

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2012</th>
<th>2017</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 - Matvarer</td>
<td>0.000</td>
<td>55.401</td>
<td>-8.586</td>
<td>-34.289</td>
</tr>
<tr>
<td>02 - Ikke-Alkoholholdige drikkevarer</td>
<td>0.000</td>
<td>15.122</td>
<td>-4.261</td>
<td>-12.736</td>
</tr>
<tr>
<td>03C - Brennevin og spirit</td>
<td>0.000</td>
<td>7.552</td>
<td>-3.336</td>
<td>-8.361</td>
</tr>
<tr>
<td>03D - Vin</td>
<td>0.000</td>
<td>7.996</td>
<td>-2.480</td>
<td>-6.962</td>
</tr>
<tr>
<td>03E - Øl</td>
<td>0.000</td>
<td>4.319</td>
<td>-2.896</td>
<td>-6.610</td>
</tr>
<tr>
<td>04 - Tobakk</td>
<td>0.000</td>
<td>13.099</td>
<td>-6.065</td>
<td>-14.318</td>
</tr>
<tr>
<td>12 - Elektrisitet</td>
<td>0.000</td>
<td>44.392</td>
<td>23.383</td>
<td>14.152</td>
</tr>
<tr>
<td>13A - Fossile brenser</td>
<td>0.000</td>
<td>1.147</td>
<td>0.430</td>
<td>0.320</td>
</tr>
<tr>
<td>13B - Biobrensel</td>
<td>0.000</td>
<td>2.195</td>
<td>0.819</td>
<td>0.647</td>
</tr>
<tr>
<td>14A - Reservedeler mv.</td>
<td>0.000</td>
<td>5.662</td>
<td>-0.932</td>
<td>-2.912</td>
</tr>
<tr>
<td>14B - Bensin og autodiesel</td>
<td>0.000</td>
<td>16.140</td>
<td>-5.648</td>
<td>-14.975</td>
</tr>
<tr>
<td>14C - Verkstedreparasjoner mv.</td>
<td>0.000</td>
<td>25.048</td>
<td>-8.220</td>
<td>-20.970</td>
</tr>
<tr>
<td>21 - Klar og skotøy</td>
<td>0.000</td>
<td>78.225</td>
<td>-3.318</td>
<td>-27.808</td>
</tr>
<tr>
<td>25 - Utstyr til fritidsaktiviteter</td>
<td>0.000</td>
<td>63.896</td>
<td>-4.686</td>
<td>-27.352</td>
</tr>
<tr>
<td>41 - Mobler og varige konsumvarer</td>
<td>0.000</td>
<td>107.770</td>
<td>35.397</td>
<td>30.309</td>
</tr>
<tr>
<td>42 - Elektriske husholdningsart.</td>
<td>0.000</td>
<td>14.684</td>
<td>7.037</td>
<td>4.893</td>
</tr>
<tr>
<td>30 - Kjøp av egne transportmidler</td>
<td>0.000</td>
<td>-96.707</td>
<td>-44.071</td>
<td>-48.781</td>
</tr>
<tr>
<td>24 - Andre varer</td>
<td>0.000</td>
<td>54.280</td>
<td>-6.849</td>
<td>-27.979</td>
</tr>
</tbody>
</table>
| 50 - Boli...
Table 2 above shows the effect of an increased user price on capital on the allocation of consumer spending. The table shows absolute changes in private consumption in given prices in the reform scenario. It shows to what extent the consumers increase or reduce their consumption of the different goods when prices have changed and additional government tax revenue is distributed using lump-sum transfers. Therefore, it makes it possible to see the shifts in consumer spending when the consumers decide their consumption of goods and leisure so that welfare is maximized.

