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Essays on taxation and government expenditure

Tuomas Kosonen

Master of Social Sciences

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Abstract

This thesis consists of an introduction to a topic of optimal use of taxes and government expenditure and three chapters analysing these themes more in depth. Chapter 2 analyses to what extent a given amount of subsidies affects the labour supply of parents. Municipal supplement to the Finnish home care allowance provides exogenous variation to labour supply decision of a parent. This kind of subsidy that is tied to staying at home instead of working is found to have fairly large effect on labour supply decisions of parents. Chapter 3 studies theoretically when it is optimal to provide publicly private goods. In the set up of the model government sets income taxes optimally and provides a private good, if it is beneficial to do so. The analysis results in an optimal provision rule according to which the good should be provided when it lowers the participation threshold into labour force. Chapter 4 investigates what happened to prices and demand when hairdressers' value added tax was cut in Finland from 22 per cent to 8 per cent. The pass-through to prices was about half of the full pass-through and no clear indication of increased demand for the services or better employment situation in the sector is found.

Key words: Public economics, optimal taxes, government expenditure, labour supply, VAT

Tiivistelmä: Tämä väitöskirja koostuu julkistaloustieteen alan verotusta ja valtioiden varojen käyttöä esittelevästä johdantoluvusta ja kolmesta luvusta, jotka analysoivat tämän aihealueen osateemoja tarkemmin. Luku 2 tutkii kuinka paljon vanhemmille annettu tuki vaikuttaa heidän työn tarjontapäätöksiinsä. Kotihoidontuen kuntalisä tarjoaa vanhempien työn tarjontapäätöksistä riippumatonta vaihtelua tukien suuruuksissa. Tämän tyyppisen tuen, joka on sidottu kotona olemiseen työnteon asemasta, havaitaan vaikuttavan suhteellisen paljon vanhempien työn tarjontaan. Luvussa 3 tarkastellaan teoreettisen mallin avulla milloin julkisen vallan on optimaalista tarjota yksityishyödykkeitä. Mallissa valtio asettaa tuloverot optimaalisesti ja tarjoaa yksityishyödykettä, jos sen havaitaan olevan

optimaalista. Luvun analyysi tuottaa julkiselle vallalle tarjontasäännön, jonka mukaan yksityishyödykkeen tarjoaminen on optimaalista, jos sen tarjoaminen alentaa työvoimaan osallistumisen kynnystä. Luku 4 tutkii mitä hinnoille ja palveluiden kysynnälle tapahtui, kun parturi-kampaamojen arvonlisäveroa alennettiin Suomessa 22 prosentista 8 prosenttiin. Veron alennus meni hintoihin läpi puolella täyden läpimenon määrästä. Merkittävää kysyntävaikutusta tai työllisyyden lisäystä alalle ei tutkimuksessa löytynyt.

Avainsanat: Julkistaloustiede, optimaaliset verot, julkinen tarjonta, työn tarjonta, ALV

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When writing this thesis I have for the most part been employed in Finnish Doctoral Programme in Economics (FDPE) and University of Helsinki. Most of the time my office has been located in Government Institute for Economic Research (VATT). I have also visited University College London (UCL) for one year and received 10 months of funding from the Academy of Finland project led by professor Matti Tuomala and governed through University of Tampere.

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I dedicate this book to my grandmother Sirkka who, being wise and strong mind, is a true source of inspiration and strength to continue pursuing my goals in life.

Helsinki, December 2010

Tuomas Kosonen

Contents

Chapter 1

Introduction

1.1 Background

How to collect tax revenue and how a government should spend that revenue is one of the age-old questions in economics. The question has not lost its importance in modern times, since the amount developed countries collect in tax revenue has increased. The answer will depend on the economic conditions and what we think about economic behaviour. Consequently, the development of economic theory has affected the answer economists will give about what kind of tax system is optimal.

Early on, the debate was about how to collect enough revenue with little distortion. There was some discussion as to whether income taxes or consumption taxes were preferable. Eighteenth-century economists tended to favour consumption taxes and in many countries income taxes were implemented as late as in the 19th or 20th centuries (Salanié 2003). Adam Smith, for example, considered that taxes on wages were fully shifted to wages, but had a more elaborate analysis about the shifting of consumption taxes to the prices of goods (Blaug 1997, Ch 2). Nowadays most research tends to focus on income taxation. It is important to analyse both types of taxes, not least because they are widely used as sources of government income in developed countries.

However, the more fundamental question relates to the existence of tax-

ation in the first place. In public finance it is thought that the main role of taxation is to redistribute income and guarantee certain basic functions of the state (at a minimum). The former is usually achieved through income taxes and subsidies, including all sorts of income transfers from the government to individuals. The latter includes a wide range of activities from national defence to the public provision of day care for children. While in general these topics have attracted much research in the past, recent developments in this field reveal that there is still much to learn. Even if it is agreed that there should be some taxation, there is uncertainty regarding the optimal design of a tax structure. To what extent should the government support those not in the labour force relative to the taxes it imposes on those in it? Should taxes on different commodities be uniform or should they differ from each other? These are questions where further research will be needed.

1.1.1 Research Traditions

Efficiency

Efficiency was the main concern in early 20th-century economics. Standard economic theory claims that the consumption of goods depends on supply and demand factors. These form a static equilibrium, which is defined by prices and quantities. In this standard model, the first and second welfare theorems state that market outcomes lead to efficient allocations. An equilibrium is efficient if no reallocation is Pareto improving. When implementing economic policy, the more efficient the policy is the less losses it creates.

The models used in public finance take into account the specific way in which taxes can be distorting. In conditions that lead to efficiency in market allocations, lump-sum taxes can be used to redistribute income without inducing inefficiency. At a given government revenue requirement, revenue can be collected efficiently using lump-sum taxes. These are uniform if it is also assumed that individuals are homogeneous. With heterogeneous individuals, lump-sum taxes differ across individuals, but are undistorting

if they do not depend on decisions taken by individuals rather than their type.

Empirically, states collect revenue via other forms of taxes which are distorting. Then the aim of tax theory is to provide results that minimise the inefficiency caused by distorting taxation. The seminal article by Ramsey (1927) analysed this kind of problem. In his article there are n consumption goods that are taxed linearly. The simplified version of this result where the optimal tax of a good depends inversely on its own demand elasticity is particularly well known. The general version of the Ramsey result is more complicated than that. The result could be interpreted in such a way that the effect of a tax on changes in the equilibrium quantity of each good should be uniform. Alternatively, the distortions imposed by taxation on each good should be equal. The efficiency loss induced by taxation depends on the effect of the quantity of each good. Thus the Ramsey model is a general equilibrium model that accounts for efficiency effects resulting from linear commodity taxation.

Equity and Efficiency, the Mirrlees Model

In 1970s the assumption of informational asymmetry was incorporated into the analysis of tax systems. In this second-best world taxes can be distorting because of the inefficiencies created by the information asymmetry. This creates a specific reason why lump-sum taxes are not possible tax instruments to the government. For this reason consumption taxes can not be set differently depending on amount consumed to each household, since it is not known how much each household consumes. Instead consumption taxes need to depend on the value of the good consumed. Moreover income taxes can not be levied as a lump sum since it is not known how much each individual would produce in the absence of taxation. Levying too much tax on individuals would induce inefficiency since the labour supply decision would be distorted downwards. If a state wants to redistribute income - an equity problem - it needs to take into account to what extent the taxes it collects distort - an efficiency problem.

Mirrlees (1971) formulated a theory of optimal income taxes which takes into account both equity and efficiency considerations. The main aspects of the model are a government that aims to maximise a welfare functional, information asymmetry and heterogeneity regarding the ability of individuals to supply labour. Equity considerations are addressed in this model through the government's objective of redistributing income. The extent of this desire can be adjusted by selecting different welfare functionals that weight the utilities of individuals across the income distribution according to the redistribution objective. The efficiency enters the model through the information asymmetry allowing the labour supply to diminish if taxes are set too high. Individuals know their ability type, but governments only observe total labour income, i.e. productivity multiplied by the working hours or intensity of an individual. If individuals are not given proper incentives, they will alter their labour supply behaviour.

In solving this problem, one is able to balance the equity and efficiency requirements with an optimal income tax schedule. The solution formulated by Mirrlees (1971) is not completely informative about the shape of the income tax schedule. The general results inform us that the optimal tax schedule is not linear, it can be progressive and marginal tax rates are not negative. There is also a zero result for individuals in the bottom and top points of income distribution if there is no bunching, but these results are very local in terms of the whole distribution.

Technically the Mirrlees model is formulated as an optimal control problem. The incomes and utilities of individuals are optimised over a continuum of ability types, rather than time. The incentive compatibility constraint that allows individuals to choose according to their type forms the equation of motion. The government revenue constraint is incorporated into the objective functional.

Mirrlees's (1971) article was followed by a large amount of literature. Recently, Saez (2001) derived results from assumptions similar to those of Mirrlees (1971), but producing much more practical rules utilising the elasticities and shape of an empirical income distribution rather than a theoretical ability distribution. This makes it easier to obtain the shape of optimal

income tax schedule in empirical simulations. There is a parameter describing the redistributive tastes of the government and labour supply elasticity parameters for each part of the income distribution so as to capture the inefficiency effects of taxation.

One of the simplifying assumptions in the Mirrlees model is that the individual's decision is simply to choose the amount of working hours or work intensity; there is only an intensive labour supply elasticity. In this intensive elasticity it is assumed that individuals respond to marginal changes in taxes solely through marginal adjustments in the amount or intensity of labour supplied. Saez (2002) considered a more complicated problem where there is an extensive labour supply elasticity in addition to an intensive labour supply elasticity. Then changes in taxes can induce some individuals to drop out of the labour force, even if they are not at the bottom of the income distribution. In this model it can be optimal to have negative marginal tax rates, thus making in-work subsidies optimal. This feature is amplified in proportion to the degree of the extensive labour supply elasticity. In the second essay of this thesis (chapter III), I analyse public provision of goods in an optimal income tax model that incorporates both the extensive and intensive labour supply margins.

Consumption taxes

Taking information asymmetry and the equity considerations into account will affect which kind of consumption taxes are desirable. The Ramsey (1927) model is valid when using linear income taxes and taking efficiency into account. However, the Ramsey model is a representative household model, making it impossible to take equity considerations into account. Later literature has adjusted the optimal consumption tax analysis to more realistic situations. For example, Myles (1989) formulated the Ramsey result with imperfect competition.

What about the choice between income taxes and consumption taxes? In a static framework, linear income tax and uniform consumption taxes yield equivalent outcomes in terms of collecting revenue. Corlett and Hague

(1953) investigated the relationship between consumption taxes and labour taxes in an economy where there are at least two consumption goods and individuals also supply labour. Proportional income taxation is assumed. Their main finding is that goods that are complementary to leisure should be taxed more than goods that are substitutes for leisure. One drawback of this model is that the supply side is assumed to be perfectly elastic so that the equilibrium quantities of goods are affected only through demand-side effects. Then it is not possible to obtain the Ramsey effect that taxing one good differently from others also affects the equilibrium quantities of other goods (possibly through changes in production). Another missing element in the Corlett and Hague (1953) model is a more realistic treatment of income taxation.

Diamond and Mirrlees (1971) address the missing equity aspect in the Ramsey model by generalizing it to a population of heterogeneous households. The problem of the Ramsey model is that the result tends to put higher taxes on necessities such as food and lower taxes on luxuries. This has been seen to be a socially unjust rule, and stems from considering efficiency alone. The Diamond and Mirrlees model (1971) takes both aspects, efficiency and equity, into account. The resulting rule has an element that suppresses taxes on the kind of goods that are consumed by socially valued individuals who have a high marginal value for money. There is also an element relating to efficiency, similar to that in the Ramsey model, that emphasises the effect of taxes on the quantity of a good in equilibrium. Thus their result balances between these two effects.

Considerable attention is also given to conditions where uniform commodity taxation is optimal (Diamond and Mirrlees 1971 and Atkinson and Stiglitz 1976). If the consumption of goods and leisure is weakly separable in individual utility functions, consumption taxes should be uniform across commodities. All the necessary redistribution can be dealt with through optimal income taxes, and differentiating consumption tax rates does not increase efficiency.

Another set of results considering commodity taxes has addressed the question, whether income should be redistributed through income taxes or

consumption taxes. The question is similar to that addressed by Corlett and Hague (1953), but now there is income to be redistributed across a heterogeneous population. If optimally set income taxation takes care of redistribution, then consumption taxes could be uniform. Mirrlees (1976) sets up a model where heterogeneous individuals supply labour and consume goods. Income taxes are set optimally together with consumption taxes. Optimal consumption taxes are not uniform if they reveal information about the ability or productivity of an individual. A similar result was obtained by Atkinson and Stiglitz (1976). These models assume that there are constant returns to scale and the supply side is perfectly elastic. Thus Ramsey-type efficiency considerations are not properly taken into account. Naito (1999) has investigated the general equilibrium model with two types of workers.

Public goods

Part of the tax revenue collected is used in government expenditure to provide public goods. Public goods satisfy non-excludability and non-rivalry properties. No-one can be excluded from consuming them once they are provided. Examples of public goods are infrastructure, national defense and pure air. Therefore a public good enters all utility functions in an economy. For this reason there is market failure. Since everyone can consume them, the market prices are not informative of the extent to which they are produced. Instead it is efficient to provide such goods collectively (Myles 1995, Ch 9).

If market prices do not provide information how much of a public good should be provided, how do we know what is the optimal amount? Samuelson (1954) developed a simple rule that equates the marginal substitutions of private and public goods to the marginal rate of transformation to produce the public good. The interpretation of this rule is that the good should be provided as long as individuals on aggregate enjoy the marginal increase in their consumption of the public good. This is equated with the marginal costs of producing the good.

Few goods are actually pure public goods. In many instances individuals

could be prevented from consuming the good in question with finite costs. For this reason, the analysis has been extended to the case of publicly provided private goods (Blackorby and Donaldson 1988 and Besley and Coate 1991). Examples of these kinds of goods are education, health care and child care. Standard economic reasoning states that it is better to give monetary transfers than goods. Then the recipient can decide how to spend the extra income in a way that is optimal for him or her. However, it is optimal to provide a private good publicly because this helps to alleviate the information problem. If everyone is given the amount needed for health care it is more expensive than to provide the health care because everyone would accept the money but only those who need the health care would consume it. This reasoning works if it is not known who needs health care.

The state collects the taxes and provides the public good. Thus optimal taxes and public goods should be considered in the same analysis. There is literature considering the provision of a public good together with optimal income taxes (Mirrlees 1976, Christiansen 1981). The findings are that public provision should follow the Samuelson rule if consumption of a public good does not alleviate the information problem of the government. If the public good is separable from leisure in an individual utility function, the consumption of public good does not reveal information about the individual's ability type and thus provision of public good should follow the Samuelson rule. On the contrary in a situation where consumption of public good and leisure are not separable, it is optimal to provide a public good that is a substitute for leisure more than the Samuelson rule implies. Government provision improves efficiency, since taxes need not be as distorting as they would be without provision of the public good. In the second essay of this thesis I study the public provision of a private good when the government sets income taxes optimally. There is also an extensive margin of labour supply in the model and the public provision of the good can affect this margin.

A prime example of this kind of good is children's day care. Public provision of day care may be optimal because the good is related to the employment decisions made by parents. When day care is complementary

to the labour supply, it should be provided to a greater extent than the Samuelson rule implies. In the first essay of this thesis (in chapter II), I analyse how child care related subsidies affect the labour supply decisions of parents.

1.2 Summary of the essays

Here I give a short summary and the main results of the essays in the thesis.

1.2.1 The effect of child care subsidies on the labour supply of parents

For any modern state it is essential that most of the population supplies labour. There are instances where it is not possible for working-age individuals to do so. In developed countries the public sector provides them financial support. While it is agreed that this kind of social security is needed, there is also a worry that too much of it discourages working. For empirical research the challenge is to measure to what degree financial support discourages working. In the first essay (Chapter II) of this thesis, I study the labour supply decisions of parents who are given financial support if they stay at home taking care of their children. The question this article answers is, how large is the participation elasticity for a sub-population of mothers.

In the Finnish day care system a relatively generous home-care allowance is given to parents who stay at home to take care of their children. It consists of a national allowance and a supplement in some municipalities. This subsidy clearly increases incentives to stay outside of the labour force for prolonged periods. Changes in the municipal supplement provide exogenous variation in the labour supply of mothers. The variation is exogenous to the labour supply since being eligible for a supplement does not depend on one's current labour supply decision or income prior to maternity leave. A mother is eligible for a supplement based on the municipality she lives in and the age of her youngest child.

Using this feature of the Finnish day care system, I am able to study the parameters used in optimal income tax models. In Saez (2002) the participation decision depends on the difference in after-tax incomes corresponding to two different employment status, working and not working. With variation in the home-care allowance, I also have variation in this difference. It corresponds to the after-tax income when one is not working. Thus, the home-care allowance can be used to estimate the participation elasticity of individuals who are at different points along the income distribution when employed.

The main results show a supplement leads to significant negative labour supply and earned income effects. The estimated effect indicates that 4 per cent fewer mothers participate when a supplement is increased by 100 euros per month. Surprisingly, I find a larger response for higher-educated than for lower-educated mothers. To put these reduced-form estimates into a policy context, I estimate participation elasticity using the exogenous variation as an instrument. The results indicate a participation elasticity of 0.9 for all mothers. These findings survive a battery of sensitivity and robustness checks. I perform all estimates for fathers as well, but do not find any effect on their labour supply.

In comparison to previous studies, a municipal supplement provides several attractive features to study how changes in taxes affect the labour supply. Municipalities have changed their supplements on several occasions. This allows me to compare very similar people with each other. For example, Eissa and Liebman (1996) compared the outcomes of mothers with women without children and Blundell et al. (1988) compared the outcomes of women across education levels and cohorts, although it is reasonable to assume that these two groups behave in different ways. The multiple reforms introduced at different points of time also help to clean out macro shocks from the treatment and control groups. This would not be the case if the reforms were enacted simultaneously or there was only one treated group as in Schone (2004) and Baker et al. (2008).

Many reforms used in previous studies have mostly affected income of low-income individuals when they are working (e.g. Eissa and Liebman

1996 and Milligan and Stabile 2007). On the other hand, a municipal supplement affects the after-tax income of everyone when they are not working. Consequently, I am able to estimate the participation elasticity for different income levels using education as a proxy for income. These participation elasticities can be used in tax simulations analysing the optimality of tax systems (Saez 2001, Saez 2002 and Immervoll et al. 2007). To improve these policy relevant simulations, it is important to know more about the labour supply responses of different subgroups. In contrast to most earlier results, the results show an increasing participation elasticity profile in income (Eissa and Liebman 1996).

This study also adds to the literature estimating the labour supply effects of child care policies. The policies range from lowered day care prices (Lundin et al. 2008, Baker et al. 2008 and Lefebvre and Merrigan 2008) to employment responses of maternity leave (Baker et al. 2008b) to child care-related benefits (Milligan and Stabile 2007)[1].

1.2.2 Public provision of private goods with optimal income taxation and extensive margin

Public sector services vary across countries. Health care, day care for children, care for the elderly and education are mostly publicly provided in Nordic countries, while in Anglo-Saxon countries the system relies more on private markets. The second essay of this thesis studies the optimality of public provision of a private good when the good can affect the extensive margin of labour supply. The model includes income taxation that is set optimally by the government. Therefore, the model analysed here is connected to the Mirrlees (1971) tradition.

In the original Mirrlees (1971) model there is only an intensive labour supply margin. This assumption does not fit with the actual working hours

[1]Milligan and Stabile (2007) studied the National Child Benefit reform in Canada. With province-level reforms, the variation that they observed does not arise from a single treated group, a problem in many of the articles cited above. Their results indicate an elasticity of 0.96 from having earnings as a major source of income, which is comparable to what I find.

distribution, where there is bunching at zero hours and strictly positive working hours, but nothing between. Recent optimal income tax literature has addressed this issue (Saez 2002, Immervoll et al. 2007 and Eissa et al. 2008). Taking the participation decision into account makes it optimal to have negative marginal tax rates. It can be optimal to radically reduce the tax burden of the working poor and at the same time reduce unemployment benefits. Also, empirical studies find the extensive elasticity to be larger than the intensive elasticity (Eissa and Hoynes 2004, Blundell 2006). This tends to amplify the significance of taking the extensive margin into account in optimal income tax models.

The second essay studies the optimality of public provision whilst taking the participation decision into account. To model that, there is a fixed cost arising from participation. This assumption has been used in earlier papers (Cogan 1981, Immervoll et al. 2007 and Eissa et al. 2008). The intuition is that to participate, one needs to suffer or pay a fixed cost. The fixed cost can be any cost or burden that is a one-time event and arises only when participating. This could be, for example, children's day care, the time cost involved in travelling to work or, at a more general level, the cost of finding a job.

As in Saez (2002), here the government can affect the utility difference between working and not through income taxes. At the same time, the government can affect the distribution of fixed costs through public provision. If the good is children's day care, public provision of it lowers the fixed cost relative to a situation where people buy day care on the private market at a higher price. Thus, provision of day care in this case is beneficial, since it allows more people to participate. Other things being equal, the government receives higher tax revenue.

It is assumed that the fixed cost is private information and individuals are heterogeneous in terms of the extent of it. Thus, the fixed cost is very much like the ability type in the traditional Mirrlees (1971) model. The difference here is that there is a threshold for the fixed cost. If an individual has a fixed cost higher than the threshold value, he or she decides not to participate.

From this setting the optimal tax rates and optimal public provision rules are derived. The results imply that in this second-best world it is optimal for the government to use both taxes and public provision of goods to redistribute a given amount of income as efficiently as possible. The limiting case, where public provision should follow only the Samuelson rule, is when it has no effect on the distribution of fixed costs. In all other cases the provision rule depends on direction in which public provision affects the distribution of fixed costs. The participation tax rate amplifies this effect.

1.2.3 What was actually cut in the barbers' VAT cut?

As noted in section 1.1.1 of this introduction, there are competing ideas in economic theory as to how to set consumption taxes optimally. In the third essay of this thesis I focus on the Ramsey tradition. In this setting the level of the consumption tax on a good relative to the taxes on other goods depends on the elasticities of demand and supply for that good and cross-price elasticities with other goods. Incomplete competition can be introduced into the model. If a good has inelastic demand and elastic supply this tends to lead taxes to be forward-shifted completely to consumer prices. Then there is no change in the amount of goods purchased, since demand does not react to changes in taxes.