The table shows that consumer spending is reduced on most goods and services. On the other hand, even though we can see reductions, the table does not show to how large extent consumers are affected by differences in price increases, since we cannot see the percentage change in consumption compared to the reference scenario. Even though some of the goods experienced larger price changes than others, but not the largest spending reduction, the percentage change in spending may be higher. It is therefore important to note that a reason for implementing the FAT is because of too low consumer price of financial services when these services are exempt from VAT. When we see that consumers reduce their consumption, I interpret this as an effect of increased prices making consumers adjust their consumption behavior. When consumers reduce their consumption, producers have to adjust their production. It is possible that come firms have to exit because of reduced demand for their products. This effect contributes to reduce the welfare of consumers, who have a love for variety.

The moderate price changes we saw in table 1 have created effects that makes consumers want to reduce their consumption of most goods. Even spending on necessities such as food and transport are reduced. Increased prices reduce the real wage rate of consumers, creating a negative income effect. This negative income effect is reduced by the distribution of lump-sum transfers. The net effect is ambiguous, since the changes in spending may be results of substitution effects, even though we observe a reduction in spending on most goods. The fact that we also see increase in spending on some goods, indicate that consumers substitute away from the relative more expensive goods rather than having to reduce their total spending. We should at least expect that food has a low expenditure elasticity. The substitution effects are present since prices change differently. For instance, Norwegians consumption abroad increases, indicating a substitution away from domestically produced goods that have become relatively more expensive. Another possible substitution effect is the substitution away from
consumption of goods towards consumption of more leisure. When the real wage rate of consumers is reduced, leisure becomes relatively cheaper than consumption of goods. The labor-leisure decision is distorted because of distorted relative prices.

The table shows that both consumption of private transport and of public transport is reduced. All of these experienced a price increase, as seen in table 1. Spending on own means of transport (30) is reduced the most in absolute value, but has not experienced the highest percentage change as seen in table 2. On the other hand, own means of transport is connected to the use of gasoline and auto diesel (14B), where we also can observe reduced spending. The reductions in consumption of public transport is given by road transport (75) and rail- and tram transport (77). Since we observe price changes for all these transport opportunities, I interpret this as a substitutional effect, where consumers reduce their use of more expensive goods.

The larges effect is on housing, where the increased user price of capital leads to a reduction in loan-financed housing consumption with 555.305 million NOK in 2017. The tax on the user price of capital serves as a tax on housing investments, which in turn reduces loan financed housing investments. Even though an increased price serves as a negative effect on social welfare, it also gives rise to welfare gains since return to housing investments to a large degree is exempt from taxation, whereas return to other investment forms are not. Heterogenic tax treatment of investments leads to distorted relative payoffs, which in turn increases the investments in some objects relative to others. Hence, such a tax treatment of housing is inefficient and leads to a too high allocation of capital into housing relative to other investment forms or usages. Therefore, the increased user price of capital may serve as a contribution to reduce risk and unbalances in the financial sector concerning loan funded housing, even though the main task of the tax is to make up for a too low consumer price.

Bye and Åvitsland (2001) analyses the welfare effects of imposing tax neutrality between housing capital and financial capital. Especially when looking at how taxes have changed because of internalization and mobility of tax bases, taxing house investments may be an additional source of financing public spending. They find that there are possible welfare improving tax reforms in the economy if the increased tax revenue due to a neutral capital income tax is used to reduce either marginal labor income tax or the marginal capital income tax. If instead the generated tax revenue is distributed with lump sum rebating, the efficiency gain would be outweighed by the efficiency loss.
Reduced loan-financed house consumption leads to lower loans for households. Lower loans reduced the interest deductions, which leads to an increase in the tax base of general income for households. On the other hand, the increased loan interest rate increases the deductions so that the tax base is reduced. Which effect dominates is ambiguous.

In the MSG6-model the model specifications are so that the government has to balance its budget in each period. Additional tax revenue collected is therefore transferred to consumers through the use of lump-sum transfers. Positive transfers serve as a counteractive effect on the negative income effect caused by increased consumer prices, but the substitutional effects because of different price increases are still present. Figure 4 below illustrates this.

Figure 4: Reallocation of consumption after a lump-sum transfer is given
(The figure is made using Adobe Illustrator)
In figure 4, the initial settling point is in point 1, where the transformation curve and the budget line intersect. The transformation curve shows different combination of possible production given the resources available, and the budget line shows which combinations of the two goods the consumer can afford. Efficiency require that these two lines are equal, giving the efficient exchange ratio of the two goods. Good $X_1$ is therefore priced too low, which gives a too high consumption of that good. 2: good $X_1$ is taxed to make up for the too low price. The price increase changes the consumption possibilities for the consumer, and the curve becomes steeper. 3: The tax contributes to raise the government tax revenue, which is redistributed using lump-sum transfers. This gives an income effect, making the consumer adjust her consumption bundle. 4: this point shows the new settling point for the consumer after the lump-sum transfer is received. How the figure is drawn, we can see that the lump-sum transfer gives the consumer a higher indifference level than the initial when the consumer reallocate her consumption bundle. The lump-sum transfer gives a positive income effect, making it possible for the consumer to consume more of each good. But, the exchange ratio between the two goods is still not optimal. Tax does not fully make up for the too low price of $X_1$, but some of the misallocation is counteracted. Even though the initial combination of goods is still a possible settle point, the consumer maximize utility by substituting away from the more expensive good.

As described above, higher prices of consumer goods make consumers have to reduce their consumption because of reduced consumption possibilities and because of their preferred exchange ratio between the goods. At the same time, prices change differently, which gives rise to substitution effects, making consumers want to adjust their consumption bundle by substitution away from the more expensive goods. To what degree they do so, depend on their preferences and their ability to reduce their use of some goods. Lump-sum transfers distributed to consumers also reduce or fully compensate consumers for the negative income effect due to increased prices. For instance, a reduced negative income effect may lead to a dominating substitution effect. Since the price of most goods increase, consumers may substitute in the direction of increased consumption of leisure. Whether consumer experiences a welfare reduction or a welfare improvement is not observable. Even though we see a reduction in consumer spending on most of the goods, it may be the case that the reallocation of consumption after the introduction of a tax leads to an increased utility for consumers.

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28 Marginal rate of substitution equals marginal rate of transformation
Thus, the effect on welfare is determined by the consumers’ valuation of their consumption bundle in the reform scenario compared to the valuation of the bundle in the reference scenario.

The way the tax revenue is distributed affects the outcome on social welfare. When using lump-sum transfers, we get the effects described above, with a positive income effect counteracting the negative income effect due to increases in prices. But there are other ways to redistribute that can counteract the effect on consumers’ labor-leisure decision. If for instance the tax revenue generated had been used to reduce labor income taxes, it would serve as a dampening effect on the reduced labor supply. Buettner and Erbe (2013) find a moderate welfare gain when they analyze welfare effects of repealing the VAT-exemption of financial services in Germany, provided that the tax revenue is used to reduce the VAT-rate or other distortive labor taxes. A positive effect of using additional tax revenue to reduce other distortionary taxes is also found by Bye and Ávitsland (2001), who in addition find that lump-sum transfers do not fully outweigh the efficiency losses created, as mentioned above. These two examples show that a tax can be welfare improving, if the tax revenue generated is used to reduce other distortionary taxes.

**Labor demand**

Wages are given in the model, while demand for labor is endogenously determined. Model simulations do not show how wages may change when production and consumption change, or how production and consumption responses may change the wage rate. If wages were allowed to vary, there are several possible effects. For instance is the effect of reduced wages due to lower real capital per worker caused by lower investments not present in the model. Less real capital per worker indicate lower marginal product per worker, and hence a reduced wage rate. Further, a reduced wage rate could potentially lead to a higher demand for leisure, in addition to the effect caused by higher consumer prices and lump-sum transfers. Factor substitution because of increased price of capital could give a dampening effect, but depends on the firms’ ability to substitute in a direction of becoming more labor intensive. Both these effects could lead to a higher wage because of increased need for labor.