This article aims to estimate empirically how taxes shift to prices and their effect on demand. I utilise the tax reform that introduced reduced value added tax (VAT) rates on hairdressers' services in Finland. The reduced VAT is exogenous to the economic conditions of hairdressers, since this group was selected in the European Commission directive long before the experiment was implemented in Finland. There are natural control groups for hairdressers: beauty salons, day spas and masseurs. These are labour-intensive services like hairdressers, but do not benefit from a reduced VAT regime.

This study adds to the knowledge about the tax incidence of consumption taxes. Doyle and Samphantharak (2008) study tax incidence on gaso-

line prices. They have a credible method for revealing the effect of taxes from regional temporary tax repeals in some regions in the USA. They find 100 to 70 per cent pass-through to prices. The results are not directly comparable with this study due to the different product (gasoline) they study. There are other studies focusing on the tax incidence of sales taxes on various products (Poterba (1996), Besley and Rosen (1999) and Alm, Sennoga and Skidmore (2009)). These studies give valuable information in a very understudied subject area. If consumption taxes across different commodities are to be set optimally, there should be knowledge of the demand elasticities for all the goods categories.

The reduced VAT experiment in Finland offers several advantages in analysing the tax incidence of VAT. First, since the reform is exogenous to the behaviour of firms, it is possible to use a natural experiment set-up in analysing the effects. The outcomes of the treatment and control groups can be compared before and after the experiment takes place. Second, the data contains both remitted taxes and prices for a sample of firms. Consequently, it is possible to analyse how VAT affects the demand for labour-intensive services. Any effect on employment in these services has to go through changes in demand for the services.

The results indicate about a 50 per cent pass-through to the consumer price. The response shows interesting heterogeneity according to firm type and product type. Turnover evaluated in consumer prices follows the direction in which consumer prices change, but not to the same extent. From the sample where prices and turnover information can be linked to the same firm, the results for demand do not indicate any significant increase due to the VAT reduction. Thus I conclude that for this group consumption taxes should not be lower relative to some other services. With little effect on demand, the effect on employment is negligible.

The interesting feature of the third essay is that the experiment is exogenous to the economic conditions of the selected industries, making the results more reliable. Also, the subject is labour-intensive services, for which lower VAT is claimed to produce large employment effects (EC 1999).

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Chapter 2

The effect of child-care subsidies on the labour supply of parents

[1]

Abstract

This paper studies the effect of child-care subsidies on maternal labour supply. In the Finnish child-care system, parents taking care of their children at home receive a relatively generous home-care allowance. I use variation arising from changes in the municipality-specific supplement to this allowance to identify the causal effect of subsidies on the labour force participation of mothers. A municipal supplement creates plausibly exogenous variation, since being eligible for it depends on municipal-level rules, but not on changes in individual labour supply decisions. I find a large negative effect on the labour force participation and income of mothers. 100 euros more supplement per month reduces the maternal labour supply by 4 per cent. The estimated effect is larger for higher-educated than for lower-educated mothers.

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2.1 Introduction

A key question faced by most industrialized countries concerns policy measures aimed at increasing labour supply. With ageing populations, a smaller workforce will have to provide for a larger retired share of the population. At the same time it has proved difficult to extend working lives through changes in retirement policies (Lindbeck and Persson (2003) and OECD (2009)). This has led to increased attention towards the study of labour supply decisions in different phases of working age. One important gap in working lives occurs when parents have children. Mothers in particular may not participate in the labour force for many years after they give birth.

This paper studies the impact of child-care subsidies on maternal labour supply. In the Finnish day-care system a relatively generous home-care allowance is given to parents who stay at home to take care of their children. This subsidy clearly increases incentives to stay outside of the labour force for prolonged periods. Changes in a municipal supplement to this allowance provide exogenous variation in the labour supply of mothers. The variation is exogenous to the labour supply since being eligible for the supplement does not depend on current labour supply decisions or income prior to maternity leave. A mother is eligible for a supplement based on the municipality she lives in and the age of her youngest child.

A municipal supplement to the home-care allowance provides a good case for using a regional experimental set-up. There are no other regionally varying policies that affect mothers of young children in Finland. Moreover, a municipality might offer a supplement simply because it is a popular policy among voters. The decision to do so is not likely to depend on the municipal employment situation. There is, however, a worry that a supplement policy could be endogenous to the labour supply. After presenting the estimation approach, I discuss institutional reasons and empirical evidence showing that policy endogeneity does not cause a threat to the identification strategy.

The main results show that increasing the supplement has significant negative labour supply and earned income effects. The estimated effect indicates that 4 per cent fewer mothers participate when a supplement is

increased by 100 euros per month. Surprisingly, I find a larger effect for higher-educated than for lower-educated mothers. To put these reduced-form estimates into a policy context, I estimate participation elasticity using exogenous variation as an instrument. The results indicate a participation elasticity of 0.9 for all mothers. These findings survive a battery of sensitivity and robustness checks. I perform all estimates for fathers as well, but do not find any effect on their labour supply.

In comparison with previous studies, a municipal supplement provides several attractive features for studying the labour supply effects of a policy. Having many treatment and control regions allows me to compare very similar people with each other. For example, Eissa and Liebman (1996) compared mothers and women without children and Blundell et al. (1998) compared women across education levels and cohorts, although it is reasonable to assume that these groups behave in different ways. Municipalities have changed their supplement policies on several occasions. The multiple reforms introduced at different points of time help to distinguish the treatment effect from common macro shocks to treatment or control group. This would not be the case if the reforms were enacted simultaneously or if there was only one treated group (Schone (2004) and Baker et al. (2008)).

Saez (2002) defined that the decision to participate depends on the relative difference in after-tax income when working and when not. There can be variation in both, income when working and when not. Most previous studies (e.g. Baker et al. (2008), Milligan and Stabile (2007) and Lundin et al. (2008)) utilize exogenous variation in the former: the after-tax income when working. On the other hand, a municipal supplement affects the latter: after-tax income when not working. Using this feature, a municipal supplement allows us to estimate participation elasticity. To estimate the participation elasticity, the income associated with the counterfactual participation status needs to be simulated for everybody in the sample. The municipal supplement is used as an instrument for the change in after-tax income simulated for everybody. The amount of supplement one is eligible for does not depend on family income. Consequently, the municipal supplement is a good instrument for the income difference. The

resulting IV estimate, the participation elasticity, can be used in tax simulations analysing the optimality of tax systems (Saez (2001), Saez (2002) and Immervoll et al. (2007)). The estimated participation elasticity of 0.9 is higher than that used in many simulations. It highlights that the participation response varies across sub-groups.

An attractive feature of the variation in the municipal supplement is that in absolute terms it affects individuals from any part of the income distribution equally when they do not work. Although the income that the parents would have had when participating is missing, their acquired education is known. Since education is a good proxy for income, the divided sample results by education can be used to estimate the effect taxes have across income distribution. This is interesting since many earlier papers analysed policies where most of the variation in labour supply incentives affected the lower end of income distribution (e.g. Eissa and Liebman (1996) and Milligan and Stabile (2007)). In this case, I am able to estimate the participation response across the whole income distribution of parents. In contrast to earlier studies, the divided sample results indicate an increasing income profile (Eissa and Liebman (1996)).

This study also adds to the literature estimating the labour supply effects of child-care policies. These policies range from lowered day-care prices (Lundin et al. (2008), Baker et al. (2008) and Lefebvre and Merrigan (2008)) to the employment responses of maternity leave (Baker et al. (2008b)) to child-care-related benefits (Milligan and Stabile (2007)[2]. A typical finding is that policies have some effect, although not in all cases[3].

The rest of the paper proceeds as follows. In section 2.2, I present the source of the variation in child-care subsidies. I also provide a short

[2]Milligan and Stabile (2007) studied the National Child Benefit reform in Canada. With province-level reforms, the variation that they observed does not arise from a single treated group, a problem in many of the articles cited above. Their results indicate an elasticity of 0.96 from having earnings as a major source of income, which is comparable to what I find.

[3]Lundin et al. (2008) do not find any employment effect from a Swedish reform that put a cap on child-care prices. Similarly, Havnes and Mogstad (2009) do not find that a Norwegian day-care reform had any effect on maternal labour supply. This is interesting, since the Swedish and Norwegian child-care institutions are similar to those in Finland, except that Finland has a significant home care-allowance system.

description of the Finnish child-care system. The identification issues and the econometric specification are discussed in section 2.3. In section 2.4, there is a description of the data-set and the descriptive statistics. The estimation results are given in section 2.5. In the same section there are some robustness checks. A discussion of the economic interpretation of the results and an estimation of participation elasticity are presented in section 2.6. Section 2.7 discusses the economic policy implications of a supplement. The last section concludes the study. The appendices contain the tables and figures referred to in the text.

2.2 Forms of child care

Child care can be structured in many ways. To understand the particular features of the Finnish institutions, I first compare these to the arrangements in other countries. I then describe the Finnish day-care system in more detail and discuss how the institutions result in exogenous variation in the labour supply of parents.

2.2.1 How is Finland doing compared to other countries?

The Nordic countries provide extensive public day-care and parental leave policies. Children are entitled to a place in a public day-care centre. The price for day-care is heavily subsidized by the government. In Anglo-Saxon and central European countries day-care relies more on private providers. The price a household ends up paying for day-care can be much higher than in the Nordic countries. Parental leave policies are provided in the Nordic countries for parents whose youngest child is under one year old (with national variation). This is much more than in the other OECD countries in general. In Finland the home-care allowance continues for as long as two years after maternity leave. The home-care allowance works in a similar way to parental leave: one has the right to return to one's previous

work place after the leave and there is a subsidy from the government to the mother.

A key feature that countries try to influence through their child-care institutions is the employment rate of mothers. Figure A1 presents maternal employment rates by the age of the youngest child in selected countries in 2005. It is evident that the Nordic countries have higher employment rates than the OECD countries on average.

The first column in figure A1 shows the employment rate of mothers whose youngest child is under 3 years old. This column stands out for Finland even compared to the other Nordic countries. In contrast to Sweden and Denmark, Finland provides a home-care allowance for this group. I hypothesize that the Finnish home-care allowance system has an effect from on the labour supply of parents. When mothers are no longer eligible for this allowance, their employment rate shoots back to the high level seen in the other columns in figure A1.

2.2.2 Finnish day care

The idea of the Finnish child-care system has been to provide financial assistance to parents regardless of the choice a parent makes. After maternity leave (when the newborn child is 10 months old), parents can choose essentially between three child-care alternatives, all of which are financially subsidized by the government: home care, public day care or private day care.

Public day care is the predominant choice in Finland for a typical family. Every child under the age of 7 (when they start primary school) is entitled to a public day-care place if requested[4]. Day-care fees (DC) are regulated by the government - a typical family with two children in public day care paid 380 euros per month in 2005. Private day care is also subsidized[5].

[4]This is stated in legislation. Before 1995 the law stated that every child under the age of 4 is entitled to public day care.

[5]This system has been in place nationwide since 1997. Between 1995 and 1997 there was an experiment in 33 municipalities that provided a similar allowance. Viitanen (2007) describes this experiment in detail. She found a positive effect on the use of private day care, but little effect on labour force participation.

Furthermore, municipalities are able to pay a municipal supplement on top of the private day-care allowance if they choose to.

This study focuses on the employment effect of the home-care allowance and a supplement to it. Thus, the point of interest is not whether a family chooses private or public day care. These two choices are similar in terms of the employment decision.

When a child under 3 years of age is cared for by a parent, he or she is entitled to the child home-care allowance (HCA). This national allowance can be paid until the youngest child not in public or private day care reaches the age of 3. The amount depends on the family's characteristics and is from 300 to 500 euros per month. The child home-care allowance may be paid to either parent, although it is predominantly the mother who takes up the allowance.

A municipal supplement (S) to the home-care allowance constitutes an interesting variation in this study. Some municipalities have decided to pay a supplement on top of the national home-care allowance while other municipalities have no supplement policy. The municipal supplement has been part of the Finnish child-care system since the 1980's. The observation period reaches from 1995 to 2005. Over this period, there were around 450 municipalities of which 5 had adopted a supplement policy in the beginning, rising to 65 at the end. Figure A2 shows how the municipal supplement has spread over time. There is also a map showing the population in each municipality. Clearly the group offering a supplement contains bigger cities than the group that does not, but there are cities in the group that does not have the supplement policy.

A parent faces who works faces different fee and subsidy schemes than a parent who does not. Below the fees and subsidies when a parent is in work (I_{work}) and when not ($I_{Notwork}$) are described:

$$I_{work} = Earned(I) - DC(I) \tag{2.1}$$

$$I_{Notwork} = HCA(I) + S * 1(m = 1, childage < 3, other) \tag{2.2}$$

where *Earned* refers to earned income net of tax, DC to day care fees, HCA to home-care allowance and S to the supplement to it. The I in parentheses indicates that the fee or subsidy is a function of personal or family income. The eligibility for the supplement depends on municipal level rules, but not on income (in most cases).

Although there are strict national rules about how municipalities have to provide child care, municipalities may choose their supplement policies relatively freely. Thus there is a lot of variation in the details of how each municipality pays its supplement. Typically a municipal supplement is paid per child. It is possible to receive an extra supplement if the youngest child has older siblings. The mean monthly supplement level in the data is 200 euros and the mean sibling extra supplement is 50 euros per family. With the exception of a few municipalities, the municipal supplement does not depend on family income. There is also a prior-work condition in some smaller municipalities, according to which to be entitled to the municipal supplement the parent must have worked prior to going on parental leave.

For what reasons do municipalities pay supplements to the home-care allowance? The literature does not say much about the reasons why municipalities provide a supplement. Typically municipal councils use assessments made by civil servants in municipality to indicate what would happen if a supplement is implemented in municipality. These assessments typically compare the costs arising from placing all the children in an age group to public day care or to home care taking the potential supplement into account. These assessments typically do not take the labour supply decisions of parents into account. Some municipality councils may also appreciate the idea of a parent taking care of young children themselves instead of a paid nurse.

2.3 Identification and econometric strategy

To estimate the effect of a municipal supplement on maternal outcomes, I apply a differences-in-differences (DD) and a triple difference approach. In the DD strategy I compare outcomes for mothers living in different munic-

ipalities before and after there was a change in supplement policy. Mothers living in a municipality that did not change its supplement policy comprise the control group. A supplement policy is measured as the actual supplement a mother is eligible to based on her observable characteristics. Thus it is not a dummy variable as in the basic DD approach. The model is estimated for mothers with children between 9 months and 3 years old. In the triple-difference estimation the third difference is whether or not the youngest child is under 3 years old. This distinction is meaningful, since the upper age limit for the youngest child to receive a supplement is 3 years old. I estimate the OLS equation:

$$Y_{iym} = \alpha + \beta_1 P_{iym} + \beta_2 X_{iym} + \beta_3 Mun_m + \beta_4 Year_y + \varepsilon_{iym} \tag{2.3}$$

The dependent variable is labour supply or earned income, Y. In the labour supply case it is a dummy variable with a value of 1 when a parent participates and zero otherwise and in the earned income case it is a continuous variable. The key explanatory variable is P (eligibility to municipal supplement). The model identifies β_1, the effect of a subsidy P_{iym} on labour supply Y_{iym} in year y, municipality m and individual i. In the case of labour supply, β_1 shows the change in probability of a parent supplying labour when P is increased by one unit. The other variables in equation (4.3) are the municipal Mun_m and year $Year_y$ dummies and a control vector X_{iym}. When estimating the triple difference, the control vector includes the interaction terms of the dummies used in the DD approach. Any change in P is allocated to a simultaneous change in Y. The only reason for a change in Y should be that there is a change in P, conditional on the covariates. Since P varies in the municipality and year dimensions, the identification relies on municipal and year-level changes. That is why the controls include municipal-level variables such as average unemployment rate and share of children in day care relative to the number of children in a municipality. The control vector also includes individual-level variables to cope with the individual-level variation. This should reduce variation in the error term.

Changes in a municipality's supplement rules depend on the age of the

youngest child. Simultaneously a mother's decision to return to work is correlated with the age of the youngest child. Consequently, β_1 would be biased away from zero if this correlation were not taken into account. Municipal supplement rules regarding the youngest child's age vary considerably. In some cases the upper age limit for eligibility is raised gradually from 1 year and 2 months to 2 years. Thus to be able to control for this variation in a flexible way, I needed to include dummies for the age of the youngest child. In the main estimates a dummy for each 3 months of age of the youngest child controls away all the unwanted correlation between policy rules and child's age. Other specifications for the length of the age interval in the dummy produce similar results as in the main estimates.

2.3.1 Identification issues

The DD approach identifies a causal effect of the municipal supplement on outcome Y provided that certain assumptions hold. I use the standard DD assumption that selection into treatment should be exogenous to outcome. In particular, the model identifies β_1 conditional on controls if the following condition holds:

$$E[Y^0_{iym}|m, y, P_{iym}, X_{iym}] = E[Y^0_{iym}|m, y, X_{iym}] = \delta_m + \lambda_y + \beta_1 X_{iym} \quad (2.4)$$

where I note the outcome of the control group by Y^0_{iym}. The assumption that guarantees the identification here is that P_{iym} (eligibility to supplement) is exogenous to Y^0_{iym} (labour supply). Also, the aggregate employment time trends should be parallel between the treatment and control groups. It seems credible that mothers within a municipality do not self select into treatment, since the municipal supplement is offered to everyone living in a municipality with children of the correct age. There would be a problem with identification if changes in a supplement would induce mothers to be more fertile. This seems unlikely that fertility is a problem from the identification point if view, since a change in supplement potentially affects employment this year. Potential increase in fertility would lead to

increased number of 1 year old children two years from the change in supplement. Finally the composition of the groups ought to be similar; people are not expected to move from municipality to other based on changes in supplement policy. After the estimation results I present some robustness checks as a defense against these potential problems.

"How Much Should We Trust Differences-in-Differences Estimates" is a question raised by Bertrand et al. (2004). Their simulations show that potential problems with inconsistent standard errors are less severe if there are many treated and control groups and the reforms are implemented at different points of time. One virtue of analysing the Finnish home-care allowance system is that there are over 400 municipalities, 65 of which had supplement policies in 2005. The reforms were implemented at different points of time.

2.3.2 Policy endogeneity

One potential problem here is policy endogeneity, as discussed by Card and Levine (2000) and Lalive and Zweimuller (2004). The main worry is that a shock to municipal economy leads to a change in supplement rules. In this case it might appear that the supplement has an effect to an economic outcome, such as employment, when in reality there is no causal effect. Fortunately for the identification, there are institutional reasons and empirical evidence against policy endogeneity hypothesis.

Municipal councils usually make the decision to implement a supplement based on assessment made by civil servants working in the municipal government. The assessment typically includes calculations about financial situation of the municipality, how many children would be affected by the new policy and how large are the costs of the new policy to the public day care in the municipality. After having the report the municipal council deals with the proposal and if it is approved, the municipal government makes the final decision in their meeting. This whole process takes time and the civil servants have influence to the decision implying that quick changes based on sudden shocks or political desires are not likely to be possible to

implement. The identification in this paper relies on the effects of sudden changes in municipal policy. This implies that the slow decision process is one defense against policy endogeneity because the shock to the municipal economy is unlikely to affect the supplement policy quickly, whereas .

As to why municipalities want to implement supplement policies, it seems the main reasons are attempting to reduce the number of children in public day care and having an image of child-friendly municipality. This reasoning still does not guarantee that the policy endogeneity is not present. Therefore, as a further evidence against policy endogeneity hypothesis, I describe below how municipal level data behaves prior to implementing a supplement policy.

Figure A4 and table A1 presents coefficients from a fixed-effects regression on municipal-level data where indicator of implementation of supplement to home care allowance ($1(implem)$) explains number of dependent variables (Y_{tm}) in year t and municipality m. The regression model used is:

$$\begin{aligned} Y_{tm} &= \alpha_m + \beta_{-2}1(implem_{t-2,m}) + \beta_{-1}1(implem_{t-1,m}) + \beta_0 1(implem_{t,m}) \\ &\quad + \beta_1 1(implem_{t+1,m}) + \beta_2 1(implem_{t+2,m}) + X'_{tm}\zeta + \epsilon_{tm} \end{aligned}$$

I have included leads and lags of the implementation indicator variable ($1(implem_{t-2,m})$ - $1(implem_{t+2,m})$) and year fixed effects and in some cases number of children as covariates (X'_{tm}). Evidence of policy endogeneity emerges if I find that there are shocks to dependent variables prior to implementation of the supplement. The identification strategy used in the micro-level analysis uses municipal level fixed effects. Therefore level differences between municipalities are not endangering identification, shocks prior to implementing a supplement are.

The first dependent variable in both the table and the figure is the extent of resources in euros a municipality uses to the supplement. The idea of this variable is to show that the supplement policy rules affect the dependent variable when they should. Figure A4 shows results of three other variables: Number of babies (aged 0 or 1 years), Net costs of municipality in all local government activities and the Employment rate of women. The important

fact to take away from the figure is that there are no significant variation in coefficients of implementation variables prior to implementation of a supplement. The stable coefficients indicate that a municipal supplement was not implemented in response to a sudden change in economics conditions that these variables describe.

Women are a relevant group as a potential future treatment group, therefore their employment rate describes important economic conditions for the analysis. Majority of women are not mothers of 1-2 years old children in any one point of time. Thus women in general are much more general group than sub-group of mothers who have small children.

Table A1 shows leads and lags from regressions with other dependent variables: in column (2) cost of child care to municipality in log euros, in column (3) logarithm of number of children in private care, in column (4) logarithm of number of children receiving home care allowance, in column (5) employment rate and in column (6) logarithm of migration to a municipality. Number of children receiving home care allowance could be affected after the municipality implements supplement to it. Indeed there is slight increase in this variable one year after the municipality implements the supplement. The evidence against policy endogeneity in these results is that there does not seem to be significant variation in coefficients prior to implementation of the supplement. More rigorous robustness tests are performed with micro data after the main estimation results.

2.4 Data and descriptive statistics

The main data set in this study is individual-level micro data for the years 1994 to 2005. The data comes from multiple sources. The base data, Income Distribution Statistics (IDS), comes from Statistics Finland and is individual-level data, containing over 25,000 observations from about 10,000 households per year from a population of about 5 million Finns. The main estimation sample includes families whose youngest child is between 9 months and 3 years old. Pooled for all years, there are about 6,000 households in this group and about 14,000 households that have children

under the age of 6. In the data there is a rich set of variables describing family characteristics, demographics, incomes and benefits derived from registers and surveys. The rest of the information is at the municipal level and has been linked to IDS data. It comes from a survey of municipalities conducted by the University of Turku, a survey of municipalities conducted by the author, from the Social Insurance Institution of Finland and from Statistics Finland. The data is a repeated cross section at the individual level, although there is a rotating panel system[6]. Aggregated to the municipal level, the data is a panel where each municipality can be followed over the years.