To sum up the effects, we have seen that the FAT, which is introduced as an increased user price of capital, results in increased prices. Increased prices are in themselves welfare worsening, because consumers experience a reduced real wage rate. The possibility of firms
opting out can potentially also contribute to a reduced utility for consumers. On the other hand, lump-sum transfers gives a counteracting income effect, making consumers able to consume more of all goods compared to the case of only prices increasing. Different changes in prices because of different need for capital in production leads to substitutional effects. Reduced spending of goods does not necessarily imply a welfare loss, since consumers may substitute away from the more expensive goods and receive a consumption bundle that increases consumer utility. For instance the possible effect of increased consumption of leisure.

Regarding economic efficiency, we observe a higher price of financial services, which is a desired effect of the FAT. Further, an increased price leads to a reduced demand for these services, so that the too high demand and the too high production of financial services are counteracted. The FAT therefore contributed to reduce some of the distortions created by the VAT-exemption. Another positive effect regarding economic efficiency is the effect on loan funded housing. Housing investments have previously faced a rather low taxation compared to other investment opportunities. When imposing a tax on housing, this distortion of relative prices is reduced. On the other hand, a FAT leads to a worsening of pre-existing distortion regarding the business-use of financial services.
6 Summary and conclusion

This thesis is a contribution to illuminate the welfare effects of consumers when introducing a financial activity tax on previously VAT-exempted financial services, and where those effects stems from. Starting off by looking at how taxes are implemented, and which possible tradeoffs faced by the government when implementing a tax, I moved over to show how a general VAT is neutral because of undistorted relative prices, whereas a VAT-exemption of one sector leads to distortions making producers and consumers change their behavior. The VAT-exemption of the financial sector has created unwanted distortions that the government wants to counteract. When a tax like the FAT is introduced, it is with the aim to substitute for the lacking VAT on the majority of financial services.

Taxation of financial services has been widely discussed in the literature. It is a complex issue with reflecting results both on whether to tax and how to tax. The first difficulty lies in the ability to define a tax base. Further, financial services are a heterogenic group of services. When the ideal is to implement a neutral tax, financial services consequentially require a heterogenic tax treatment. Therefore, there are both technical and administrative difficulties in levying a VAT on the value added by the financial sector.

A FAT was introduced in Norway January 1 2017. An additional tax on wages of 5 % and a 1 %-age point higher company income tax than for other sectors are used as proxy for the value added in the financial sector. The FAT solves the problem of a too low consumer price of financial services, but not the problem of tax cascading. On the other hand, it raises the government tax revenue. A larger government revenue is associated with a welfare gain. To what degree, depends on consumers’ valuation of government revenue.

In the theoretical presentation of the input-output model, I illuminated the efficiency losses created when exempting a sector from VAT, and looked at which effects arise when introducing a FAT. Both tax regimes create distortions in terms of distorted relative prices. They both give a too high price on consumer goods produced using financial services as inputs, but the FAT solves the problem of a too low consumer price on financial services. The FAT therefore contributes to reduce some of the inefficiencies caused by the VAT-exemption, a too low consumer price that further leads to a too high demand for these services, followed by a too large production. The FAT reduces the distortion of relative prices faced by
consumers and therefore solved a problem of inefficiency. In addition, introducing a FAT increases the tax base, leading to a higher government tax revenue than in the case of VAT-exemption. A higher price of some good is associated with a welfare loss, at the same time as increased government revenue works as a positive effect on social welfare. The government tax revenue gives consumers utility, since it is transferred back to consumer through for instance increased provision of public goods or a reduction in other distortionary taxes.

The empirical analysis shows the effects of a FAT on social welfare. The FAT has been implemented in the MSG6-model by increasing the user price of capital with the same amount the loan interest rate has to increase to keep the interest margin constant when the payroll tax in the financial sector increase with 5 %-age points. Social welfare is expressed as the sum of indirect utility of prices and consumers’ valuation of government revenue. Effects on consumer prices are direct effects due to the introduction of the tax because of full pass through of costs.