Table A2 shows descriptive statistics derived from the data. It categorizes mothers according to the age of their youngest child. Mothers in the main estimation sample, shown in the first column, are on average 32 years old and have at least high school education almost 50 per cent of the time. The most typical families are those with one or two children, but there are also larger families in the data.

The outcome variables in this study are employment rate and earned income. I construct the employment rate using earned income statistics. The data for these variables originally come from tax records and are on annual basis. I define mothers as employed when their annual income is higher than half the mean income of women who are between 22 and 55 years old and not disabled from working or retired[7]. The employment trend of mothers according to this variable by the age of the youngest child is shown in figure A5. This shows clearly how the employment rate of mothers increases with the age of the youngest child. From this figure it is clear that the employment rate of mothers is correlated with the age of the youngest child. The figure also shows the share of those receiving a municipal supplement relative to all mothers in the sample by the age of the youngest child. It is noticeable how the two lines have opposite slopes.

[6]In rotating panel each household is surveyed in two consecutive years and each year half of the sample consists of new households. Thus there are two consecutive observations for each individual. The data is a panel at the municipal level.

[7]This specification ensures that I calculate the mean income from a population that is mainly in the labour force.

The explanatory variable used in the main estimations is a supplement to the home-care allowance. In estimating participation elasticity, the home-care allowance, day care fees and family income are also used as dependent variables to measure the change in after-tax incomes associated with entry. The amount one is eligible for is imputed to everyone in the sample using observable characteristics (family size, age of children and municipality they live in) and the eligibility rules. These rules are described in section 2.2. To make income uncorrelated with actual working status, it is imputed for those not being in work based on observable characteristics and the incomes of those who are in work. Two after tax incomes are calculated for each family, one corresponds to the mother not being in work and the other to the mother being in work. If there are multiple children the only scenario calculated is one where all the children are treated similarly.

The mean values, standard deviations and number of observations of supplement and employment rate are shown in table A3. In the table, the share receiving supplement column describes the size of the share of the sample that is eligible for a supplement. The table contains statistics of mothers whose youngest child is between 9 months and 3 years old, and for selected years. Table A3 is divided to two parts: the left panel contains everybody in the sample for the year in question, and the right panel contains only those who live in a municipality with a supplement policy in place in the year in question. From the table it is evident that it has become more common to be entitled to receive a supplement. Over the same time period, the mean amount of supplement has changed for those receiving it. The average monthly supplement is around 200 euros towards the end of the observation period. Mothers do not on average have a very high participation rate, and this is also reflected in their low gross incomes. The right panel only contains those receiving a supplement that year. It is interesting to note that the employment rate and the mean gross income have fallen over time relative to the whole sample in the left panel.

2.5 Estimation results

Table B1 shows the main estimation results. The dependent variables are the mothers' labour supply dummy and earned income. The monetary variables (like the municipal supplement and earned income) are in 100 euros per month. I perform all the estimations for fathers as well and find zero effect on their labour supply.

The results in table B1 are organized as follows: there are two panels, top and bottom, which are divided according to the dependent variable. The top panel presents the results for the employment dummy, which is coded as 1 if the earned income is more than half the average income of working-age women. In the bottom panel the dependent variable is earned income. In column (i) there is a plain regression of municipal supplement on the dependent variable. Column (ii) presents a difference-in-differences (DD) estimate, including year and municipal-level dummies, dummies for the age of the youngest child for every three month intervals, and a number of control variables. By controlling away municipal-level differences, the results become more significant and negative. Column (iii) presents the triple difference results. The third difference is between having the youngest child in the age group of 9 months to 2 years or of 3 to 5 years. The latter age group is never entitled to a supplement to the home-care allowance. An advantage of the triple-difference estimate is that it allows controlling for municipality-specific time trends.

The main result for the work-dummy indicates that increasing the municipal supplement by 100 euros per month causes 4% fewer mothers to participate. The main result for income indicates that increasing the municipal supplement by 100 euros per month decreases the annual income by 1190 euros[8]. Since there is probably some variation in the way in which mothers respond to the municipal supplement, I interpret these results as the average treatment effect on the treated.

The result in column (iii) seems to be robust with quite a flexible set

[8]The average net income per month for a woman working full time is around 1410 € (own calculations).

of control variables. As a sensitivity check I tried to include a linear time trend for every municipality, use another definition for the work dummy[9] and exclude some individual municipalities or years. Tables C2 and C3 show some of the results. Since the point estimate does not change much when conditioned on municipal-level variables, the result does not depend directly on the macroeconomic conditions of the municipality. The coefficient of the supplement is in general quite robust to controlling for many individual and municipal-level effects. However, one variable deserves special attention; age of the youngest child. Since this variable is closely correlated with the employment of mothers and the treatment is not constant within the age of the youngest child, it turns out to be important to include this covariate.

There are various threats to identifying true average treatment effect on the treated with the chosen strategy, as discussed in the identification section. I perform robustness checks in table B2 to check if there is a problem with identification. Column (i) introduces a pseudo-rule that makes mothers whose youngest child is between 3 to 5 years old eligible for the municipal supplement if they live in a supplement municipality. The estimates are otherwise similar to those in table B1, column (ii) for the work-dummy outcome. Families with older children appear natural candidates for performing a robustness check on, since their characteristics should otherwise be close to families that just have a little younger child. The zero result here indicates that a supplement policy does not have a delayed effect on mothers employment. The result is in line with OECD (2007) statistics that indicate that the employment of mothers with children of this age is much higher than the employment of mothers with younger children.

Column (ii) of table B2 presents a robustness check for a different group: women who are going to have a child the following year. Here I utilize the rotating panel feature of the data. The model is estimated for families that will have a child aged 9 months or younger the following year, but do not currently have any children between 9 months and 3 years old. Thus, they

[9]The other definition is the number of months worked as based on a survey question. The results for this are shown in table C1. There is a measurement error in this variable, thus I did not use it in the main estimates.

are not yet entitled to municipal supplement, but live in municipalities that have the policy. This estimate should tell something about the potential anticipation effect. However, the coefficient of the supplement is zero. This indicates that there is no serious anticipation effect (although the sample size is only 533 in this estimate).

Column (iii) checks if there is a higher probability of ending up in the estimation sample associated with changes in a supplement policy. The outcome is a dummy indicating whether or not a person is a child under three years old (who are usually those who are entitled to a supplement). This model is estimated for everyone in the data. The result shows that the supplement does not have any effect in terms of causing children to end up in the estimation sample. Thus families with small children do not seem to move to municipalities offering a supplement[10]. Moreover, mothers in supplement municipalities do not seem to be more fertile because of the supplement. Column (iv) presents a base-line estimation, but with the simplified rules needed for the implementation of a supplement used in other robustness checks. The coefficient of the municipal supplement is similar to main estimates, and the simplification of rules does not seem to affect the estimates.

The treatment effect may also be heterogeneous. To check for this, I divided the sample according to two dimensions: the number of children in a family and the mother's education. The results are shown in table B3. The dependent variable is the mothers' labour supply dummy and the supplement is measured in 100 euros per month.

The interesting thing in these results is that the result is much stronger for families with 1 or 2 children (coefficient is more significantly different from zero) and the coefficient for larger families, although non-significant, is actually positive. It is surprising that for the higher education group, where mothers have an educational qualification higher than high school, the coefficient is larger than for the lower education group[11]. Eissa and

[10]Finnish municipalities are typically large in surface are. Thus, moving to another municipality usually means moving to a completely different city or town.

[11]This difference is somewhat smaller when the income of a spouse is controlled for,

Liebman (1996) found a larger estimate for their lower education group. However, the reform analysed by Eissa and Liebman was Earned Income Tax Credit (EITC) reform targeted to working poor. It is therefore not surprising if they found small effect for higher educated mothers. The municipal supplement, in contrast, is based on the municipality a mother lives in. Consequently, the amount one is eligible to does not depend on the education one has. The supplement thus provides a good way to analyse participation responses across education levels.

The result that those with higher education respond more is surprising, since in the literature the opposite is assumed (Saez 2002 and Eissa et al. 2008). Education is usually taken as a proxy for income or at least the capability to earn higher income. The result in table B3 can be interpreted as mothers with higher earnings responding on average more than those with lower earnings. In the literature on optimal income taxes with an extensive margin of labour supply it is usually assumed that the poor have higher participation elasticity than the rich (see e.g. Saez 2002 and Immervoll et al. 2007). This assumption is usually made when simulating the welfare effects of a tax reform across income distribution. If at the same time the participation tax rate is high at the bottom of the income distribution, the assumption about a declining participation elasticity profile makes an EITC-type tax profile more attractive.

2.6 Participation elasticity

This section presents the participation elasticity results. It is interesting to put the effect of a supplement on labour supply in a policy-relevant context. The participation elasticity is a parameter that can be used for this. For instance, in optimal income tax models taking the extensive margin into account there is an inverse elasticity rule that uses the inverse of the participation elasticity analysed here (Saez 2002).

To estimate the participation elasticity, I need to calculate net after-tax

but still exists

income associated with participation for everybody. For this, I need to know two income numbers for every mother. One measures after-tax income when not working and taking care of children and the other measures after-tax income when working and having children in public day care. The incomes used in the analysis corresponding each choice are shown in equations (2.1) and (2.2). The net after-tax income is formed by taking the difference of these two measures. I need to make assumptions here, and one of them is that the two choices just described are the only ones available to mothers in respect of taking care of their children.

One of the two incomes is always non-observable for a person. A typical solution to this is to simulate the two income measures for everybody based on pre-determined characteristics. I use information in the data set about incomes for those in work to predict incomes based on the observable characteristics including age, education and gender.

The difference in these would itself suffer from an endogeneity problem. Therefore I use the municipal supplement as an instrument for the change in after-tax incomes associated with participation. The various robustness checks presented in the previous section contribute to validating the use of this instrument. To be a good instrument, the municipal supplement should be exogenous to the labour supply of an individual. On the other hand, it should directly affect the income one gets when the change in participation status is made. The coefficient should have a positive sign because the subsidies enter the income equation with a negative sign.

The results are shown in table B4. The explanatory variable is again a dummy for participation status. Now the unit is 1 euro per year. The first stage, shown in the first line, is very strong. There is almost a one-to-one relationship between change in incomes and the amount of supplement one is eligible to. The second stage results from 2SLS suggests that the amount mothers gain when they participate leads to an increase in participation probability of .0028 % for each additional euro per year.

The participation elasticity (η) implied by the coefficient in the table B4 can be calculated as

$$\eta = \frac{dparticipation}{dincome} * \frac{income}{participation} =$$

$$\beta * \frac{income}{participation} = 0.0000277*((11600)/(0.355)) = 0.91$$

The above elasticity is calculated on an annual basis. The 11,600 euros is the average change in net income associated with labour market entry for a typical mother. The 0.355 is the average participation rate in the population for which the estimation was made. Table B5 shows the participation effect by education level. The result is significant only for mothers with a university degree or higher. The participation elasticity implied by that estimate is 1.48 with a mean yearly income of about 16,000 euros and a participation rate of 0.61. The results for other education groups imply a lower participation elasticity than in the main estimate for the whole population.

The estimate is performed more structurally here than in other studies analyzing child-care benefits and prices (Baker et al. (2008) and Milligan and Stabile (2007)). Here the change in net after-tax income associated with entry is taken explicitly into account. This is possible since supplements do not directly depend on income. To report some earlier estimates in the literature, Baker et al. (2008) estimated a participation elasticity of 0.236 resulting from decreasing child-care cost, and Milligan and Stabile (2007) reported an elasticity of 0.96 for having earnings as a major source of income utilising the Canadian benefit reform. Eissa and Liebman (1996) estimated a participation elasticity of 0.6 for single mothers.

2.7 Policy implications

This section presents crude calculations of the economic implications of supplement policies. Based on the estimates in this paper and aggregate municipal-level statistics, it is possible to look at how desirable a supplement policy is from the municipal point of view and the total economy point of view. To be able to fully assess the optimality of the policy, I would need

an estimate of the welfare of individuals and the effects of the policy on other groups, most notably children.

To make the calculations certain assumptions need to be made. I only present results for mothers. This is justified because I find that fathers do not often take up supplements and that the estimated labour supply effect for them is zero. I assume that the children are put in public day care in the cases where the mother works, which is the prevalent choice in Finland. I need to calculate the effect on an average mother. To this end, based on my own calculations from the data, I assume that a mother has 1,4 children, has a spouse who is in work, earns 1600 euros per month when working and faces municipal and national income tax rates of 16 per cent and 25 per cent respectively.

I compare the situations where a mother is in work and where she is not in work from a government expenditure point of view. If a mother works, she pays on average 500 euros in taxes and 280 euros per 1.4 children in day care fees per month. But, the day-care costs to the government are 1300 euros per month. If the mother does not work, she receives 300 euros in home-care allowance per month. Summing these rough estimates (500+280-1300 = - 522 euros compared to -300 euros), it seems that without a municipal supplement it is less costly for the government if the mother does not work. This result is driven mainly by the high cost of public day care to the government. These calculations would look different if the longer-term effects were taken into account. Then lost pension savings and the effects of deteriorating working skills would be taken into account.

From the municipality point of view, it might seem lucrative to keep mothers out of work. Municipalities receive less tax revenues than the national government, but need to cover the expenses of public day care. However, it might not be optimal for the municipality to provide a supplement. Even with a fairly large participation elasticity estimate, the costs of increasing a supplement are larger than the gains. This can be seen from a simple example. Assume there are 1000 mothers in a municipality, of whom 355 are in work and the rest are taking care of their children. Increasing the home-care allowance by 100 euros per month via a supplement would

on average induce 40 more mothers to stay at home and not work. The amount of public funds saved from day-care costs is 40*(1300-280)=40,800 euros. At the same time the municipality would need to pay the supplement to every mother already staying at home. The cost of the new policy is then 685*100=68,500 euros. Thus this rough example shows quite clearly that municipalities lose out in reforms introducing a supplement to the home-care allowance.

2.8 Conclusion

This paper presents evidence on the extent to which child-care benefits affect the maternal labour supply. An important component of this study is a particular feature of the Finnish child-care system: a municipal supplement to the child home-care allowance. This provides plausibly exogenous variation to the labour supply of mothers.

To be entitled to a municipal supplement a parent needs to stay at home taking care of children, the children must be below a specified age limit and live in a municipality that has the policy in place. Because of regional policy reforms, the control group and the treatment group consist of very similar mothers. The municipalities changed their policies many times during the observation period.

I found that a municipal supplement to the home-care allowance has a negative effect on the labour supply decision of mothers. The main estimate indicated that increasing a municipal supplement by 100 euros per month causes 4 per cent fewer women to participate. I did not find any effect on the labour supply of fathers.

To put the results into a policy relevant context, I estimated the participation elasticity. In the estimation the effect of changes in incomes associated with entry was regressed on the probability of entering the labour force. The municipal supplement was used as an instrument of the changes in incomes. It is a good instrument, since it clearly affects the changes in incomes when entering the labour market. At the same time prior analysis has established that supplements are exogenous to labour supply. The re-

sult implies a participation elasticity of around 0.9. This estimate is towards the high end of the elasticities found in other studies for the population as a whole. It thus confirms the idea that the participation response is larger for mothers than for the rest of the population (Blundell and Macurdy 1999).

The effect estimated describes to what extent a certain monetary amount affects participation. It is therefore surprising to find a larger effect for those with higher education, which contrasts with the result found by Eissa and Liebman (1996). This is interesting in itself. Also, when education is taken as a proxy for income, one would expect that those with higher potential earnings would be less responsive to the same monetary incentives than those with lower potential earnings. In studies where the effects of a tax reform are simulated, it is assumed that a participation elasticity profile is declining in income (e.g. Saez 2002 and Immervoll et al. 2007). The result obtained in this study implies that the participation response may be high towards the middle and high end of the income distribution, not just at the bottom end of the distribution. Since for example the Earned Income Tax Credit (EITC) is targeted towards the working poor, this finding may have implications regarding the optimality of an EITC-type reform.

The results also show that when the home-care allowance period ends, mothers return to employment. Thus the policy does not seem to have a delayed effect.

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2.A Appendix Tables and Figures

All the tables and figures are in this appendix.

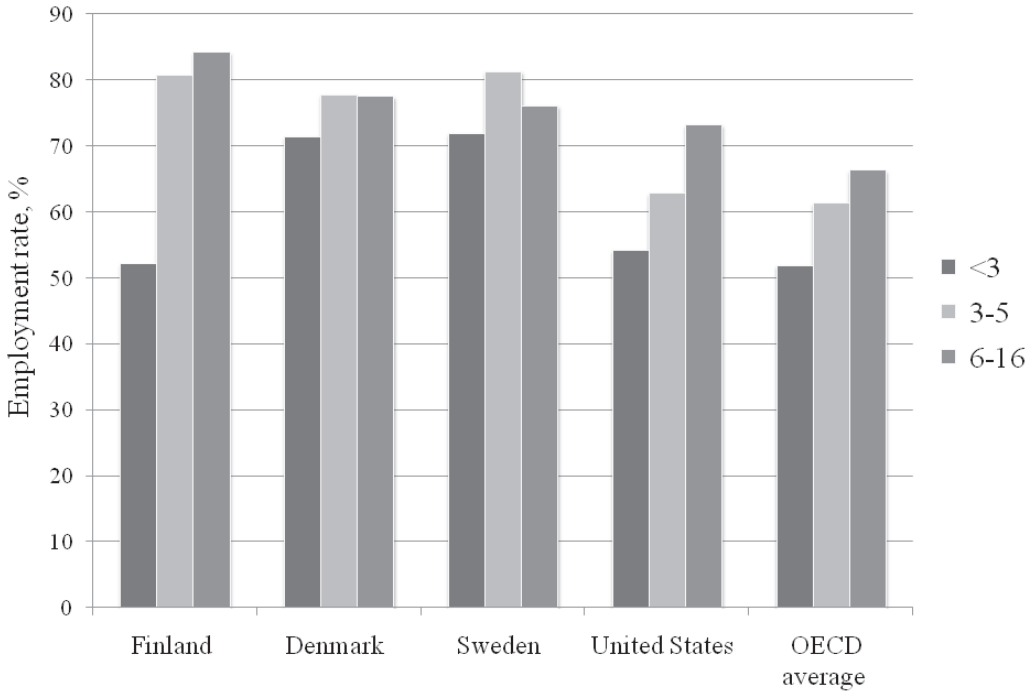

Figure A1: The employment rate of mothers by the age of the youngest child. Source: OECD (2007).

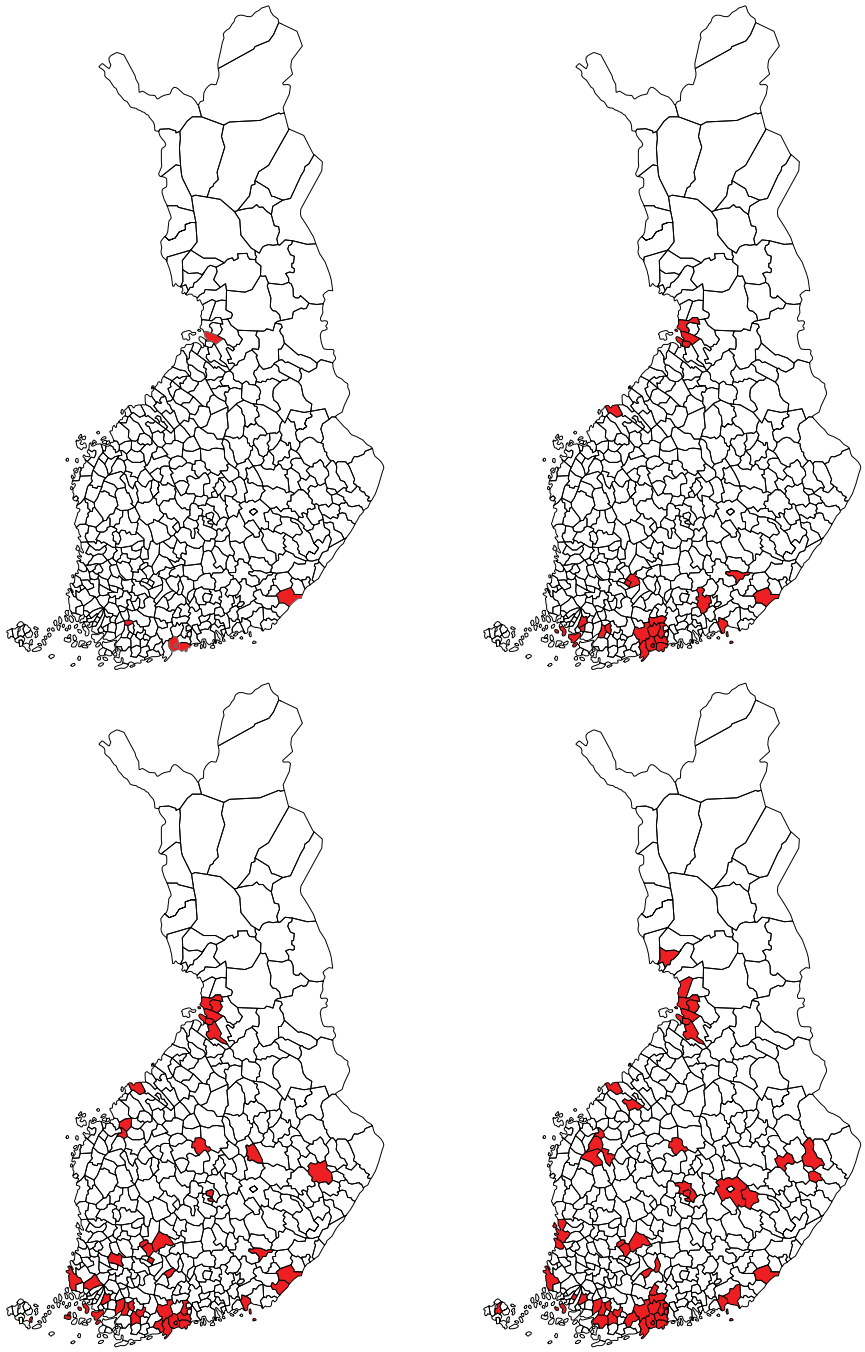

Figure A2: Maps of Finland showing municipalities having a supplement policy in selected years

Note: The above maps of Finland show municipalities with a supplement policy marked in red. The maps correspond to the situations in 1995, 1998, 2001 and 2005 respectively.

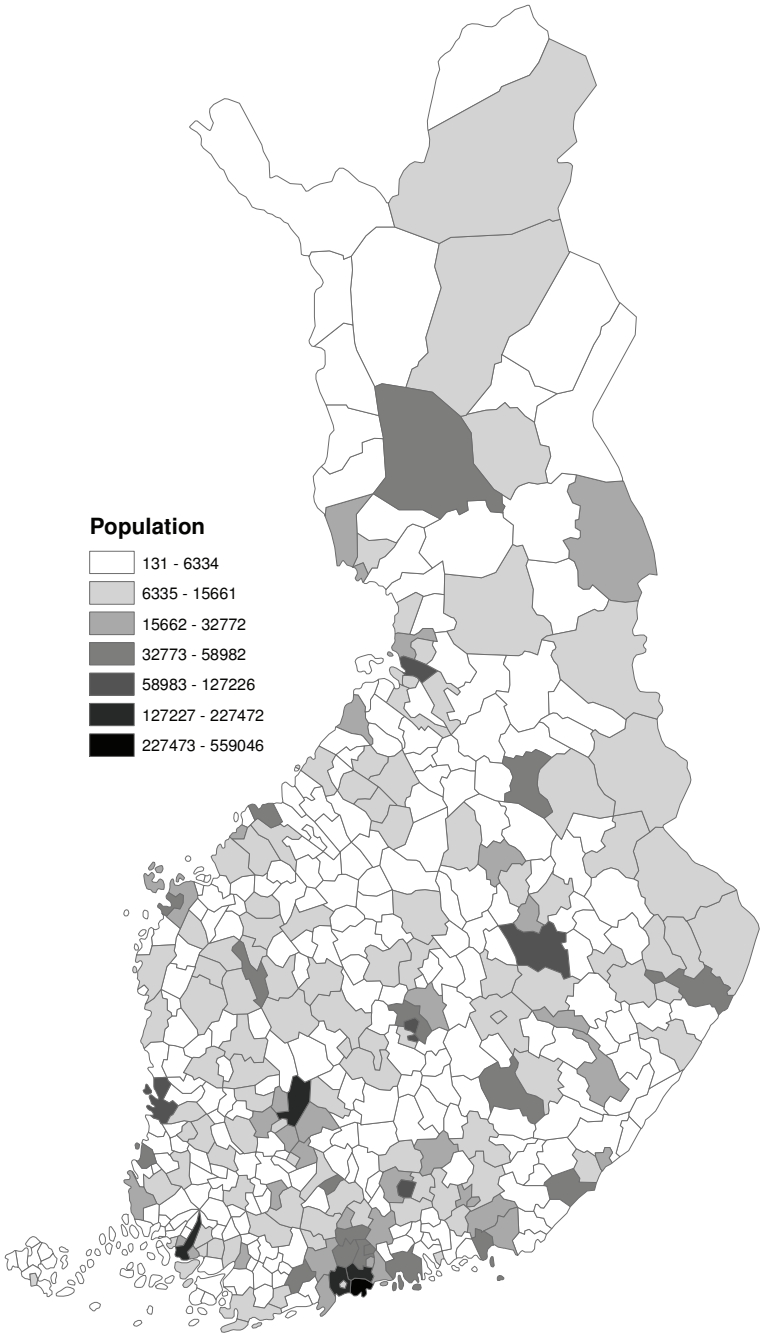

Figure A3: Map showing the population of each municipality in 2005

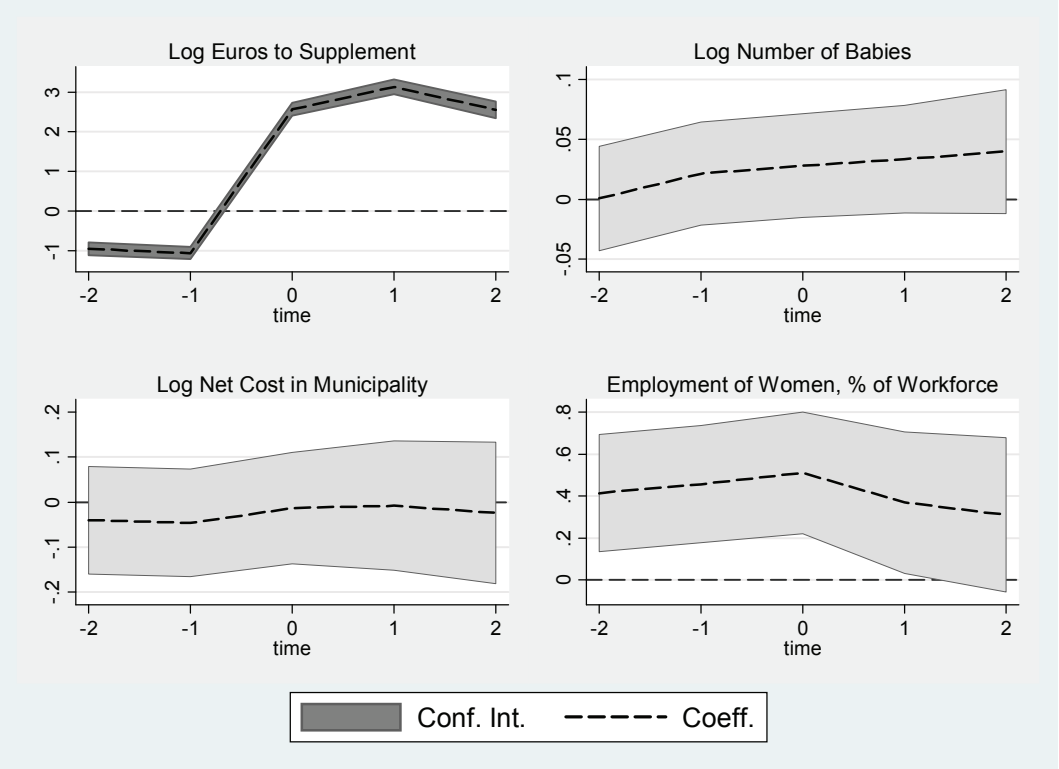

Figure A4: Leads and lags of regression coefficients when a supplement to home care allowance was implemented in a municipality. 4 different dependent variables.

VARS	(1) Supplem.	(2) CareCost	(3) Priv.care	(4) Homecare	(5) Empl	(6) Migrate
implem.-2	-0.95***	0.017	-0.068	0.0033	0.0065**	-0.005
	(0.08)	(0.022)	(0.069)	(0.013)	(0.0033)	(0.028)
implem.-1	-1.06***	0.018	-0.103	-0.0084	0.0069**	-0.015
	(0.08)	(0.022)	(0.069)	(0.013)	(0.0033)	(0.031)
implem.	2.56***	0.005	-0.07	6.6e-05	0.0109***	-0.023
	(0.08)	(0.021)	(0.07)	(0.013)	(0.0034)	(0.036)
implem.+1	3.14***	-0.004	-0.162**	0.0244*	0.0076*	-0.021
	(0.1)	(0.022)	(0.079)	(0.0145)	(0.004)	(0.036)
implem.+2	2.54***	0.014	-0.039	0.0182	0.0066	-0.042
	(0.11)	(0.025)	(0.086)	(0.0157)	(0.0044)	(0.041)
Constant	-5.96***	5.22***	-3.86***	-1.17***	3.58***	3.34***
	(0.51)	(0.13)	(0.55)	(0.1)	(0.00)	(0.187)
N	4057	4173	3406	3406	4494	3430
R^2	0.49	0.18	0.06	0.64	0.8	0.26
N of Mun	290	321	319	319	321	312

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A1: Leads and lags of coefficient having value 1 when municipality implements supplement to home care allowance

	Youngest child 9 mon. to 2 yo.		Youngest child 3 to 7 yo.	
	Mean	Sd	Mean	Sd
Number of obs.	5709		8411	
Age	32.09	(5.26)	36.24	(5.40)
Earned income	7726	(10510)	14983	(12979)
Employment rate	0.35	(0.48)	0.65	(0.48)
Education N/A	0.11		0.12	
Basic education	0.42		0.43	
Higher education	0.26		0.26	
Bachelor or higher	0.21		0.18	
N of children under 7	1.65	(0.70)	1.24	(0.45)

Table A2: Descriptive statistics

Note: Mean level of descriptive statistics. The standard deviations of the means are given in the second column, where applicable. The left panel contains the group of families where the youngest child is between 10 months and 3 years of age and the right panel contains families where the youngest child is between 3 and 7 years of age.

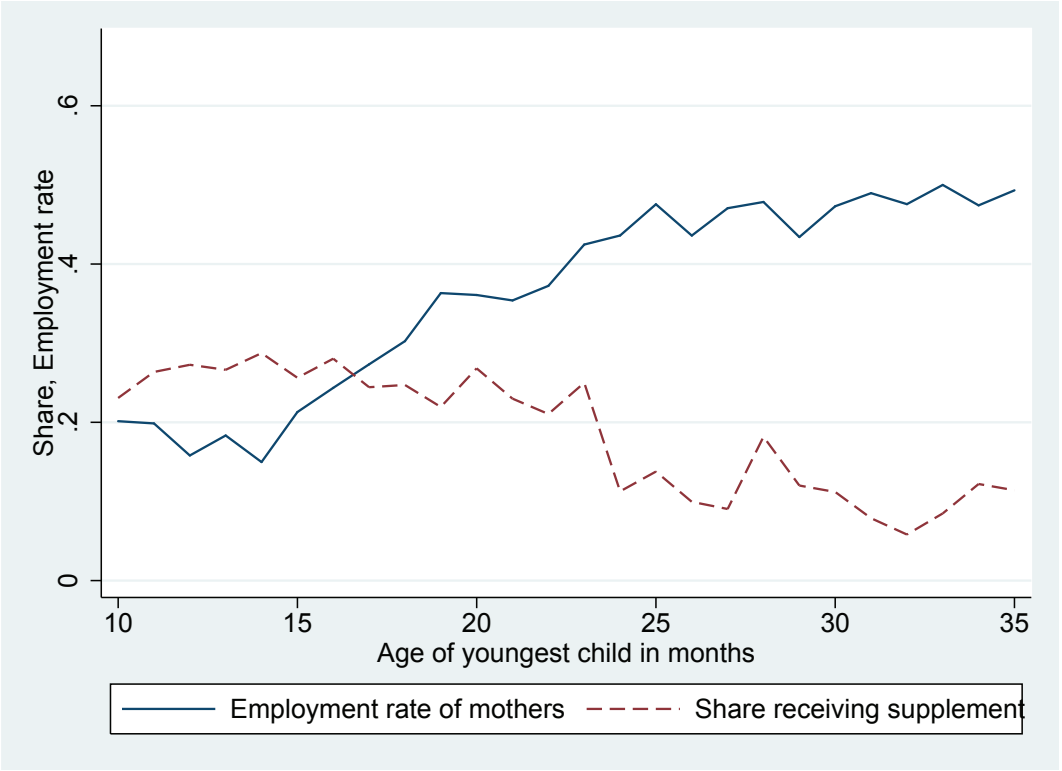

Figure A5: Employment rate of mothers by the age of youngest child and proportion receiving a supplement.

	All				Conditional on receiving supplement			
Year	Share receives supplement	Employ-ment rate	Earned income	N	Supple-ment	Employ-ment rate	Earned income	N
1995	0.06	0.36	6305	761	120	0.46	7881	46
	0.24	*0.48*	*8294*		*30*	*0.50*	*9754*	
1997	0.12	0.42	8244	761	185	0.40	7448	91
	0.32	*0.49*	*10016*		*71*	*0.49*	*8102*	
1999	0.17	0.37	7941	693	206	0.39	8491	116
	0.37	*0.48*	*10306*		*83*	*0.49*	*9997*	
2001	0.20	0.39	8932	713	212	0.35	7216	145
	0.40	*0.49*	*10554*		*76*	*0.48*	*8906*	
2003	0.20	0.37	9452	667	204	0.30	9029	132
	0.40	*0.48*	*12735*		*67*	*0.46*	*14672*	
2005	0.23	0.36	9466	638	190	0.32	7453	144
	0.42	*0.48*	*11989*		*75*	*0.47*	*9374*	

Table A3: Outcome and treatment variables

Note: The left panel contains all observations for the selected years and the right panel only those who are eligible for a supplement in that year. The standard deviations are given in italics below the mean values.

2.B Estimation Results

Outcome	Coefficient	(i)	(ii)	(iii)
Work	Supplement	-0.00622	-0.0327***	-0.0400***
		(0.00727)	(0.0107)	(0.0137)
	Obs	5709	5709	11209
	R-sq	0.000	0.246	0.397
Income	Supplement	274.5*	-960.2***	-1194***
		(159.9)	(263.1)	(379.4)
	Obs	5725	5725	11287
	R-sq	0.001	0.311	0.450
Years		No	Yes	Yes
Municipalities		No	Yes	Yes
2nd level interactions		No	No	Yes

Standard errors in parentheses (clustered on municipal level)

*** p<0.01, ** p<0.05, * p<0.1

Table B1: The main estimation results

Note: OLS estimates for a population of mothers. In the top panel, the dependent variable is the labour supply dummy of mothers. In the bottom panel, the dependent variable is earned income of mothers. The supplement is measured in 100 euros per month. Column (i) is a plain regression of the supplement on the dependent variables. Column (ii) shows the DD results. Column (iii) presents the triple difference results. The third difference is between whether or not the youngest child is older than 3 years of age. Individual covariates used: age, education, number of children, the size of household and indicators for each 3 month intervals of children's age. Municipal-level covariates used: municipal income tax rate, municipal unemployment rate, average income in municipality, average number of places in public child day care relative to the number of children in municipality.

	(i)	(ii)	(iii)	(iv)
Supple-	0.0129	0.0149	-2.83e-06	-0.0316***
ment	(0.0136)	(0.0509)	(1.41e-05)	(0.0101)
Constant	-1.055	-20.46	0.366	9.070**
	(5.005)	(18.09)	(0.266)	(4.569)
Obs.	4722	541	217837	5877
R^2	0.219	0.548	0.057	0.259
Years	Yes	Yes	Yes	Yes
Municipalities	Yes	Yes	Yes	Yes

Standard errors in parentheses(clustered on municipal level)
*** p<0.01, ** p<0.05, * p<0.1

Table B2: Robustness checks

Note: The dependent variable in columns (i), (ii) and (iv) is the mother's labour supply dummy and in column (iii) it is an indicator with the value of 1 for children under the age of 3 as a dependent variable . Column (i) is calculated for a population of mothers whose youngest child is between 3 and 5 years old. They receive a supplement if they live in a municipality that has the policy. In column (ii) the estimation is performed for women who will have a child next year and currently do not have a child that is under 3 years old. Column (iii) shows the effect a supplement has on a child ending up in the treatment group estimated on all households in the sample. Column (iv) shows a similar estimate to the main results, but with simplified supplement rules.

	Basic educ	Lower educ	Higher educ	1 child	2 children	3 or more children
Supplement	-0.0433	-0.0149	-0.0769***	-0.0432***	-0.0498***	0.0196
	(0.0314)	(0.0124)	(0.0277)	(0.0131)	(0.0115)	(0.0452)
Obs.	647	3873	1189	2633	2535	541
R^2	0.459	0.226	0.343	0.295	0.307	0.503

Standard errors in parentheses(clustered on municipal level)
*** p<0.01, ** p<0.05, * p<0.1

Table B3: Divided sample results

Note: The dependent variable for all the results is the mothers' labour supply dummy. The sample of mothers whose youngest child is between 10 months and 3 years is divided by family size and mother's education. All the estimates were controlled with the same control vector as for the main results.

	(i)
First	-1.006***
stage	(.032)
F-value	983.88
Change in	-.0000277***
incomes	(9.25e-06)
Constant	-0.541
	(0.397)
Obs.	5879
R^2	0.225

Standard errors in parentheses
(clustered on municipal level)
*** p<0.01, ** p<0.05, * p<0.1

Table B4: Change in mothers participation in response to change in incomes

Note: 2SLS results for the mothers' participation dummy. The first stage regresses municipal supplement on change in incomes associated with entry. The second stage explains the participation dummy with the first-stage predicted value.

	(i)	(ii)	(iii)
First	-1.04***	-1.02***	-1.09***
stage	.098	.024	.051
F-value	113	1825	462
Change in	-1.69e-05	-1.42e-05	-5.65e-05***
incomes	(2.15e-05)	(9.74e-06)	(2.02e-05)
Obs.	699	3977	1203
R^2	0.42	0.21	0.28

Standard errors in parentheses(clustered on municipal level)

*** p<0.01, ** p<0.05, * p<0.1

Table B5: Participation response by mothers education

Note: 2SLS results for the mothers' participation dummy divided by their education level. Column (i) shows results with basic education or whom education information was not available, in column (ii) the highest degree attained is high school or equivalent and in column (iii) bachelor level or higher. Change in incomes and other monetary values measured in euros per year.

2.C Robustness and sensitivity checks

Table C1 reports estimates based on an outcome variable where mothers have reported working 10 or more months in an interview. Column (iii) reports a DD estimate equivalent to the main estimates. Although the coefficient is smaller, it implies a similar participation elasticity, since the participation elasticity measured in this way is smaller than in normal estimates.

	(i)	(ii)	(iii)
Supplement	-0.0548***	-0.0843***	-0.0140*
	(0.00616)	(0.00958)	(0.00827)
Years	No	Yes	Yes
Municipalities	No	Yes	Yes
Child age		No	Yes
Obs.	6023	6023	6023
R^2	0.013	0.139	0.273

Standard errors in parentheses(clustered on municipal level)

*** p<0.01, ** p<0.05, * p<0.1

Table C1: Estimations with work dummy based on survey question

Note: OLS estimates for the mothers' labour supply dummy with a value of 1 when reported working 10 or more months per year in a survey. Supplement measured in 100 euros per month.

Outcome	Var	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Work	Supple-	-0.026*	-0.034*	-0.023	-0.024**	-0.029***	-0.02*
	ment	(0.014)	(0.02)	(0.015)	(0.011)	(0.009)	(0.012)
	Obs.	5709	3572	4493	5273	5709	5709
	R^2	0.267	0.288	0.262	0.243	0.262	0.234
Income	Supple-	-979***	-1131***	-866**	-687***		
	ment	(339.9)	(418.1)	(360.8)	(227.6)		
	Obs.	5725	3581	4506	5289		
	R^2	0.322	0.346	0.318	0.308		

Standard errors in parentheses(clustered on municipal level)

*** p<0.01, ** p<0.05, * p<0.1

Table C2: Sensitivity checks

Note: OLS estimates for the mothers' labour supply dummy and earned income. Supplement measured in 100 euros per month. Column (i) includes linear municipal trends where some smaller municipalities were grouped together. Column (ii) presents estimates for years from 1995 to 2001. Column (iii) includes years from 1998 to 2005. Column (iv) leaves out the largest municipality in the sample. Column (v) reports results for labour supply dummy with a value of 1 when yearly earned income is over 80 per cent of the mean and column (vi) presents the result of a similar exercise with mothers categorized as working when they earn over 30 per cent of the annual mean.

Outcome	Coefficient	(i)	(ii)
Work	Supplement	0.0026	0.0043
		(0.0093)	(0.0095)
	Obs.	5527	5527
	R^2	0.197	0.224
Income	Supplement	244	-91
		(279)	(262)
	Obs.	5560	5560
	R^2	0.366	0.387

Standard errors in parentheses(clustered on municipal level)
*** p<0.01, ** p<0.05, * p<0.1

Table C3: Sensitivity check: results for fathers

Note: OLS estimates for fathers' labour supply dummy and earned income. Supplement measured in 100 euros per month. Column (i) is similar to the main DD estimates for mothers. Column (ii) adds linear municipality trends to this.

Chapter 3

Public provision of private goods with optimal income taxation and extensive margin

Abstract

This paper studies the public provision of private goods. It presents a model where a government sets taxes optimally and provides a private good. In contrast to the earlier literature on public provision of goods, the good provided by the government affects the extensive margin of labour supply. A fixed cost not visible to the government arises when an individual participates. The publicly provided private good affects this fixed cost. I derive an optimal rule for the provision of the publicly provided private good in this set-up. The resulting rule links the optimal public provision rule with its effect on the share of the population in work and the tax differential associated with the participation decision. It can be welfare improving to have positive levels of public provision even when optimal income taxes are used to redistribute income.

3.1 Introduction

The degree of government-provided public services varies across countries. Health care, day care for children, care of the elderly and education are mostly publicly provided in the Nordic countries, while in Anglo-Saxon countries the system relies more on private markets. When is public provision at an optimal level? How does the public provision of goods depend on the tax system? These are questions that this study tries to answer.

This paper studies publicly provided private goods in a setting where income taxes have been set optimally. Therefore this study is connected to the Mirrlees tradition. One assumption in the original Mirrlees (1971) model is that there is only an intensive labour supply margin. The intensive margin describes the extent to which each individual changes his or her labour supply. This assumption is not realistic, since it is relatively uncommon to work a very small amount of hours. Recent optimal income tax literature has addressed this issue (Saez 2002, Immervoll et al. 2007 and Eissa et al. 2008). Assuming that there is also an extensive labour supply margin can make it optimal to have negative marginal tax rates. Consequently, the tax burden on the working poor and at the same time unemployment benefits can be radically reduced. The significance of these results is borne out in empirical studies that find the extensive labour supply elasticity to be larger than the intensive labour supply elasticity (Eissa and Hoynes 2004, Blundell 2006).

In this paper the publicly provided private good affects the participation decision. To create a micro-founded reason for the extensive margin, there is a fixed cost arising from participation. This assumption has been used in earlier papers studying the extensive margin (Cogan (1981), Immervoll et al. (2007) and Eissa et al. (2008)). The intuition is that to go to work, one needs to suffer or pay some fixed cost that need not be paid if the participation decision is not made. The fixed cost is not visible to the government, but the government provision affects the fixed costs and thereby the number of individuals participating in the labour force. Therefore, in addition to setting taxes optimally, the government can affect the

number of taxpayers through the deployment of public expenditure. This kind of dependence between public provision and participation decisions in connection with optimal taxes has not been made in earlier public goods literature[1].