Output from the MSG6 model simulations of the reform scenario show that consumer prices increase when the user price of capital increase. Increased prices give a negative income effect since the real wage rate of consumer is reduced. Consumer prices increase differently because of different need for capital as input in production. As sees in chapter 3.3 regarding the tax wedges created by a FAT, these price increases will hit the producers using most financial services in their production the hardest, creating spillover of costs into consumer prices. The FAT therefore worsen the pre-existing distortions of relative prices. This gives rise to substitutional effects. The use of lump-sum transfers to redistribute the additional tax revenue counteracts the negative income effect, but substitution effects are still present. Price changes are rather small, and we observe both reductions and increases in consumer spending. I find that consumers substitute away from the relatively more expensive goods, such as private- and public transport, and also necessities such as food. I also discuss the possibility of a substitution away from consumption of goods in order to consume more leisure.

Investment in housing has the largest price increase, of almost 0.29 %, and also the largest absolute reduction in spending. The FAT serves as a tax on investments in housing, which has previously been faced with a rather low taxation compared to other types of investments. Even though a larger price for consumers is associated with a welfare loss, this tax treatment may serve as a positive effect on economic efficiency because it counteracts the distortion in relative prices of different investment opportunities.
The fact that wages are given in the model and that tax revenue is distributed using lump-sum transfers may give unfortunate effects on consumer prices and social welfare. Further studies should therefore include a more throughout analysis of employment, in addition to look at different distributional schemes regarding the tax revenue. I mention two examples in the literature that have studied the effects of using the additional tax revenue raised to reduce other distortionary taxes. Using the additional tax revenue to reduce for instance labor income tax or the general VAT-rate could give different effects on consumer spending. The key difference is that a reduction in taxes as the two mentioned do not lead to a substitution towards more leisure, rather, they work as an opposing effect. As I did in the theoretical presentation of the tax reforms, a further analysis on this subject could include simulations comparing a neutral tax regime to the case of VAT-exemption. The FAT is implemented to serve as a substitute for missing VAT, so comparing these results with the ones I interpret would give a better understanding of strengths and weaknesses concerning the design of the FAT.

A FAT is not a VAT. Even though some distortions are counteracted, the FAT is not a neutral tax. The FAT contributes to reduce the distortion of a too low consumer price of financial services, but we will still have cascading of taxes onto other industries tax bases. How the tax affect social welfare, depend on consumers’ valuation of their new consumption bundle. How the additional tax revenue is distributed is an important contribution to the welfare effects. It has also been argued that the VAT-exempt of financial services has given the sector the possibility of growing too large and to attract too much risk, as addressed by Finanskriseutvalget and Keen (2011). Even though the aim of the FAT is to substitute for the missing VAT, the tax may in addition contribute to stabilize the financial sector through reduction of risk when the use of financial services is reduced for both consumers and businesses. As pointed out by Keen (2011), it may be reasons to put neutrality aside in order to reduce risk. Thus, increasing the costs in the sector by introducing a tax will lead to wanted spillovers into prices, leading to a reduction in both private- and business demand for financial services, which is a desired effect when wanting to reduce risk. So, even though the FAT introduced is not a neutral tax it may cause less distortion than the VAT-exemption. It is up to further research to decide whether the effects on social welfare needs further consideration, and how to optimally distribute the additional tax revenue.
References


Appendix A


Central assumptions in the reference scenario:

The reference scenario is an extrapolation of the Norwegian economy from 2009 to 2050. Exogenous parameters are retrieved from the reference scenario in Perspektivmeldingen, see Perspektivmeldingen (2013) for a detailed overview. Exogenous parameters consists of taxes from today’s tax system, consumption in public sector, and oil- and gas production. World market prices and productivity growth in private sector increase by 1.6 % annually. Population growth is obtained from estimates made by Statistics Norway.
### Table A1: Production sectors in the MSG6-model