However a literature has studied optimal public provision with the intensive margin of labour supply in a setting where income taxes have been set optimally. Public provision should follow the Samuelson rule if consumption of public good does not convey additional information on individual ability types (Mirrlees 1976). Such is the case if labour supply and consumption are separable in the individual utility function (Christiansen 1981 and Boadway and Keen 1993). Conversely, if the consumption of public good does reveal information about the type of the individual, it can be optimal to provide such a good to a different extent than the Samuelson rule implies. When, for example, public good is complementary to working, it should be over-provided relative to the Samuelson rule because in this case public good benefits more those who work more. Then public good provision makes the distortions created by income taxation less severe.

Since the public provision in this paper is targeted at individuals who decide to participate, the good is private in nature. Publicly provided private goods have been studied in a number of papers (Blackorby and Donaldson 1988 and Besley and Coate 1991). Although there is no market failure as with pure public goods, it can be socially optimal for the state to provide these goods rather than redistribute through taxation. Usually the reason for this is related to information asymmetry. Blomquist et al. (2010) studied public provision of private goods in connection with optimal income taxation. Thus, their article is closely related to this study, although they did not have extensive labour supply margin in their model.

Including the ingredients of publicly provided private goods and nonlinear income taxes with the extensive margin of labour supply, this paper provides a rule for optimal government provision of a private good. The results imply that even if the government uses optimal income taxation to

[1]Bergstrom and Blomquist (1996) studied the optimality of child care in connection with the participation decision

redistribute income as efficiently as possible, it can be welfare improving to provide a private good publicly. This situation occurs when the public provision decreases the fixed costs of individuals. The limiting case, when public provision does not affect welfare and thus should be at zero level, is when it has no effect on the distribution of fixed costs. In all other cases the provision rule depends on direction in which public provision affects the distribution of fixed costs. The participation tax differential amplifies the effect public provision has on fixed costs.

The assumption that part of the population is excluded from consuming the good fits the case of the day care of children particularly well. Moreover the access to good quality day care to an individual clearly affects costs arising from participation. If access to day care for children is less costly to parents, it is easier for the parents to work rather than staying at home taking care of their children. Furthermore, it is entirely conceivable that the size of the net tax differential between the taxes when participating and when not affects the participation decision. The greater is the net difference in taxes from participating including the cost of day care, the more extra provision of day care can affect the participation decisions of parents.

Section 3.2 describes the key assumptions made in the model. It discusses the use of the fixed cost, individual optimisation problem and the features of the government objective function. It derives first-order conditions and optimal tax rates. Section 3.3 derives the rule for the public provision of the good in the case of one ability type and discusses the features of this simple rule. Section 3.4 adds a continuum of ability types to the model and presents the rule for publicly provided private goods in this case. Finally, section 3.5 concludes.

3.2 The basic set up

This section presents how participation decisions are analysed with only one ability type. There is a government that wants to redistribute income using taxation so that it's welfare functional is maximised. The welfare functional comprises individuals' utility functions, which are given uniform weight for

simplicity here. The government also provides a good for individuals to consume. Lump-sum taxes are not available to finance the public provision, since the types of individuals are not observable. Therefore non-linear income taxes are used. To minimise the efficiency loss, taxes need to be set optimally. It is optimal for the government to provide the good if it reduces the efficiency loss from taxation.

There have been various ways of analysing the extensive margin of labour supply in the literature. Here I use the fixed costs of work - approach. Another way to model the participation decision would be to assume that there are discrete "working places" between which people jump if the tax incentives change (Saez 2002). This would produce much the same result, but does not give a micro-founded reason for the existence of discontinuous choice. In a similar way as the fixed cost here, Diamond (1980) uses work disutility distributed continuously throughout the population. Demand side-related reasons for discontinuous working hours are not possible options in the model analysed here, since the demand side is not properly modeled.

In the model in this section individuals are heterogeneous in terms of fixed costs and there is only one ability type. This produces the result that for a given number of working hours everybody has the same income. Since the important aspect of the model is that the publicly provided private good affects the participation decision, the basic mechanisms are revealed with this simpler model. In section 3.4, a distribution of ability types is added to the model.

3.2.1 Individuals' optimisation problem

Individuals consume a private consumption good, c. An individual of type n receives income y when he or she supplies h hours of labour, so that $y = hn$. At this point everybody has the same ability type n. Supplying labour consumes the individual's leisure. It is assumed that both leisure and consumption are normal goods. The utility function of an individual is

$$u(c, y, q, g) = v(c, y) - q(g)$$

$$u(c, y, q, g) = v(c_0, 0)$$

when participating in work and when not, respectively. q is a fixed cost and g a publicly provided private good. It is assumed that in the individual utility function the fixed cost is separable from consumption and labour supply. This assumption is relevant for the results. From this assumption it follows that once the participation decision is made, marginal changes in taxation affect only the working hours decision. Furthermore, it follows that public provision of the private good targets the participation decision and does not affect the working hours decision.

I assume there is a continuum of fixed costs that people suffer only when they decide to participate, $q*1(y > 0)$. Individuals first pick their draw of q from the fixed costs distribution and then participate if the fixed cost is not too high. They can not themselves affect their fixed costs after it is realized. The fixed costs are distributed on a positive real axis up until some finite upper limit R: $q \in [0, R]$ with a density function $f(q|g)$ and a cumulative distribution function $F(q|g)$. The amount of workers is normalised to one, $F(R|g) = 1$.

The government can not remove any individuals from society or remove their fixed costs completely, just increase or decrease them. g only affects the shape of the distribution $f(q|g)$. I assume that the q is some well defined monotone function of g : $q(g)$ so that altering g does not change the order of people with different q's.

Conditional on participating, individuals make their working hours decision by maximising the utility conditional on the budget constraint:

$$\max v(c, y) - q(g)$$

$$\text{s.t. } c = y - T(y)$$

where $T(y)$ is tax on labour income. The following condition emerges from the FOC for the above problem:

$$\frac{\frac{\partial u}{\partial y}}{\frac{\partial u}{\partial c}} = 1 - T'$$

which states that the indifference curves in the (c, y) space should be tangent to the marginal tax rate. It should be noted that the fixed cost does not affect the working hours decision. Individuals participate if the utility from working and suffering the fixed costs $q(g)$ is greater than the utility from not participating. If an individual does not participate, he or she consumes the transfers that government provides to non-participants, $c_0 = -T(0)$. The condition for participation can be expressed as:

$$v(c, y) - q(g) \geq v(c_0, 0) \Rightarrow \bar{q} = v(c, y) - v(c_0, 0) \tag{3.1}$$

where $\bar{q}$ defines the threshold value for participation, $\bar{q} \in (0, R)$. Using this threshold value, the number of individuals participating is the cumulative number of those who have a lower fixed cost than $\bar{q}$, noted $F(\bar{q}|g)$. Then the amount of non-participants is simply $1 - F(\bar{q}|g)$. For further reference, using equation (3.1), the following rules can be formulated: $\frac{\partial v}{\partial c} = \frac{\partial \bar{q}}{\partial c}$, $\frac{\partial v}{\partial y} = \frac{\partial \bar{q}}{\partial y}$and $\frac{\partial v}{\partial c_0} = -\frac{\partial \bar{q}}{\partial c_0}$. These simply state that changes in consumption and labour supply have an equal effect on the utility and the threshold value for participation. It is assumed that g does not affect the threshold value $\bar{q}$, since the threshold value depends on the $v()$ function which does not depend on $q(g)$. Nevertheless, g affects the distribution of q, thus it affects the number of participants. On the other hand, the threshold value $\bar{q}$ is affected by the tax differential when participating and when not. In a similar vein, $\frac{\partial y}{\partial g} = 0$, since g only affects the participation decision through its effect on the distribution of q, not the hours decision conditional on participating.

3.2.2 Government optimisation

The government wants to redistribute income and at the same time minimise the efficiency loss from taxation. Its tool is a non-linear income tax

schedule that depends on income, denoted $T(y)$ for participants and $T(0)$ for non-participants. It provides a private good, g. The government is assumed to be benevolent and utilitarian. It optimises a welfare functional, which has individual utility functions as its argument. There is also a budget constraint on objective function of the government. To capture the idea that utility is maximised for everybody, those outside the labour force are also within the utility maximisation problem. The general formulation can be stated as: $\max_{c,y,c_0,g} W = \int_0^R u(c,y,g,q)f(q|g)dq$ s.t. budget holds. This is formulated into Lagrangian using the equation (3.1) to separate between participants and non-participants:

$$max_{c,y,c_0,g}W = \int_0^{\bar{q}} v(c,y)f(q|g)dq - \int_0^{\bar{q}} q(g)f(q|g)dq + \int_{\bar{q}}^R v(c_0,0)f(q|g)dq$$

$$+\lambda(\int_0^{\bar{q}} (y-c)f(q|g)dq - \int_{\bar{q}}^R c_0 f(q|g)dq - \int_0^{\bar{q}} rgf(q|g)dq) \tag{3.2}$$

The terms that are integrated over the interval $(0,\bar{q})$ include the participants, and the remainder includes the non-participants. λ is a Lagrange multiplier for the government budget constraint. There is no incentive compatibility constraint in this problem, since there is only one ability type. Instead, the problem of the government is to ensure that all those whose fixed costs are low enough participate. This is ensured by setting taxes optimally, since the government does not observe the fixed costs of individuals, only their distribution.

I take the first-order conditions from the government objective (3.2) to derive rules for optimal taxes:

$$\frac{\partial W}{\partial c_0} = \int_{\bar{q}}^R \frac{\partial v(c_0,0))}{\partial c_0} f(q|g)dq + \lambda[\frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g)(y-c+c_0-rg) - (1-F(\bar{q}|g))] = 0 \tag{3.3}$$

$$\frac{\partial W}{\partial c} = \int_0^{\bar{q}} \frac{\partial v(c,y))}{\partial c} f(q|g)dq + \lambda[\frac{\partial \bar{q}}{\partial c} f(\bar{q}|g)(y-c+c_0-rg) - F(\bar{q}|g)] = 0 \tag{3.4}$$

$$\frac{\partial W}{\partial y} = \int_0^{\bar{q}} \frac{\partial v(c,y))}{\partial y} f(q|g)dq + \lambda[\frac{\partial \bar{q}}{\partial y} f(\bar{q}|g)(y - c + c_0 - rg) + F(\bar{q}|g)] = 0 \tag{3.5}$$

The government welfare functional, the first line in the equation (3.2), contains the individual utilities. Changes in consumption and income affect this part directly. The indirect effects come through the budget. I use Leibniz's rule in these derivations because the integral limit $\bar{q}$ depends on consumption and income. Further derivation steps are given in the Appendix 3.A.

3.2.3 Optimal taxes

Since there is only one ability type, conditional on participating, everybody has similar marginal utilities, as seen in the individual's maximisation problem. The government sets taxes so that the one ability type chooses hours optimally, conditional on participating.

From equations (3.4) and (3.5), I write the following rule:

$$\frac{\int_0^{\bar{q}} \frac{\partial v(c,y)}{\partial y} f(q|g)dq}{\int_0^{\bar{q}} \frac{\partial v(c,y)}{\partial c} f(q|g)dq} = \frac{\frac{\partial v(c,y)}{\partial y} F(\bar{q}|g)}{\frac{\partial v(c,y)}{\partial c} F(\bar{q}|g)} = \frac{\lambda[\frac{\partial \bar{q}}{\partial y} f(\bar{q}|g)(y - c + c_0 - rg) + F(\bar{q}|g)]}{\lambda[\frac{\partial \bar{q}}{\partial c} f(\bar{q}|g)(y - c + c_0 - rg) - F(\bar{q}|g)]}$$

The first equality follows from the fact that since the social welfare functional is already at optimum, the second-order effects do not affect its value. Thus the integral limit is not affected by changes in incomes and consumption in the welfare functional, and the terms $\frac{\partial v}{\partial c}$ and $\frac{\partial v}{\partial y}$ can be taken out of the integral. The integral limit is affected in the government budget constraint, which is not already at optimum. Then I can write:

$$\frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}} = \frac{[\frac{\partial \bar{q}}{\partial y} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y - c + c_0 - rg) + 1]}{[\frac{\partial \bar{q}}{\partial c} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y - c + c_0 - rg) - 1]}$$

$$\Rightarrow \frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}}[\frac{\partial \bar{q}}{\partial c} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y - c + c_0 - rg) - 1] = [\frac{\partial \bar{q}}{\partial y} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y - c + c_0 - rg) + 1]$$

$$\Rightarrow \frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}} = \frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}} \frac{\partial \bar{q}}{\partial c} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y-c+c_0-rg) - \frac{\partial \bar{q}}{\partial y} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y-c+c_0-rg) - 1$$

$$\Rightarrow \frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}} = \frac{\partial v(c,y)}{\partial y} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y-c+c_0-rg) - \frac{\partial v(c,y)}{\partial y} \frac{f(\bar{q}|g)}{F(\bar{q}|g)}(y-c+c_0-rg) - 1$$

$$\Rightarrow \frac{\frac{\partial v(c,y)}{\partial y}}{\frac{\partial v(c,y)}{\partial c}} = -1$$

This last line follows from the definition of $\bar{q}$, according to which $\frac{\partial v}{\partial c} = \frac{\partial \bar{q}}{\partial c}$, $\frac{\partial v}{\partial y} = \frac{\partial \bar{q}}{\partial y}$ as noted above. The marginal tax rate is:

$$MTR = \frac{v_y}{v_c} + 1 = 0 \tag{3.6}$$

The resulting rule states that the marginal tax rate for the participating worker is zero. There is nothing surprising about this result. Since the fixed cost from participating is separable from labour supply and consumption in the individual utility function, there is no reason to distort the hours decision after the individual has made the decision to participate. Moreover, even with two ability type settings it is normal to have the result that the highest ability type has zero marginal tax rates (Stiglitz 1982).

Another question is how the tax differential for participants and non-participants should be set optimally. Marginal tax rates are not meaningful, because the decision to participate is not continuous. Instead, I derive a rule for the participation tax rate defined as the difference between $T(y)$ (taxes faced by workers) and $T(0) = -c_0$ (subsidies government gives to non-participants) divided by the consumption difference in these two states as in Saez (2002). In this case the participation tax rate is affected by the public provision of a private good multiplied by its production cost, rg.

From equation (3.3):

$$\frac{\partial v(c_0, 0))}{\partial c_0}(1 - F(\bar{q}|g)) + \lambda[\frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g)(y - c + c_0 - rg) - (1 - F(\bar{q}|g))] = 0$$

$$\Rightarrow \lambda \frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g)(y - c + c_0 - rg) = \left(-\frac{\partial v(c_0, 0))}{\partial c_0} + \lambda \right) (1 - F(\bar{q}|g))$$

$$\Rightarrow (y - c + c_0 - rg) = \left(-\frac{\partial v(c_0, 0))}{\partial c_0} + \lambda \right) \frac{(1 - F(\bar{q}|g))}{\lambda \frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g)}$$

$$\Rightarrow \frac{T(y) - T(0) - rg}{(c - c_0)} = \left(\frac{\partial \bar{q}}{\partial c_0} + \lambda \right) \frac{1 - F(\bar{q}|g)}{\lambda \frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g)(c - c_0)}$$

$$\Rightarrow \frac{T(y) - T(0) - rg}{(c - c_0)} = \left(\frac{\partial \bar{q}}{\partial c_0} \frac{1}{\lambda} + 1 \right) \frac{1}{\eta}$$

where $\eta = \frac{\partial (1 - F(\bar{q}|g))}{\partial c_0} \frac{(c - c_0)}{1 - F(\bar{q}|g)} = -\frac{\partial \bar{q}}{\partial c_0} f(\bar{q}|g) \frac{c - c_0}{1 - F(\bar{q}|g)}$ is the participation elasticity. This rule states that the size of the optimal participation tax rate depends inversely on the absolute value of the participation elasticity, which is similar to Saez (2002) and Eissa et al. (2008). The optimal participation tax rate also depends on how the benefits for non-participants affect the threshold value for participation and the shadow price of the government budget, λ. Both the participation elasticity and the change in $\bar{q}$ are negative numbers. It is proved in the Appendix 3.B that the $T(y) - T(0) - rg$ term is positive in the optimal allocation. Therefore the participation tax rate is positive as long as the consumption of participants is higher than that of non-participants. The larger the participation elasticity is as an absolute value, the smaller the participation tax rate becomes. It is also proved in the Appendix 3.B that c_0 is positive when taxes are set optimally. Thus the government is providing subsidies to non-participants.

In solving the optimisation problem, the public provision of g is first kept constant and the government sets taxes optimally. Nevertheless, the amount of public provision g evaluated at its cost r affects the participation tax rate. This is natural, since the public provision is targeted only at the participating share of the population. Thus the public provision affects the net tax differential when working and when not. Large values of rg could offset an otherwise large difference between the tax rates $T(y) - T(0)$.

3.3 Public provision of private goods

Let us now consider the public provision of private goods. The aim is to develop a welfare maximising rule for optimal government provision. The interesting part is to look at what kind of impact unobserved fixed costs have on the government provision rule. If public provision does not have any effect on participation behaviour through fixed costs, the government could still provide the good. In that case it might not be welfare improving to do so. The government redistributes through optimal income taxation. The question is whether public provision can increase social welfare even if the taxes have been set optimally.

The aim is to derive a rule where the sum of marginal rates of substitution between public and private goods is equated to the rate of transformation to produce the publicly provided private good. In this model the good g only affects the fixed cost distribution $f(q|g)$, while consumption c affects the $v(c,y)$ part of the individual's utility function. Moreover, non-participants do not suffer the fixed cost and therefore they do not benefit from government provision. If the public provision of g does not affect the fixed costs of individuals in any way, the derivative of g with respect to q and its distribution are zero :$\frac{\partial q(g)}{\partial g} = 0 \Rightarrow \frac{\partial f(q|g)}{\partial g} = 0$

I assume here that the government has set taxes optimally. To derive a rule for optimal provision of g, I take the FOC for g from the government objective function (3.2):

$$\begin{aligned}
&\frac{\partial W}{\partial g} = \\
&\int_0^{\bar{q}} v(c,y)\frac{\partial f(q|g)}{\partial g}dq - \int_0^{\bar{q}} \left(q(g)\frac{\partial f(q|g)}{\partial g} + \frac{\partial q(g)}{\partial g} f(q|g) \right) dq \\
&+ \int_{\bar{q}}^{R} v(c_0,0)\frac{\partial f(q|g)}{\partial g}dq \\
&+ \lambda \left(\int_0^{\bar{q}} \frac{\partial y}{\partial g} f(q|g)dq + \int_0^{\bar{q}} (y-c)\frac{\partial f(q|g)}{\partial g}dq - \right) \\
&+ \lambda \left(\int_{\bar{q}}^{R} c_0 \frac{\partial f(q|g)}{\partial g}dq - \int_0^{\bar{q}} \left(\frac{\partial rg}{\partial g} f(q|g) + rg\frac{\partial f(q|g)}{\partial g} \right) dq \right) = 0 \qquad (3.7)
\end{aligned}$$

This equation is modified to obtain a simpler rule for the optimal provision of g:

$$\int_0^{\bar{q}} \frac{-\partial q(g)}{\partial g} f(q|g))dq + \int_0^{\bar{q}} (v(c,y) - q(g)) \frac{\partial f(q|g)}{\partial g} dq + \int_{\bar{q}}^{R} v(c_0, 0) \frac{\partial f(q|g)}{\partial g} dq$$

$$= -\lambda(\int_0^{\bar{q}} (y - c) \frac{\partial f(q|g)}{\partial g} dq - \int_{\bar{q}}^{R} c_0 \frac{\partial f(q|g)}{\partial g} dq - \int_0^{\bar{q}} rg \frac{\partial f(q|g)}{\partial g} dq - rF(\bar{q}|g))$$

$$\Rightarrow \int_0^{\bar{q}} \frac{\frac{-\partial q(g)}{\partial g}}{\frac{\partial v(c,y)}{\partial c}} \frac{\partial v(c,y)}{\partial c} f(q|g))dq = -\lambda((y - c + c_0 - rg) \frac{\partial F(\bar{q}|g)}{\partial g} - rF(\bar{q}|g))$$

In the last equation the first two distribution effects ($\frac{\partial f(q|g)}{\partial g}$) were enveloped out, since the government welfare functional was already at optimum. The distribution effects work through the government budget, however. Also, $\frac{\partial y}{\partial g} = 0$ because in this simple case g is separable from y in the individual utility function. Below I use the government welfare weights which are $\omega = \frac{\partial v}{\partial c} f(q|g)/\lambda$ for workers. The rule for providing g then becomes:

$$\int_0^{\bar{q}} MRS_{gc} \omega dq = rF(\bar{q}|g) - (T(y) - T(0) - rg) \frac{\partial F(\bar{q}|g)}{\partial g}$$

The MRS_{gc} term describes the marginal valuation of g compared to c for each participant. It is weighted by the government welfare weights. It is imminent from the derivations of the above rule that if g does not have any effect on the fixed costs, then the optimal public provision level is zero. On the other hand, if public provision has effect on the fixed costs, the marginal rate of substitution is equated with marginal rate of transformation ($rF(\bar{q}|g)$) and the distribution effect $\left(\frac{\partial F(\bar{q}|g)}{\partial g}\right)$ multiplied by the size of the participation tax differential ($T(y) - T(0) - rg$). If the public provision produces negative MRS_{gc} it is not welfare improving and should not be carried out. This is because if in the above rule MRS_{gc} is negative, $\frac{\partial q(g)}{\partial g} > 0 \Rightarrow \frac{\partial F(\bar{q}|g)}{\partial g} > 0$. This means that there are no benefits from providing g in terms of welfare or distributional gains.

The significance of the additional terms to the MRT on the right hand side is that if they are negative (positive), g should be over-provided (under-provided) relative to the simple rule where MRS_{gc} is equated with MRT. If the government provision of g shifts the weight of the fixed cost distribution towards workers (and at the same time away from non participants), the distribution effect is positive and the total effect is negative. Increasing government provision shifts the distribution towards workers if it decreases the fixed costs. The tax differential is always positive, which is proved in the Appendix (3.B). The role of the participation tax rate is to amplify the distribution effect; the greater the net income differential is between participation and non-participation, the more it amplifies the effect through changes in distribution.

A real-world example that fits this theoretical model best is the day care of children. It is sometimes provided by the government, although in nature it is a private good. When public provision makes day care more accessible, participation becomes easier for parents. Thus public provision of day care lowers the fixed cost for participation. The added provision shifts the fixed costs for a small number of parents below the threshold value $\bar{q}$ and consequently they find it optimal to participate. This effect is amplified if the existing participation tax differential is at a high level. In the tax differential the level of public provision affects the participation tax rate. If the provision of day care is already at a high level, increasing government provision even further does not have as great an impact on the provision rule as when existing provision is at a lower level.

3.4 Adding a distribution of ability types

From here on I assume that for each fixed cost there is a distribution of ability types. This assumption makes the heterogeneity of the population two-dimensional. The idea here is that some individuals are more able to produce and some more eager to participate. The two characteristics do not depend on each other. In this setting it is possible that an individual of a higher ability type (who is productive) does not participate because the

fixed cost of participation is too high for that individual. I first set up the individual optimisation problem, then the government problem and then study the optimal public provision of goods.

The individual utility function can now be written:

$$u(c, y, g, q, n) = v(c, y, n) - q(g)$$

Thus the fixed cost q is separable from the ability type n. If an individual does not participate the utility function is written:

$$u(c, y, g, q, n) = v(c, 0, n)$$

Conditional on participating, an individual chooses working hours according to the utility maximization problem:

$$\max \; u(c, y, g, q, n)$$

$$s.t. \; c_n = y_n - T(y_n)$$

where c_n and y_n denote the consumption and labour income of type n, respectively. It is additionally assumed that given q the only difference in preferences is that more productive individuals earn more with the same number of working hours: $y = hn$. The government only sees total income y, not h or n separately.

At the participation limit, the utility from participating and not participating must be equal:

$$v(c, y, n) - q(g) = v(c, 0, n)$$

$$\Rightarrow \bar{q}_n = v(c, y, n) - v(c, 0, n) \tag{3.8}$$

where $\bar{q}_n$ defines the threshold value for participation of type n.

3.4.1 Government optimisation

The government aims to maximise the welfare functional where the arguments are the individual utility functions. There is a budget constraint which balances the revenue collected in taxes and the expenditure on the government provision of g.

Now an incentive compatibility constraint needs to be introduced into the model. This is to cope with the possibility that more able workers pretend to be less able if the tax incentives are not set correctly. This kind of problem with an ability type distribution was first introduced by Mirrlees (1971) and followed by a sizeable literature. Although there is another dimension of heterogeneity in the present model - fixed costs - the incentive compatibility constraint can be formulated in a normal way. I demonstrate how the fixed cost does not affect the derivation of the normal incentive compatibility constraint in the Appendix 3.C. The intuition is simply that since the fixed cost q and the ability type n are separable in the individual utility function, the fixed cost does not affect the choice of working hours, which depends on ability type.

For later purposes I denote $\frac{dv}{dn} = \gamma$. This is the incentive compatibility constraint used in the derivations below. It requires that the first-order condition for the utility with respect to ability type is zero. If this condition is fulfilled, type n chooses the allocation intended for type n. Before inserting this into the government objective function, it is integrated by parts.

The government objective is integrated over the distribution of ability types. For each ability type, it is separated between participants and non-participants using equation (3.8), as was done in the one ability type case. Now that there is a continuum of fixed costs for each ability type, I write the fixed cost distribution conditional on ability type, $f(q|n, g)$. Then there is a different share of participants for each ability type, denoted by the cumulative distribution function $F(\bar{q}|n, g)$. Additionally, there is a distribution for the ability types denoted $h(n)$.

The Lagrangian for this problem is formulated as follows:

$$
\begin{aligned}
&max_{c,y,c_0,g} W = \\
&\int_{\underline{n}}^{\bar{n}} \left(\int_0^{\bar{q}_n} v(c,y,n) f(q|n,g) dq - \int_0^{\bar{q}_n} q(g) f(q|n,g) dq \right) h(n) dn \qquad (3.9) \\
&+ \int_{\underline{n}}^{\bar{n}} \left(\int_{\bar{q}_n}^{R} v(c_0,0,n) f(q|n,g) dq \right) h(n) dn \\
&+ \lambda \int_{\underline{n}}^{\bar{n}} \left(\int_0^{\bar{q}_n} (y-c) f(q|n,g) dq - \int_{\bar{q}_n}^{R} c_0 f(q|n,g) dq \right) h(n) dn \\
&- \lambda \int_{\underline{n}}^{\bar{n}} \left(\int_0^{\bar{q}_n} rg f(q|n,g) dq \right) h(n) dn \\
&- \int_{\underline{n}}^{\bar{n}} (\alpha' v + \alpha\gamma) dn + \alpha(\underline{n}) v(\underline{n}) + \alpha(\bar{n}) v(\bar{n}) \qquad (3.10)
\end{aligned}
$$

The last two terms are the transversality constraints. For them to work without problems, I need to assume that the distribution of ability types covers all the fixed cost types. The incentive compatibility constraint needs to work for each n. There is no need to integrate it over the fixed cost distribution, since fixed costs do not affect the working hours decision.

The tax properties are derived in earlier literature (Saez 2002, Immervol et al. 2007 and Jacquet, Lehmann and Van der Linden 2010), so I do not derive them here. The general properties of the optimal tax rates are that there is a non-linear tax schedule for participants. For each ability type there is different participation rate. Depending on the size of the extensive and intensive labour supply elasticities, the tax schedule may incorporate negative marginal tax rates. The higher the extensive labour supply elasticity in lower income groups, the more likely the tax schedule is to have in-work benefits for the working poor.

3.4.2 Publicly provided private goods with many ability types

Here I derive the provision rule for g_n in the case of many ability types. I take the first order conditions with respect to the publicly provided private good, g_n, for each n separately.

$$\begin{aligned}
&\frac{dW_n}{dg_n} = \\
&\left(\int_0^{\bar{q}_n} v(c,y,n)\frac{\partial f(q|n,g)}{\partial g}dq\right)h(n) \\
&-\left(\int_0^{\bar{q}_n}\left(q(g)\frac{\partial f(q|n,g)}{\partial g}+\frac{\partial q(g)}{\partial g}f(q|n,g)\right)dq\right)h(n) \\
&+\left(\int_{\bar{q}_n}^{R} v(c_0,0,n)\frac{\partial f(q|n,g)}{\partial g}dq\right)h(n) \\
&+\lambda(\int_0^{\bar{q}_n}(y_n-c_n)\frac{\partial f(q|n,g)}{\partial g}dq-\int_{\bar{q}_n}^{R} c_0\frac{\partial f(q|n,g)}{\partial g}dq \\
&-\int_0^{\bar{q}_n}\left(\frac{\partial rg}{\partial g}f(q|n,g)+rg\frac{\partial f(q|n,g)}{\partial g}\right)dq)h(n)=0
\end{aligned}$$

where y_n and c_n indicate the income and consumption of type n. This first-order condition is very similar to that in the one ability type model. The only difference is that since this is taken separately for each n, the conditional density $f(q|n,g)$, the publicly provided good, labour income and consumption are all functions of n. Thus there is a specific provision level for participants of each ability type.

The above FOC can be derived into a simpler form as follows:

$$\begin{aligned}
&\int_0^{\bar{q}_n}\frac{-\partial q(g)}{\partial g}f(q|n,g))dqh(n) = \\
&-\lambda\left(\int_0^{\bar{q}_n}(y_n-c_n)\frac{\partial f(q|n,g)}{\partial g}dq-\int_{\bar{q}_n}^{R} c_0\frac{\partial f(q|n,g)}{\partial g}dq\right)h(n) \\
&-\lambda\left(-\int_0^{\bar{q}_n} rg\frac{\partial f(q|n,g)}{\partial g}dq-rF(\bar{q}|n,g)\right)h(n)
\end{aligned}$$

$$\Rightarrow \int_0^{\bar{q}_n} \frac{\frac{-\partial q(g)}{\partial g}}{\frac{\partial v(c,y,n)}{\partial c_n}} \omega_n dq = rF(\bar{q}|n,g) - (y_n - c_n + c_0 - rg_n)\frac{\partial F(\bar{q}|n,g)}{\partial g}$$

where $\omega_n = \frac{\partial v_n}{\partial c_n} f(\bar{q}|n,g)/\lambda$ is the welfare weight that the government puts on a worker of type n. The term describing the effect of providing g_n on the distribution of workers coming from the government welfare functional is again enveloped out. This equation can be written as follows:

$$\int_0^{\bar{q}_n} MRS_{gc}\omega_n dq = rF(\bar{q}|n,g) - (T_n(y_n) - T(0) - rg_n)\frac{\partial F(\bar{q}|n,g)}{\partial g} \quad (3.11)$$

where $T_n(y_n)$ is taxes paid by a participating worker of type n. This is the optimal provision rule for a publicly provided private good of type n. It states that the public provision of g_n is welfare improving, as long as it has a positive effect on welfare in terms of MRS_{gc} for type n. The more the provision of g_n increases the number of participants of type n, the more welfare improving it is. There should be no government provision of goods in the opposite case. The greater the tax differential is between participation and non-participation, the greater the impact of the whole additional term is to the provision rule.

The optimal provision rule depends on the ability type, in this case through the participation rate and the government welfare weights. Also, the size of the additional terms depends on the ability type. Since this rule holds for every n, the effect is different for different ability types. The responsiveness of the participation rate to changes in government provision $\left(\frac{\partial F(\bar{q}|n,g)}{\partial g}\right)$ depends on the shape of the cumulative distribution function. With bell-shaped distributions, if the participation rate is already close to it's maximum, it is difficult to increase it even further. Across different ability types, it is possible that high n types participate more than low n types. In that case, high ability types would have a smaller additional term in the absolute value than lower ability types.

The interaction with the participation tax differential adds interesting interaction to the rule. The greater the participation tax differential for

a given income group, the greater impact it has on additional terms for that group. For example, the participation tax differential could be smaller for lower income groups than for higher income groups. The pre-existing provision level of g_n affects the tax differential. Even if the participation tax differential is high without public provision, large values of rg_n can offset this.

The leading real-world application for this model is publicly provided day-care for children. The general reasons for this were explained in the one ability type case. The added implications of many ability types fits the example of child care as well. The greater effect public provision of child care has on an income group, the more it should greater welfare effect it has on an income group. For example parents on low incomes could be more responsive to the added provision of child care. They could find that a significant share of their fixed cost of participation is removed by the extra provision of day care. This effect is stronger, the higher the participation tax differential is for this group. These effects could be lower for higher-income groups if they gain more from participation in any case.

3.5 Conclusion

This study has investigated a government provision rule for a private good in a setting where the good affects the extensive margin of labour supply. The good is connected to the extensive margin through it's effect on a fixed cost arising from participation. First, the optimal tax and the public provision rule are formulated in a simple case where there is heterogeneity only in the fixed costs. The optimal marginal tax rate for those participating is zero. A participation tax rate affecting the participation decision depends inversely on the participation elasticity. The rule for government provision of the private good states that a good that increases the participation in the labour force is welfare improving to provide publicly even if the income taxes have been set optimally. The size of the participation tax differential amplifies this effect.

Second, a more general model incorporated another source of hetero-

geneity: ability types. The public provision rule in this case is similar to the simple case of just one ability type. The difference is that there is a separate rule for each ability type. The government provision rule depends on ability types through the distribution effects and the participation tax differentials that vary across ability types. With these statistics available, the rule provides a clear intuition about cases in which public provision should be extended and those in which it should not. The defining factors in the rule are the direction in which participation changes and the extent of the net income differential between participation and non-participation.

The earlier literature studying government provision of goods in connection with optimal taxes has not taken the extensive margin of labour supply into account. Thus the results of Mirrlees (1976), Christiansen (1981), Boadway and Keen (1993) and Boadway et al. (1998) state that public projects should differ from the simple cost-benefit analysis only if they convey some information on the productivity of individuals. This does not occur if consumption and leisure are weakly separable in the individual utility function. The model studied in this paper differs from this result. Indeed, even if consumption and leisure are separable, there could be reasons to publicly provide private goods. If the good that is provided by the government lowers the fixed cost of participation, it could be welfare improving to provide it even if redistribution is taken care of optimal income taxes.

Another line of earlier research has studied the implications of welfare reforms with the extensive margin of labour supply taken into consideration (Saez 2002, Immervoll et al. 2007 and Eissa et al. 2008). The extensive margin has an impact on the optimal tax and transfer schedule. While the present study does not attempt to simulate the tax schedule for welfare reform purposes, the results have some significance here. It is shown that public provision of goods affects the government revenue requirement. Empirically, government expenditure on education, child care, health care and other services can be sizeable. The results here show that this kind of provision should be taken into account when considering welfare reforms, if the provision affects the participation decisions of individuals.

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3.A Appendix Derivation of FOC

The derivation of the first-order conditions (3.3)-(3.5) from the government objective function (3.2) is shown. The objective function consists of the utility part and the budget part. Since the individual utility is already at an optimum, marginally changing consumption has only a direct effect on individual utility. From the budget part I need to take the indirect effects to private consumption into account as well. I need to use Leibniz's rule when deriving an integral where the limit depends on the derivative. In this case $\bar{q}$ depends on consumption and income. This can be seen from equation (3.1). I take the derivative $\frac{\partial W}{\partial c_0}$ in equation (3.3) as an example of how the remainder of the derivations are performed. First there is the partial derivation of the inner function of the integral term in the objective function,

$$\int_{\bar{q}}^{R} \frac{\partial v(c_0, 0))}{\partial c_0} f(q|g)dq$$

The limit is enveloped out, since in the objective function individual utility is already at optimum and the derivation only directly affects the utility for this part. The same does not hold for the government budget, since there is no utility function that is already optimised, just the amount of taxes and transfers paid by everybody and the government provision of g. The derivation of the budget becomes:

$$\lambda \frac{\partial}{\partial c_0}\left(\int_0^{\bar{q}} (y-c)f(q|g)dq - \int_{\bar{q}}^{R} c_0 f(q|g)dq - \int_0^{\bar{q}} rgf(q|g)dq\right)$$

$$\begin{aligned}
&\iff \lambda\left(\int_0^{\bar{q}} \frac{\partial}{\partial c_0}(y-c)f(q|g)dq f(q|g)dq + \frac{\partial \bar{q}}{\partial c_0}(y-c)f(\bar{q}|g)\right) \\
&+\lambda\left(+\int_{\bar{q}}^{R} \frac{\partial}{\partial c_0} c_0 f(q|g)dq - \frac{\partial \bar{q}}{\partial c_0} c_0 f(\bar{q}|g)\right) \\
&+\lambda\left(-\int_0^{\bar{q}} \frac{\partial}{\partial c_0} rgf(q|g)dq f(q|g)dq - \frac{\partial \bar{q}}{\partial c_0} rgf(\bar{q}|g)\right)
\end{aligned}$$

The first and third integrals above are zero and in the second integral the density function is not affected by the changes in c_0. Only the threshold value $\bar{q}$ is affected. The above expression then simplifies to

$$\lambda \left[\frac{\partial \bar{q}}{\partial c_0}(y - c - rg) f(\bar{q}|g) + (1 - F(\bar{q}|g)) - \frac{\partial \bar{q}}{\partial c_0} c_0 f(\bar{q}|g) \right]$$

which gives the first order condition (3.3) after combining with the direct effect from the utility part.

3.B Appendix The Sign of Taxes on Non-participants

I prove here the sign of certain terms in the optimum allocation. The FOC of 3.2 with respect to λ, the Lagrange multiplier for the government budget constraint, is:

c_{0}

$$\begin{aligned} \frac{\partial W}{\partial \lambda} &= (y - c)F(\bar{q}|g) - c_0(1 - F(\bar{q}|g)) - rgF(\bar{q}|g) = 0 \\ &\Rightarrow (y - c + c_0 - rg)F(\bar{q}|g) - c_0 = 0 \end{aligned}$$

From here on, I denote the terms $(y - c + c_0 - rg) \equiv A$, $f(\bar{q}|g) \equiv \bar{f}$ and $F(\bar{q}|g) \equiv \bar{F}$. The term A is part of the participation tax rate and is also in the rule for optimal public provision of g. Then using FOC for c_0 and y from the government objective function it follows:

$$\begin{aligned} \frac{-\frac{\partial v}{\partial y}\bar{F}}{\frac{\partial \bar{q}}{\partial y}\bar{f}A + \bar{F}} &= \frac{-\frac{\partial v}{\partial c_0}(1 - \bar{F})}{\frac{\partial \bar{q}}{\partial y}\bar{f}A - (1 - \bar{F})} \\ \Rightarrow -\frac{\partial v}{\partial y}\bar{F}\left(\frac{\partial \bar{q}}{\partial c_0}\bar{f}A - (1 - \bar{F})\right) &= -\frac{\partial v}{\partial c_0}(1 - \bar{F})\left(\frac{\partial \bar{q}}{\partial y}\bar{f}A - \bar{F}\right) \\ \Rightarrow \frac{\partial v}{\partial c}\frac{\partial v}{\partial y}\bar{f}A &= \left(\frac{\partial v}{\partial y} - \frac{\partial v}{\partial c_0}\right)\bar{F}(1 - \bar{F}) \end{aligned}$$

where the last line follows from $\frac{\partial \bar{q}}{\partial c_0} = -\frac{\partial v}{\partial c_0}$ and $\frac{\partial \bar{q}}{\partial y} = \frac{\partial v}{\partial y}$ as noted when the participation threshold was defined in equation (3.1). The last equality

proves that A is positive, since consumption and leisure are normal goods and the distribution terms are positive by definition. Using the sign of A again proves that $c_0$is positive from the following equation:

$$A\bar{F} = c_0$$

which was modified from the FOC for λ from the Lagrangian (3.2).

3.C Appendix Incentive Compatibility Constraint

I first write the indirect utility function of type n individual as $e(n)$. Then a given allocation is incentive compatible if everyone of type n receives the greatest utility from choosing an allocation intended for type n:

$$e(n) - v(c, y, n) - q(g) = 0 \leq e(n') - v(c, y, n') - q(g) \tag{3.12}$$

where n' refers to some ability type different from n. This equation takes the difference between the indirect utility and the direct utility. The equation reflects the fact that this difference should be minimised when acting according to one's own type. Choosing the allocation intended for any other type n' means that the utility achieved is smaller than when choosing an allocation intended for one's own type.

It can be seen already from this that the fixed cost drops out from this expression, since it separable from the rest of the utility function. From here on, it is possible to follow a normal derivation of the incentive compatibility constraint. I totally differentiate the expression in equation (3.12) to get:

$$\frac{de}{dn} - \frac{\partial v}{\partial c}\frac{dc}{dn} - \frac{\partial v}{\partial y}\frac{dy}{dn} - \frac{\partial v}{\partial n} = 0$$

$$\Rightarrow -\frac{\partial v}{\partial c}\frac{dc}{dn} - \frac{\partial v}{\partial y}\frac{dy}{dn} = 0$$

From here it is obvious that the fixed cost does not affect the marginal utility with respect to productivity. The intuition here is that people participate when the utility from participation is greater than the utility from not participating. Ability type affects this difference only as regards the participation part. Thus if the allocation is incentive-compatible so that everyone chooses according to their own type, they also participate if their fixed cost is low enough to do that. For this reason participation is affected through average taxes and the hours decision through marginal tax rates.

$$\frac{dv}{dc}\frac{dc}{dn} + \frac{dv}{dh}\frac{dh}{dn} = 0$$

$$\frac{dv}{dc}\frac{dc}{dy} + \frac{dv}{dh}\frac{dh}{dy} = 0$$

$$\frac{v_h}{n}\frac{dcdy}{dndc} + \frac{v_h}{n}\frac{dvdc}{dcdy}\frac{dh}{dn} = 0 \Rightarrow \frac{dv}{dn} = -\frac{v_h h}{n}$$

Chapter 4

What was actually cut in the barbers' VAT cut?

[1]

Abstract

The tax incidence of consumption taxes across various sectors of the economy is a key aspect when designing a tax structure. However, there are very few empirical findings on this subject. This paper studies the tax incidence of consumption taxes utilising a VAT reform targeted at labour-intensive services in Finland. The reform creates a natural experiment set-up, because the reduced VAT was targeted at hairdressers, whereas the normal tax treatment still applied to beauty salons. This experiment is exogenous to the economic conditions of hairdressers in Finland, since this group was selected in a European Commission Directive. I study the effects of the reform on prices and demand. The results suggest that barbers cut their prices only by half of what complete pass-through would have implied. Using the experiment as an instrument, I find little effect on demand for the services. There does not seem to be any indication of a significant effect on labour demand either.

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4.1 Introduction

Consumption taxes are significant sources of tax revenue for governments. An important question in designing consumption taxes optimally is whether they should be uniform, or differ across commodities. According to economic theory they should differ when they have a differing impact on the level demanded (Ramsey 1927)[2]. A good that has inelastic demand and small cross-elasticity with other goods should face a higher tax rate. The efficiency-related reason for this is that when there is little effect on the demand for a good from increasing the tax, there is little distortion to consumption of that good. In the opposite case of highly sensitive demand even a small increase in tax distorts the equilibrium behaviour. Consequently, to set consumption taxes optimally across commodities, the demand elasticities of each good should be known. Also employment in a given sector is affected by the changes in demand for the product it produces.

This study estimates empirically how taxes shift to prices and their effect on demand for the services. I utilise a tax reform in Finland introducing lower value added tax (VAT) rates for hairdressers. The reduced VAT is exogenous to the economic circumstances of hairdressers, since this group was selected in an European Commission Directive long before the experiment was implemented in Finland. There are natural control groups for hairdressers: beauty salons, day spas and masseurs. These are labour-intensive services like hairdressers, but do not benefit from the reduced VAT regime in Finland.

The results indicate that hairdressers cut their prices by half of what full pass-through would have implied. Turnover evaluated at consumer prices follows the direction of change in consumer prices, but not to the same extent. Finally, using the reform as an instrument for price changes does not result in a significant effect on demand due to the tax decrease. Any effect on employment in these services has to go through changes in demand

[2]Another school of thought claims that consumption taxes should not be uniform if different goods are complementary with leisure to a different extent (Atkinson and Stiglitz (1976) and Saez (2002)) or because of the equity reasons (Diamond and Mirrlees (1971)). Here the focus is on efficiency reasons which also need to be taken into consideration.

for the services, suggesting that in this case there is no effect on labour demand. I estimate similar regressions on the monthly wage sums paid by hairdressers as on demand. The results confirm the intuition that there is no effect on labour demand.

This study contributes to the literature studying the tax incidence of consumption taxes on prices. Doyle and Samphantharak (2008) study tax incidence on gasoline prices. They have a credible method for determining the effect of taxes from regional temporary tax repeals in certain regions of the USA. They find a 70 to 100 per cent pass-through on prices. The results are not directly comparable with this study due to the different product (gasoline) they study. Other studies (Poterba (1996), Besley and Rosen (1999) and Alm, Sennoga and Skidmore (2009)) focus on the tax incidence of the sales taxes of various products. These studies provide valuable information in a very understudied subject, although it is possible that the tax reforms they study are not completely exogenous to price changes.