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<tr>
<th>MSG6 kode</th>
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</tr>
<tr>
<td>12</td>
<td>Skogbruk</td>
</tr>
<tr>
<td>13</td>
<td>Fiske og fangst</td>
</tr>
<tr>
<td>14</td>
<td>Oppdrett av fisk</td>
</tr>
<tr>
<td>15</td>
<td>Prod. av andre konsumvarer</td>
</tr>
<tr>
<td>18</td>
<td>Prod. av tekstil og bekleddning</td>
</tr>
<tr>
<td>21</td>
<td>Foredl. av fiskeprodukter</td>
</tr>
<tr>
<td>22</td>
<td>Foredl. av kjøtt- og meieriprodukter</td>
</tr>
<tr>
<td>26</td>
<td>Prod. av trevarer</td>
</tr>
<tr>
<td>27</td>
<td>Prod. av kjemiske og mineralske prod.</td>
</tr>
<tr>
<td>28</td>
<td>Grafisk produksjon</td>
</tr>
<tr>
<td>34</td>
<td>Prod. av treforedlingsprodukter</td>
</tr>
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<td>Prod. av kjemiske råvarer</td>
</tr>
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<td>40</td>
<td>Raffinering av jordolje</td>
</tr>
<tr>
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<td>Produksjon av metaller</td>
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<tr>
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<td>Prod. av oljeplattformer mv.</td>
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<td>Bygg- og anleggsvirksomhet</td>
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<td>Bank og forskningsvirksomhet</td>
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<td>Utenriks sjøfart</td>
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<tr>
<td>66</td>
<td>Råolje og naturgass, utv. og transport</td>
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<td>Tjenester tilkn. olje og gassutvinning</td>
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<td>Elektrisitetsproduksjon</td>
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<td>Lufttransport mv.</td>
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<td>Jernbanetransport og sporveter</td>
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<td>Innenriks sjøfart</td>
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<td>79</td>
<td>Post og telekommunikasjon</td>
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<td>Varehandel</td>
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<tr>
<td>85</td>
<td>Annen privat tjenesteproduksjon</td>
</tr>
</tbody>
</table>

Figure A1: The structure of the utility function of the representative consumer in the MSG6 model

Total consumer demand (CB)

Food, beverages and tobacco (FBT)
- Food (00)
- Tobacco (04)
- Coffee, tea and cocoa etc. (05A)

Non-alcoholic beverages (BO)
- Alcoholic beverages (BA)
  - Beer (03A)
  - Wine (03D)

Soft drinks, carbonated water etc. (03B)

Housing (HO)
- Gross rents (RE)
  - Heating (HE)
    - Electricity for heating (12HE)
  - Electric goods (EG)
    - Electricity for electrical household equipment (12EG)
  - Electric household equipment (42)
  - Public fees charged on gross rents (50G)

Communication (CO)

Local communication (LCO)
- Local transport (LT)
  - Public transport, local (LOT)
  - User cost of cars, local transport (31L)
  - Taxi transport (75LT)

Long-distance communication (DCO)
- Postal and telecommunication services, long-distance (79D)
  - Railway transport, long-distance (77D)
  - Tramway and subway transport (77LT)
  - Motor bus transport, local (75 LB)

Local transport (LT)
- Public transport, local (LOT)
  - User cost of cars, local transport (31L)
  - Car maintenance, local transport (14AL)

Private transport, local (LPT)
- Motor bus transport, local (75 LB)
- Taxi transport (75LT)
- Car maintenance, long-distance transport (14AD)

Private transport, long-distance (DPT)
- Air transport (76)
- Car maintenance, long-distance transport (14BD)

Public transport, local (LOT)
- User cost of cars, local transport (31L)
- Car maintenance, local transport (14AL)

Public transport, long-distance (DOT)
- Petrol and oils, local transport (14BL)
- Motor bus transport, local (75 LB)
- Car maintenance, long-distance transport (14AD)

Petrol and oils, long-distance transport (14BD)

Public transport, long-distance (DOT)
- User cost of cars, long-distance transport (31D)
- Car maintenance, long-distance transport (14BD)

Public transport, long-distance (DOT)
- Petrol and oils, long-distance transport (14BD)