The reduced VAT experiment in Finland offers several advantages in studying the tax incidence of VAT. First, since the reform is exogenous to the behaviour of firms, it is possible to use a natural experiment set-up in analysing the effects. The outcomes of the treatment and control groups can be compared before and after the change in the VAT regime. Figure A2 illustrates the main approach. It is evident that the assumptions needed for the differences-in-differences to be identified work in this case. Second, the data contains both turnover and prices for a sample of firms. Consequently, it is possible to establish the effect of the VAT on the demand for labour-intensive services using a credible natural experiment approach.

Section 4.2 describes the institutional background and discusses the anticipated effect of lowering VAT. Section 4.3 presents the approach used to analyse the effects of the reform. The data is presented in section 4.4. Section 4.5 presents and explains the results and section 3.5 concludes the study.

4.2 Design of the reform and anticipated effects

4.2.1 Institutional background

The European Union requires Member States to have a consumption tax system based on value added taxes (VAT). A certain degree of harmonisation is required of individual Member States in setting their VAT rates (EC 2006a). As an exception to their normal VAT rates, Member States are allowed to experiment with reduced VAT rates for certain labour-intensive services. The aim is to allow Member States to study the incidence on prices and employment as well as the effects on the shadow economy (EC 1999 and 2006b).

Finland joined the second round of the reduced VAT rate experiment. The VAT rate was lowered from 22 per cent to 8 per cent from the beginning of 2007 and the reduced rate is to remain in force until the end of 2010 (Finlex 2006). The original European Commission (EC 1999) Directive listed the services that are eligible for reduced VAT rates. This list includes some labour-intensive services, but leaves out others (such as beauty salons). The services selected by Finland from the EC list were hairdressers and small businesses that provide services such as repairing bicycles, shoes and leather goods and clothing and household linen.[3]

Since the lowered VAT rate was implemented according to the EC Directive, it is unlikely to have been driven by the specific economic circumstances of these services. This study concentrates on hairdressers, because there is a control group for them: beauty salons, day spas and masseurs. This control group resembles hairdressers in that it is labour-intensive, but the businesses do not benefit from lower VAT rates since they are not covered by the EC Directive. There is no mention in (EC 1999 or 2006b) why hairdressers were specifically identified as being appropriate for a VAT

[3]In Finland, household services also benefit from special tax treatments, but this was implemented under a different proposal starting from 1997 (Finlex 1997). Since then the tax reduction has been gradually increased.

experiment, whilst the businesses in the control group in this study were excluded. The reasons given for selecting the target groups were on a more general level, such as "high anticipated effect on increasing employment".

In Finland consumer prices announced in price tags include VAT. For this reason, it is possible that if firms do not reduce the consumer price in response to reduced VAT, consumers will not necessarily notice that anything has changed since the consumer price remains unchanged. Thus if consumers do not know of the experiment, they would not expect firms to lower their prices. The reduced VAT rate was widely enough announced in the media around the time of the implementation of the reform. Thus large number of consumers ought to have known about the experiment and its likely effect on prices. If consumers do not know about VAT reduction, it might be possible for firms not to lower prices if there is not much competition between firms.

VAT is remitted to the Finnish tax authorities. Firms that are liable for VAT have to report it once a month to their tax authority as a sum of taxes remitted separately by tax rate. Thus in 2006 firms reported the amount of taxes remitted at the 22 per cent rate and in 2007 they reported taxes remitted at the 8 per cent rate on the same services. The chain feature of crediting VAT paid on inputs is seen in the same monthly tax report. The final amount of taxes a firm ends up paying each month is the difference between taxes charged on outputs and the taxes paid on inputs.

4.2.2 Predictions from economic theory

When a consumption tax is reduced, the standard economic model indicates that the degree of tax shifting to prices depends on the elasticities of demand and supply. If supply is much more elastic than demand, the reduced consumption tax should pass through to the consumer price (almost) completely. In this model there would be no increase in (zero) profits and there would be constant returns to scale such that no firm is able to extract any rents. These are restrictive assumptions that are not likely to hold in empirical data.

General equilibrium analysis takes into account the effects on equilibrium quantities and thereby on factor demand. These will also depend on the elasticities of other goods. These effects were analysed in the Ramsey (1927) model. In summary, if demand is inelastic and supply elastic, consumption taxes pass through to prices in full. However because the level of demand of a good that has inelastic demand will not change much, there will not be major effects on factor demand in the production of that good. In the case of small labour-intensive firms, labour is the major input. Thus, the greatest effect of increasing input demand is on labour. This study estimates empirically the extent to which demand for labour-intensive services is affected by reducing their value-added tax (VAT).

It is useful to consider the predictions of models with imperfect competition that may fit the empirical situation better. In an oligopoly model with Cournot competition Delipalla and Keen (1992), and in a model with Bertrand competition with differentiated products Anderson et al. (2001) study the effect of reducing ad valorem taxes on prices. Myles (1989) formulated a Ramsey-type model where part of the economy was imperfectly competitive. In these models the tax can over- or under-shift to the consumer price. In contrast to a fully competitive model, it is possible that the demand for a good is affected, even if prices react to the tax change. In shorter term the firms could increase their profits if the economy is not fully competitive. These profits could lead to better employment situation in the longer term if there was more entry or less entry to the affected sector. Unfortunately the empirical analysis in this paper will be able to reveal only short term effects.

The aim of the above discussion is to remind the reader what economic theory predicts would happen to the price of and demand for a good following a tax decrease. It is easier to interpret the empirical results in the light of theoretical mechanisms. In the literature there are plenty of theoretical findings stating how consumption taxes should be set optimally. Hopefully the empirical findings in this paper will be useful in this optimal tax literature. However I did not want to discuss optimal tax results here, since the focus is on understanding what happened, not what should happen.

4.2.3 What ought to happen?

In the VAT experiment for labour-intensive services the VAT was reduced from 22% to 8%. In this case full pass-through would imply that prices would be reduced by 11.5 per cent from the level before the experiment. This can be seen from the formula below that shows how the percentage change can be calculated when the producer price (ϕ) stays constant:

$$\frac{1.08 * \phi - 1.22 * \phi}{1.22 * \phi} * 100 = -11.475\% \tag{4.1}$$

The turnover (Y) evaluated at consumer price is defined as the volume or quantity ($Q(p)$) multiplied by the price (p): $Y = Q * p$. Assuming no change in demand and no change in consumer price, turnover would remain the same. If nothing happens to demand, but prices are reduced, turnover naturally declines. Reduced form regression on turnover reveals the effect reform has on this consumer price turnover.

To evaluate what would happen to demand for the products in the short term if prices change, it would be ideal to know the quantity and price. In this case turnover and price are observed, and using definition of turnover, the effect of price change on demand comes from following formula:

$$\frac{d(p * Q(p))}{d(p)} = Q(p) + pQ'(p) = Q(p)\,(1 + \eta) \tag{4.2}$$

where η is price elasticity of demand. Therefore the effect on demand can be seen by studying turnover and price changes simultaneously in the same firm. In the empirical data there is the complication that the same firm produces many services which prices may change differently from each other.

4.3 Econometric method

The econometric method used in this study is difference-in-differences (DD) approach. The short-run effects of taxes on prices and turnover are compared between the treatment and control groups before and after the beginning of 2007. The treatment group consists of hairdressers and the control

group consists of beauty salons, day spas and masseurs. I estimate the following equation for firm i and time t:

$$Y_{it} = \alpha + \beta_1 1(haird)_i + \beta_2 1(after)_t + \beta_3 1(haird_i * after_t) + \beta_4 X_{it} + \varepsilon_{it} \quad (4.3)$$

where $1(haird)$ indicates a firm in the hairdresser group, $1(after)$ indicates observations from the beginning of 2007 onwards. Y_{it} is an outcome that can be price, turnover or wage-sum depending on the specification. X is a vector of controls including flexible time trends in some specifications as well as other control variables describing the location and economic behaviour of a firm.

The DD approach should identify β_3, the effect of a changing tax environment in the treatment group relative to the control group. This approach works well if the pre-treatment time trends between the two groups are parallel to each other, indicating that the treatment group would have behaved similarly to the control group in the absence of the reduced VAT rate. Figure A2, which compares prices in the treatment and control groups, indicates that this assumption seems to work well in this case. It would be problematic if there were anticipation effects before the reform. This could happen if firms in the treatment group started to react prior to the reform, for example when the reduced VAT rate was announced but had not yet taken effect. Figure A2 again shows that prices do not show any such anticipation effects.

It is possible that there are other general equilibrium effects that would make the DD approach biased. These could include effects on entry to and exit from the treated industry. There could be effects on competition between industries in the treatment and control groups. However, the approach used identifies short-term effects. Looking at the effects in the monthly level data in particular it is difficult to believe that the general equilibrium effects mentioned above could take place in few months. Also, hairdressers are not substitutes for beauty salons, making competition between these two industries less intense.

In the second part of the analysis I am interested in how changes in

prices can explain changes in turnover. The aim is to understand how price affects demand for the services. Mathematically this relationship is shown in equation (4.2). Since the decision to reduce or not to reduce prices is made by the firm, a simple regression between these two would be biased. Even more fundamentally, turnover is defined as price multiplied by quantity, and quantity is a function of price. Thus changes in prices affect turnover by definition. To distinguish what effect sudden price change has on quantity, I use an instrumental variable (IV) strategy. Instrumental variable in this case can be explained by running a regression how much the instrument, change in VAT for the treatment group, affects both prices and turnover:

$$p_{it} = X'\pi_{10} + \pi_{11} Z_{it} + \xi_{1it}$$

$$Y_{it} = X'\pi_{20} + \pi_{21} Z_{it} + \xi_{2it}$$

where, X is a vector of covariates, Z is the instrument variable and ξ are the error terms. The instrumented effect of price on turnover is given by:

$$\rho = \frac{\pi_{21}}{\pi_{11}}$$

The coefficient ρ is the reduced form coefficient (the effect of VAT cut on turnover) divided by the first-stage coefficient (the effect of VAT cut on prices). This measures similar effect than equation (4.2), but uses only the variation induced by the VAT-reform.

More specifically, I use a two-stage least squares (2SLS) strategy, where the first stage is equation (4.3) of prices. Then in the second stage I explain the changes in turnover or wages by the first stage. The variable that is excluded is the interaction between the treatment and the after dummies. The quantity in the short term should be only affected through changes in prices induced by the VAT reform. If the reform used in the DD approach is exogenous to the economic circumstances of the targeted firms, using it as an instrument should be valid.

4.4 Data and description

The main part of the data utilised in this study comes from the Finnish Tax Administration. Monthly data is available for the VAT remitted by each tax rate, the VAT paid on inputs as well as total monthly salaries paid to employees. The data covers the years from 2002 to 2008. In addition there are yearly observations for final turnover, various costs and profits made. The data obtained from the tax authority includes every firm that is liable for remitting VAT in Finland in the selected sectors.

The price observations come from two separate sources. Both of the data sets are survey data. One was conducted by Statistics Finland and consists of the data used to calculate the official Consumer Price Index. It contains time series observations from 2002 to mid-2009. There are only a few price variables, though. The other price data was collected by the Finnish Consumer Agency. It contains only two time-observations, one before and one after the reform. It contains the prices of every product of about 400 hairdressers.

Figure A1 shows the development of the mean of various prices in the treatment and control groups over time. The prices are shown in real terms expressed in euros. The prices in the hairdressing services category (treatment group) are haircut, hair dress, colour and highlights. The vertical line shows the first month of reduced VAT, January 2007. Based on the figure it seems that there is a response in treatment group prices and none in control group prices. With a long time series, it is possible to take into account possible differences in the time trends of prices. Table A1 gives the overall statistics of the same prices seen in figure A1.

The DD approach used in this paper requires the pre-treatment trends to be similar in the treatment and control groups. To check this, figure A2 presents composite mean prices for both groups and the confidence intervals for them. The indices are calculated by adding together prices in the same group and normalising the mean of that group to 100 at the end of 2006. It is clear from the figure that the pre-treatment trends follow each other fairly well and that the confidence intervals overlap. Consequently, it seems

that the treatment and control groups resemble each other well enough. In January 2007, marked by the vertical line, the cut in VAT for the treatment group takes place. The consequent drop in mean prices can be seen for the treatment group, but not for the control group. The difference seems tentatively significant based on the confidence intervals in the figure.

Table A2 presents descriptive statistics by firm type from the administrative data set. The table is divided by firm type and shows in each case the mean, standard error and number of observations. The number of observations is large, because it is a monthly data set. Some of the variables are on an annual level, though.

Two further figures describe the conditions in the data and check whether it looks as if the assumptions required in the DD approach are met. Figure A3 presents some of the key variables over time. The tax variable is the one from which turnover is calculated. The drop in taxes remitted by the treatment group in January 2007 highlights the loss in average tax revenues when the reduced VAT was implemented. It is reassuring that there is no drop in the control group at the same time. The variable labeled "input" denotes VAT paid on all inputs by the firm. Since there is no increase in this variable for hairdressers, there does not seem to be an increase in demand for their products. If the volume of services sold by a firm increased substantially, it would eventually need to buy more inputs to produce the increased output.

Figure A4 presents the development of turnover evaluated at consumer prices over time by firm type. This variable is interesting, since it is later used as a dependent variable in the regressions. Turnover measured in this way should stay constant if there is no change in the demand for or the price of the products. After the VAT cut, marked by the vertical line, there does not seem to be a marked effect on turnover in the treatment group. Although there could be some effect, since the consumer prices themselves indicate a drop, the effect is so small that it is difficult to see it from the figure. It is clear that Sole proprietors fulfill the DD assumption of similar pre-treatment trends better than other firm types. This fact is taken into account in the regression analysis by dividing the results by firm type.

4.5 Results

4.5.1 Tax incidence on prices

Table A3 presents the differences-in-differences (DD) estimates for prices. The dependent variable is a price that includes information from both surveys and from the treatment and control groups. It is the same variable which is described in figure A2. Column (1) contains all observations; in columns (2) to (4) the data is split according to firm type: corporations, sole proprietors and partnerships. The coefficient in the first row shows the DD estimate. The results can be read directly as percentages. For all firms, the effect of reducing VAT by 14 percentage points is -7.2%. Thus, compared to the theoretical full pass-through of -11.5%, the actual pass-through is slightly over half. The Wald test indicates that this result is significantly different from full pass-through. The heterogeneous response by firm type is evident when comparing the estimates in columns (2) to (4). Corporations respond the most, sole proprietors much less and the estimate for partnerships is not even significant. The result is most robust for sole proprietors, since they account for the bulk of the data.

Tables A4 and A5 present the results for the probability of lowering prices. The dependent variable is a dummy with a value of 1 if the price is lowered by the cut-off value or more. In table A4 the cut-off value is 0.5% and in table A5 5%. The columns present estimates for similar groups as in table A3. The probability of lowering the price at least a little is on average 0.55. This means that less than half of the firms in the treatment group did not lower prices. Measured this way there is not much difference in response by firm type. For firms that lowered prices by at least 5%, the probability overall is only 0.35. There is a slight (statistically insignificant) heterogeneity by firm type. Thus it seems that firms lowered prices by different amounts on average, but the proportion of firms that lowered prices is more even between firm types.

There are two samples of prices in the data set used. To summarise the changes in the data set obtained from the Consumer Agency, figure A5

presents the mean change in each price in the data set. Since there are only two points of time when prices are measured, and this data set does not include the prices of control group products, the differences-in-differences approach can not be used here. Instead, I just present the mean change and the confidence interval of this for each price. It is interesting to note that the average price change is only around -3%. Full pass-through of the tax cut would have implied a price change of -11.475%. There is also variation across products, so that it matters which hairdresser's product one is looking at when measuring the tax incidence on prices. The last two prices, prices number 53 and 54, are the mean and sum of all the other prices.

I estimated the probability of reducing a price by 1% or more and by 10% or more. The mean of those probabilities can be seen in figure A6. Interestingly, more than half of the sample did not react to the tax change at all, while only around 10% changed prices substantially. Again, there is variation in the response probabilities between prices. The mean and sum of other prices show that it is common for some of the prices to change a little, but it is not very common for all of the prices to change substantially. The prices that tended to be reduced are the prices of standard services like "Basic haircutting, 30 minutes".

The conclusion from all of the price results is that the overall pass-through in this industry is about half and that it was relatively uncommon for firms that did lower their prices to lower them by the amount of the tax reduction. There is heterogeneity by firm type and by product type, especially in the mean response.

4.5.2 Results for turnover

Table A6 shows the DD results for the turnover evaluated at consumer prices. Column (1) shows the effect for all firms without covariates other than time. Column (2) adds firm-specific covariates such as taxes paid on inputs and the area were the firm is located. Columns (3) to (5) again present the divided-sample results by firm type for corporations, sole propri-

etors and partnerships, respectively. The results indicate that the turnover decreased modestly, which is consistent with the firms reducing consumer price, but there is no offsetting effect from increasing demand.

The result is most reliable for sole proprietors in column (4), since the DD assumptions are best met for them. The result indicates that turnover decreased by about 100 euros as a result of the reduced VAT. Just prior to implementing the reform, their mean turnover was about 3000 euros. Thus the result indicates a decrease of 3.3% from that mean level. The full response would have been -11.5%. This result could be explained by not having full pass-through to consumer prices and also that some turnover comes from other services for which VAT remained at the normal rate of 22%. None of the results are positive in a statistically significant way. Consequently, the results do not indicate that demand for the services increased.

To provide more evidence about the link between price and turnover changes, I estimate the effect price changes have on turnover. The mechanism that the IV-estimates aim at revealing is shown in equation (4.2). The idea here is to use the VAT reform as an instrument that drives the price changes and see what effect that change has on turnover. To estimate this, only the part of the data is used, where it was possible to link the price and turnover information to the same firm. This reduces the number of observations. The change in prices is instrumented with the differences-in-differences variable as is explained in section 4.3. The interpretation of the results is that if the second stage coefficients are positive, the reduced form and price change move in the same direction. If on the other hand the increase in quantity is so large that the change in turnover induced by the reform is positive even when the price decreases, the second stage coefficients are negative. Then there is a clear indication of increased demand for the services.

Table A7 shows the IV results. The first stage shows the effect that the DD variable has on prices. According to the F-test the first stage is strong enough in most cases. The price variable shows the effect the instrumented price has on consumer-price turnover in the second stage. The second stage coefficients are positive but statistically insignificant when the first stage is

significant. This is somewhat ambiguous result, but at least it means that the quantity did not increase significantly due to reform. One reason for ambiguous results is that the instrument variable comprises of one dummy and some firms reduced their prices and some did not. This heterogeneous response weakens the power of the instrument used. Also firms are very heterogeneous and some larger firms have other activities that where not affected by the VAT cut, but show up in the turnover variable.

4.5.3 Results for other variables

Table A8 shows the results for other variables that might have been affected by the reduced VAT rate. These other variables come from tax declarations and thus the variation in the variables is on an annual level. The interesting outcomes in this data are profits and net assets, since these can not be seen from the month-level data.

The only significant result in table A8 is the effect on turnover. The coefficient follows the direction of the monthly-level data and is consistent with the treatment group firms lowering their prices. It is interesting that there does not seem to be a significant increase in profits or net assets. It is possible that the profits are not significantly affected even if the entrepreneurs have benefited from the lower VAT by not lowering the consumer prices. The entrepreneurs might instead have increased their own wages or expenditures in the firm accounts.

To investigate the potential link between the tax change and labour demand, I estimated instrumental variables (IV) equation where the price changes explain the changes in the monthly wage sums paid by a firm. The method here is similar to that used to analyse the link between prices and demand in table A7. The idea here is that in the short term those firms that lower their prices will experience increase in the demand for their services and thus need to hire more labour. The IV method here reveals whether the VAT cut has any effect on actual labour demand through the channel explained above. If there is increase in wage sum, the reduced form is positive and first stage negative leading to negative coefficient in

the second stage.

Table A9 shows the results that do not display any significant effects on the wage sum. The second stage is indeed negative, but again statistically insignificant. Since there was no clear effect on quantity, it is not surprising that there is no clear effect on the wage sum.

4.6 Conclusion

This paper studies the tax incidence of a reduced VAT rate on labour-intensive services. As part of EU legislation, Finland selected some industries for a reduced VAT experiment of 8% while other similar industries continued to be subject to the normal VAT rate of 22%. The experiment is exogenous to the economic conditions of firms because the treatment group was selected on the EU level and the control groups were left out quite randomly.

The results indicate that taxes passed through to prices at a level of around 50%. The results reveal some heterogeneity in tax incidence according to firm type and product type. Corporations cut their prices more than sole proprietors.

In the short run the effects of lower VAT on turnover should follow the price response if demand stays constant. If consumer prices do not change and there is no change in demand, turnover stays constant. The results indicate that on average turnover decreased as a result of the tax reduction, but not by very much. There is heterogeneity across firm types, but not always in the same direction as for the price responses. This can be explained by the fact that corporations derive a large share of their turnover from services on which VAT was not reduced.

To analyse whether demand increased for services on which VAT was reduced, I estimated an instrumental variable model. There the change in turnover is explained by the change in prices. Since any pricing decision is made by the firm, there is possibly a selection problem if firms select into lowering their prices because their demand was decreasing. Also, the dependent variable is turnover that is a function of price by definition. To

cope with these potential problems, the price change was instrumented. The results did not show any statistically significant effect the change in prices has on turnover. Thus it is concluded that there was no significant increase in demand for the services, at least in the short term. A similar model was estimated for wages. The results do not show any effect either.

This study showed that due to tax reduction there was only a partial price response and no clear effect on demand for the services, and no significant effect on the labour demand. The Ramsey (1927) argument is that taxes that induce small changes in equilibrium quantities should be higher. According to this argument, therefore, the labour-intensive service sector should be taxed more than some other sectors. At least we learned that the reduced VAT rate was not particularly effective in creating employment through increased demand. Other justifications in theory for setting a tax rate are that the good is complement with labour (Saez 2002) and that there are equity reasons to do so (Diamond and Mirrlees 1971). According to results in this study it seems that hairdressing services are not complement with the labour supply or that at least small price changes do not induce higher demand that would reduce the time spent to hairdressing at home. It can be argued that hairdressing is to some extent a luxury good, making the equity reasons for lowering the VAT less compelling. Thus these are not robust arguments in favour of reducing the VAT on these services.

Consumers benefited from the lower taxes through prices that were lower by half of what the reduced tax implied. The rest of the tax benefited the targeted firms, probably in form of higher profits spread over different accounts in the data. The government lost about 4 million euros per month in tax revenues from hairdressers. Thus it seems the reduced VAT regime is not particularly effective policy for labour-intensive services in terms of lower prices and higher employment. In this case, reducing VAT appears to have been a costly way of increasing employment.

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4.A Appendix

All the tables and figures are in this appendix.

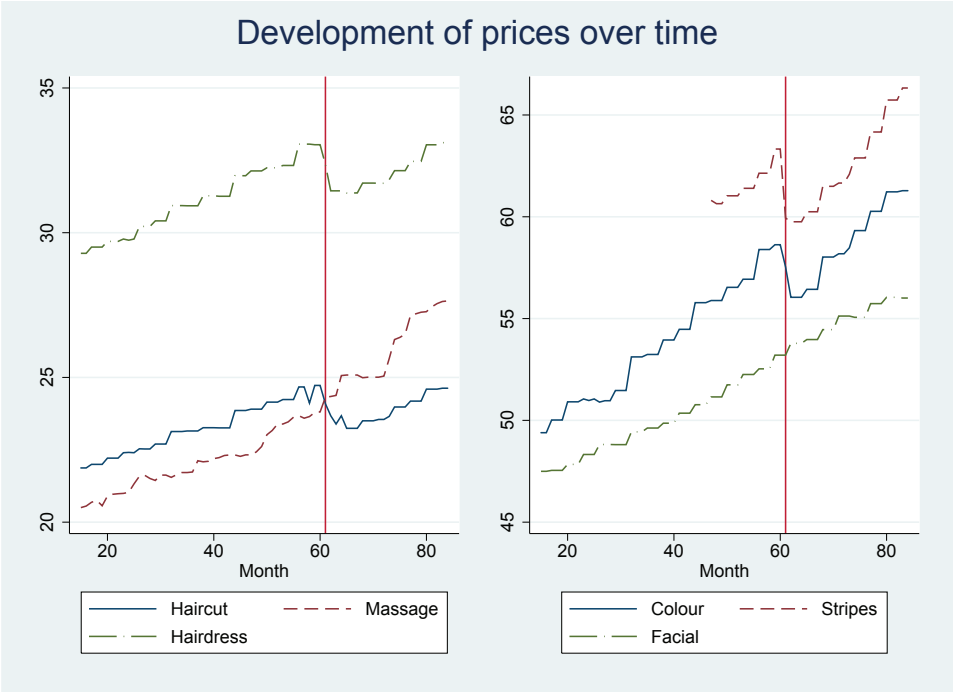

Figure A1: Comparison of development of prices in the control and treatment groups over time

Note: The prices for Haircut, Hair dress, Colour and Highlights fall within the treatment group and are prices of various services provided by hairdressers. The prices for Massage and Facial fall within the control group.

stats	Haircut	Hair dress	Highlights	Colour	Massage	Facial
mean	24	32	63	56	23	51
sd	4.2	7.4	15	15	8.3	11
p50	23	30	62	53	21	50
max	48	58	115	115	67	95
min	11	15	29	23	10	20
N	12126	11806	2445	11811	4888	4889

Table A1: Statistics of price observations

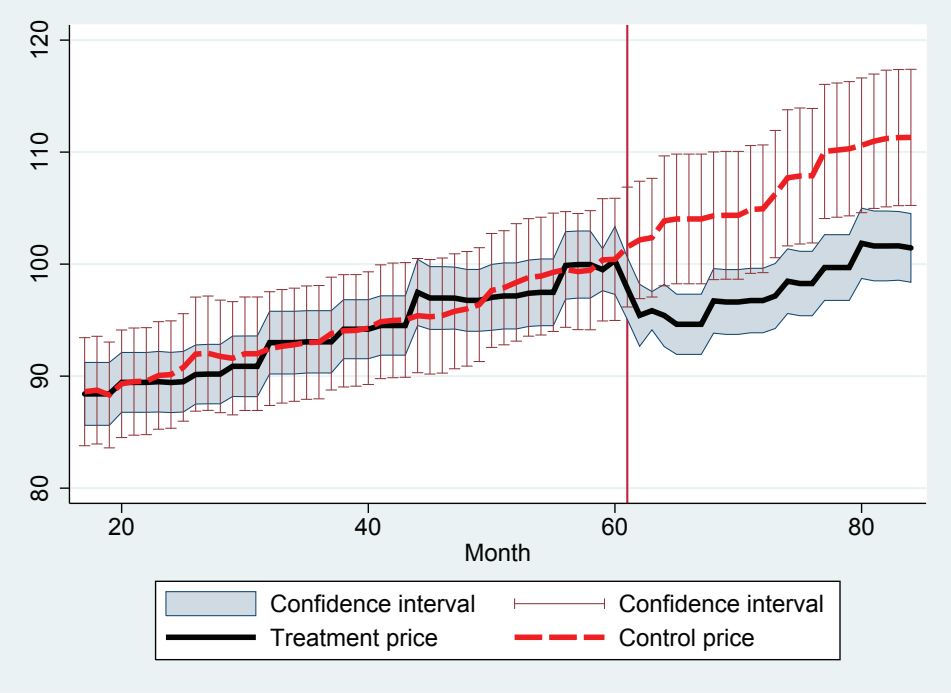

Figure A2: Prices in the control and treatment groups and their confidence intervals

Note: Comparison of the development of mean prices between the treatment and control groups over time. The prices are composite prices for both groups that are normalised to 100 at the end of 2006. The confidence intervals are calculated from the standard error of the mean.

Firm type		Mean	Sd	N
Corporation	Turnover	13527	24998	33095
	Share treat	0.459	0.498	40481
	Input tax	1820	14958	39903
	Earnings	10660	55589	40481
	Rents	80.5	2323	40481
	Wages	2691	8529	40481
Sole prop	Turnover	2651	2579	639294
	Share treat	0.734	0.442	691925
	Input tax	196	332	683116
	Earnings	4198	37235	691925
	Rents	16238	94896	691925
	Wages	0.432	57.1	691925
Small corp	Turnover	7137	9638	40249
	Share treat	0.719	0.449	43516
	Input tax	503	941	43122
	Earnings	5694	16383	43516
	Rents	3492	8789	43516
	Wages	432	3177	43516

Table A2: Descriptive statistics for the dependent and control variables by firm type

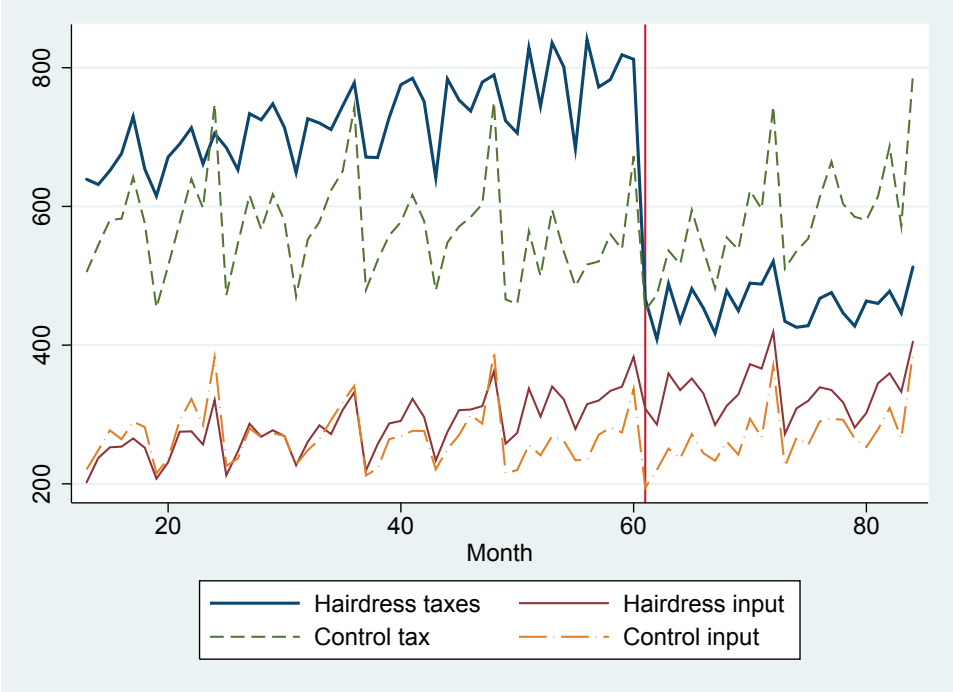

Figure A3: Descriptive over time

VARS	(1) All	(2) Corporation	(3) Sole proprietor	(4) Partnership
dd	-7.6***	-10.42***	-6.21***	-3.89
	(1.25)	(3.52)	(1.28)	(3.16)
Constant	104.7***	125.5***	100.2***	70.80***
	(1.77)	(5.51)	(1.73)	(14.36)
N	19244	4084	10385	2790
R^2	0.14	0.14	0.2	0.28
Controls	Yes	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3: Effect of reducing VAT on mean prices

Note: The first column contains all price observations, column (2) is for corporations, column (3) for sole proprietors and column (4) for partnerships. The control variables include: a dummy for each month, a separate linear time trend for the treatment group and an indicator for each city in the sample.

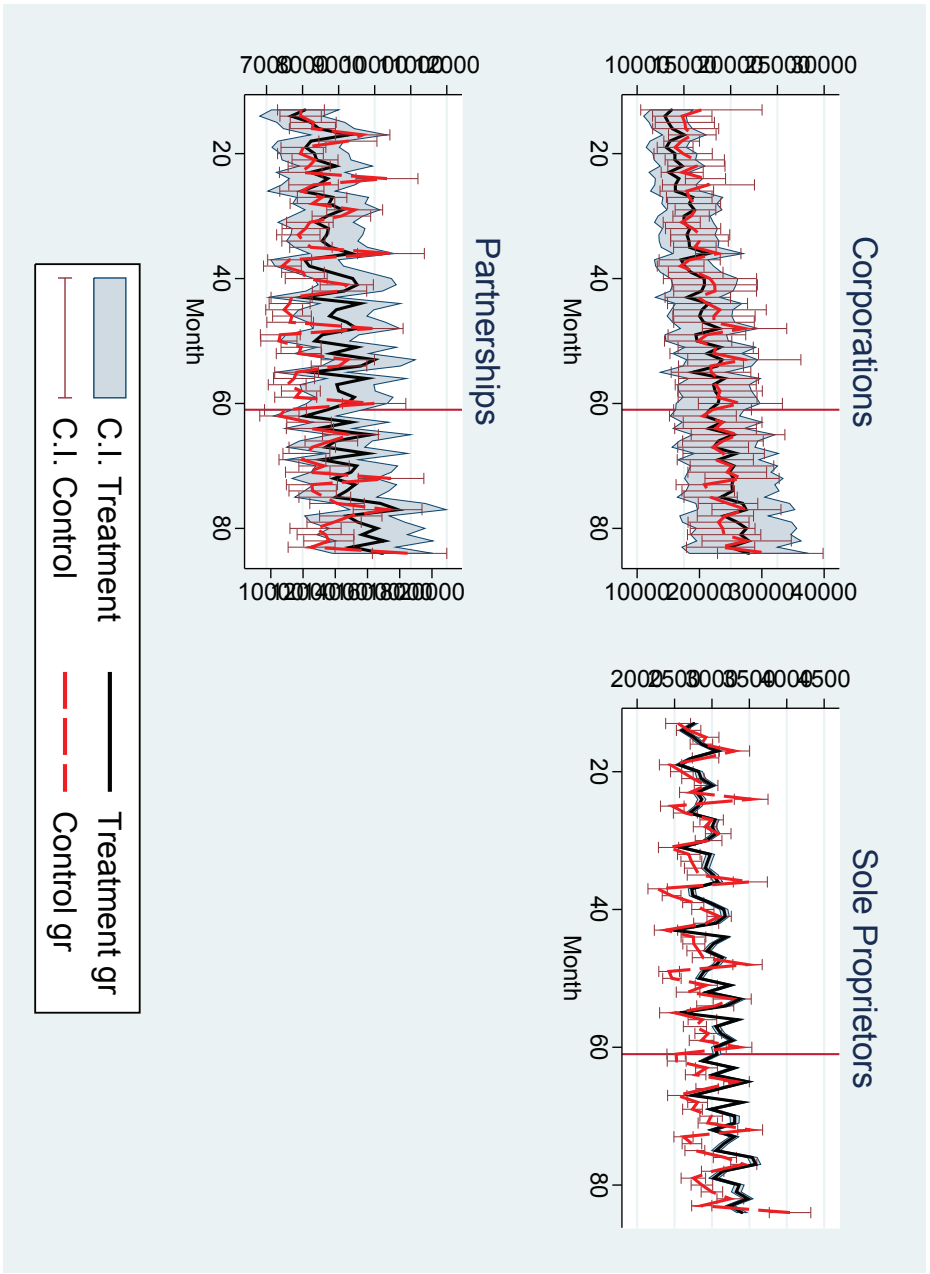

Figure A4: Turnover over time by firm type

VARIABLES	(1) All	(2) Corporation	(3) Sole proprietor	(4) Partnership
dd	0.55***	0.62***	0.53***	0.57***
	(0.009)	(0.016)	(0.012)	(0.024)
treat	-0.018***	-0.028**	-0.012	-0.048***
	(0.006)	(0.012)	(0.009)	(0.018)
after	0.057**	0.11**	0.04	-0.00
	(0.026)	(0.048)	(0.036)	(0.065)
Constant	-0.07***	0.15***	-0.10***	-0.07
	(0.02)	(0.05)	(0.03)	(0.12)
Observations	16686	3646	9313	2511
R-squared	0.5	0.62	0.47	0.55
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table A4: The effect of lowering VAT on the probability of lowering prices by at least 0.5%

Note: The first column contains all price observations, column (2) is for corporations, column (3) for sole proprietors and column (4) for partnerships. The control variables include: a dummy for each month, a separate linear time trend for the treatment group and an indicator for each city in the sample.

VARIABLES	(1) All	(2) Corporation	(3) Sole proprietor	(4) Partnership
dd	0.35***	0.41***	0.38***	0.28***
	(0.008)	(0.018)	(0.012)	(0.021)
treat	-0.02**	-0.04***	-0.01*	-0.04***
	(0.01)	(0.01)	(0.01)	(0.02)
after	0.043*	0.11**	0.02	-0.02
	(0.03)	(0.05)	(0.03)	(0.06)
Constant	-0.06***	0.27***	-0.12***	-0.12
	(0.02)	(0.05)	(0.03)	(0.11)
N	16686	3646	9313	2511
R^2	0.33	0.44	0.35	0.37
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table A5: The effect of reducing VAT on the probability of lowering prices by at least 5%

Note: The first column contains all price observations, column (2) is for corporations, column (3) for sole proprietors and column (4) for partnerships. The control variables include: a dummy for each month, a separate linear time trend for the treatment group and an indicator for each city in the sample.

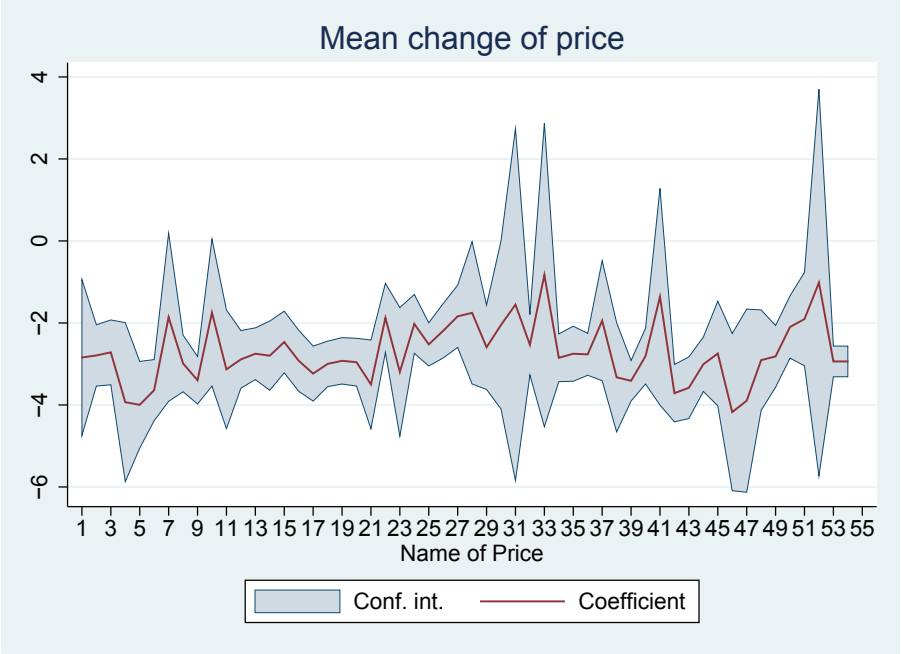

Figure A5: Mean change in prices

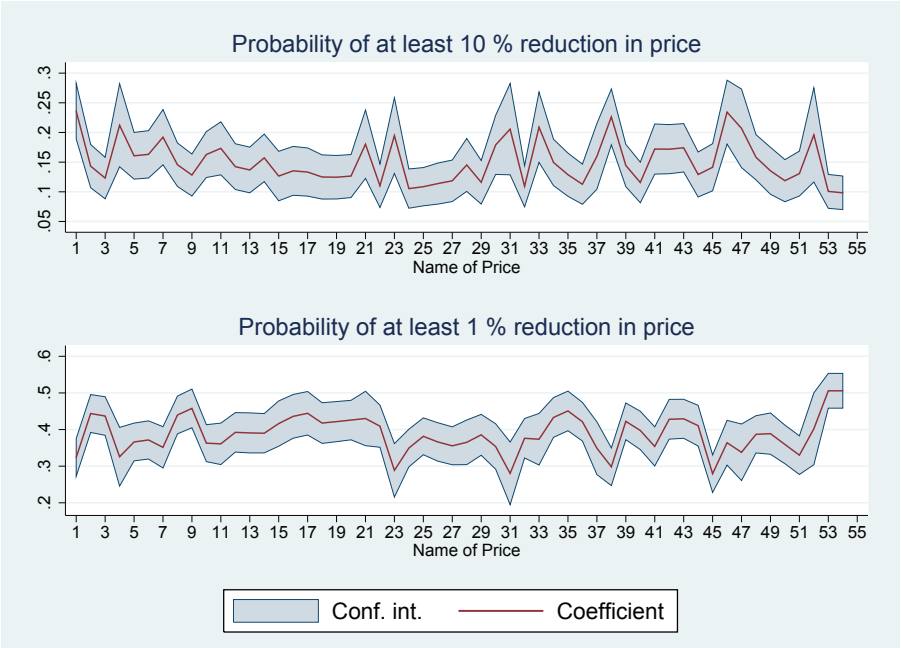

Figure A6: Probability of price changes

VARS	(1) All	(2) All	(3) Corporation	(4) Sole proprietor	(5) Partnership
dd	-432.4**	-151.4**	546.7	-102.3***	-235.1
	(201.7)	(61.7)	(845.4)	(22.0)	(224.8)
treat	-2,599.9***	-420.8***	-2,657.7***	332.1***	581.7***
	(195.6)	(59.9)	(784)	(21.8)	(208.1)
after	1,228.5***	-165.3	-2,469.7*	46.2	535.9
	(343.4)	(105.0)	(1,481.4)	(37.1)	(394.4)
Constant	5,95***	2,47***	7,68***	1,68***	1,69***
	(243)	(84)	(1,163)	(29)	(335)
N	946216	946216	53941	822919	63155
R^2	0.00	0.91	0.92	0.47	0.68
Controls	No	Yes	Yes	Yes	Yes
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1					

Table A6: The effect of reducing VAT on turnover

Note: The dependent variable, consumer price turnover, is in nominal terms. Columns (1) and (2) are for all firms, column (3) for corporations, column (4) for sole proprietors and column (5) for partnerships. The control variables include: flexible time controls, use of inputs, amount of salaries paid and use of rents.

VARS	(1) All	(2) Corporation	(3) Sole Proprietor	(4) Partnership
First stage	-6.80***	-10.38***	-7.2***	-3.11
	(1.42)	(3.5)	(1.51)	(5.07)
F-test	22.83	8.80	22.66	0.38
Price	196.9	625.4	14.91	-449.2
(2^{nd} stage)	(408.5)	(1358)	(80.51)	(1813)
Inputs	6.945***	6.912***	12.13***	10.07***
	(0.0217)	(0.0626)	(0.612)	(2.824)
Constant	1573	-35765	-2049	49012
	(43075)	(117104)	(7113)	(173088)
N	11893	2039	7875	1979
R^2	0.953	0.953	0.611	0.560
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table A7: Turnover according to price reaction

Note: The dependent variable is consumer-price turnover. The price variable is instrumented in the first stage by the DD variable. The F-test is a test of strength of the first stage. Column (1) contains all firms that had price and turnover information linked in the data, column (2) corporations, column (3) sole proprietors and column (4) partnerships.

VARS	(1) Turnover	(2) Profit	(3) Net assets	(4) Wages	(5) Employees
dd	-1,727***	1,729	-2,633	1,248	0.17
	(505)	(3,319)	(9,414)	(2,679)	(0.234)
N	50752	49537	48299	4472	4904
R^2	0.903	0.001	0.000	0.375	0.222
N of firms	13944	13662	13649	2116	2262
Standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Table A8: Fixed-effects regression results for other outcomes in the annual data

Note: The dependent variables are consumer price turnover, profits, net assets, annual wages and number of employees in one year. All regressions are fixed-effects regressions controlled for time and input use of the firm.

VARS	(1) All	(2) Corporation	(3) Sole proprietor	(4) Partnership
First stage	-6.61***	-5.91	-7.46***	-4.91
	(1.66)	(4.24)	(1.76)	6.04
F-test	15.89	1.93	18.03	0.66
Price	-2687	-18025	1684	-11084
(2^{nd} stage)	(21341)	(114644)	(3692)	(38620)
Inputs	36.43***	36.20***	245.1***	97.11
	(0.944)	(2.506)	(26.74)	(74.05)
Constant	365029	1.378e+06	-239845	899632
	(2.224e+06)	(1.107e+07)	(323947)	(3.891e+06)
N	10146	1744	6743	1659
R^2	0.272	0.351	0.313	0.199
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table A9: Wages according to price reaction

Note: The dependent variable is monthly wages. The price variable is instrumented in the first stage by the DD variable. The F-test is a test of strength of the first stage. Column (1) contains all firms that had price and turnover information linked in the data, column (2) corporations, column (3) sole proprietors and column (4) partnerships.

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