Other goods and services (OGS)
- Direct purchases abroad by resident households (66)
  - Goods for recreation, activities (25)
  - Other goods, excl. public fees (22)

Other goods, excl. public fees (22G)

Other goods, excl. public fees (22A)

Other goods, excl. public fees (60A)

Other goods, excl. public fees (60G)

Food, beverages and tobacco (FBT)
- Food (00)

Non-alcoholic beverages (BO)
- Alcoholic beverages (BA)
  - Beer (03A)
  - Wine (03D)

Soft drinks, carbonated water etc. (03B)

Goods for recreation, activities (25)

Other goods, excl. public fees (22)

Other goods, excl. public fees (22A)

Other goods, excl. public fees (60A)

Other goods, excl. public fees (60G)

Food (00)

Non-alcoholic beverages (BO)
- Alcoholic beverages (BA)
  - Beer (03A)
  - Wine (03D)

Soft drinks, carbonated water etc. (03B)

Housing (HO)
- Gross rents (RE)
  - Heating (HE)
    - Electricity for heating (12HE)
  - Electric goods (EG)
    - Electricity for electrical household equipment (12EG)
  - Electric household equipment (42)
  - Public fees charged on gross rents (50G)

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- Local transport (LT)
  - Public transport, local (LOT)
  - User cost of cars, local transport (31L)
  - Taxi transport (75LT)

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  - Railway transport, long-distance (77D)
  - Tramway and subway transport (77LT)

Local transport (LT)
- Public transport, local (LOT)
  - User cost of cars, local transport (31L)
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- Air transport (76)
- Car maintenance, long-distance transport (14BD)

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- User cost of cars, local transport (31L)
- Car maintenance, local transport (14AL)

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- Motor bus transport, local (75 LB)
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Public transport, long-distance (DOT)
- Air transport (76)

Other goods and services (OGS)
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  - Goods for recreation, activities (25)
  - Other goods, excl. public fees (22)

Other goods, excl. public fees (22G)

Other goods, excl. public fees (22A)

Other goods, excl. public fees (60A)

Other goods, excl. public fees (60G)

Food (00)

Non-alcoholic beverages (BO)
- Alcoholic beverages (BA)
  - Beer (03A)
  - Wine (03D)

Soft drinks, carbonated water etc. (03B)

Housing (HO)
- Gross rents (RE)
  - Heating (HE)
    - Electricity for heating (12HE)
  - Electric goods (EG)
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  - Public fees charged on gross rents (50G)

Communication (CO)

Local communication (LCO)
- Local transport (LT)
  - Public transport, local (LOT)
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Long-distance communication (DCO)
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  - Railway transport, long-distance (77D)
  - Tramway and subway transport (77LT)

Local transport (LT)
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- Petrol and oils, long-distance transport (14BD)

Public transport, long-distance (DOT)
- Air transport (76)

Other goods and services (OGS)
- Direct purchases abroad by resident households (66)
  - Goods for recreation, activities (25)
  - Other goods, excl. public fees (22)

Other goods, excl. public fees (22G)

Other goods, excl. public fees (22A)

Other goods, excl. public fees (60A)

Other goods, excl. public fees (60G)

Figure A2: The production structure for firms in MSG6


29 This table is the same as in Bjertnæs (2015) p. 33, but the English version is copied from Heide, Holmøy, Lerskau and Solli (2004).
## Appendix B

**Table B1**: MSG6 effect table: percentage change in user price of real capital, buildings in the reference scenario (multiplied by 100)

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<th>2012</th>
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<td>NC</td>
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</table>

Table B2: MSG6 effect table: private consumption price indexes, absolute changes in consumer prices in the reference scenario (multiplied by 100).

<table>
<thead>
<tr>
<th>Item Description</th>
<th>2009</th>
<th>2012</th>
<th>2017</th>
<th>2030</th>
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<tr>
<td>00 - Matvarer</td>
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<td>04 - Tobakk</td>
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test