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Abstract

Coping with the effects of an ageing population is among the foremost fiscal challenges in most industrialised countries. The challenge is two-fold: the ageing of the population causes a rise in age-related expenses, which should be met with rising tax revenues; but it also leads to falling labour supply, which tends to have the effect of lowering tax revenues. However, as taxation also has an effect on the incentives to work and to invest, solving this two-fold problem calls for a comprehensive re-evaluation of the structure of the whole tax system.

This paper aims at comparing the costs of different taxes with the ultimate goal of proving measures that can be used in the evaluation of tax reforms and the effects of public spending. The measure we use for the excess burden is the Marginal Cost of Funds.

In the study, we use VATTAGE, a computable general equilibrium model of the Finnish economy, to evaluate the marginal cost of public funds of three different tax instruments under four different model specifications. We find considerable differences between the MCF of different taxes. However, we also find that the estimates of MCF depend on model specification, as does the ranking of different taxes. This may have important implications for the evaluation of tax structures that go beyond the Finnish case.

The Marginal Cost of Taxes in Finland

1. Introduction

Coping with the effects of an ageing population is among the foremost fiscal challenges in most industrialised countries. The challenge is two-fold: the ageing of the population causes a rise in age-related expenses, which should be met with rising tax revenues; but it also leads to falling labour supply, which tends to have the effect of lowering tax revenues. However, as taxation also has an effect on the incentives to work and to invest, solving this two-fold problem calls for a comprehensive re-evaluation of the structure of the whole tax system.

Finland provides an interesting case for studying the pressures of ageing on public finances, as the large post-war baby-boomer generations are some years older than in most other countries, and the country thus already has to cope with the effects of ageing. Currently, a large inter-departmental working group is considering alternatives for a major revision of the structure of taxation. Among the key targets of the working group is lowering the overall excess burden caused by taxation. This paper aims at comparing the costs of different taxes with the ultimate goal of proving measures that can be used in the evaluation of tax reforms and the effects of public spending.

The measure we use for the excess burden is the Marginal Cost of Funds. In the study, we use VATTAGE, a computable general equilibrium model of the Finnish economy, to evaluate the marginal cost of public funds of three different tax instruments under four different model specifications. The evaluation bases on welfare comparisons between the current tax structure and scenarios with tax increases. The VATTAGE data base relies on very disaggregated data on the economy and allows us to distinguish between commodity taxes and taxes on different types of factor incomes as well as taxes on income transfers.

The paper raises the question of model specification in the evaluation of taxes. We find that there are significant differences between the MCF of different taxes. However, the magnitude of MCF depends on the model specification, as does the ranking of different taxes. This may have important implications for the evaluation of a tax structures.

The paper is organised as follows. Section 2 introduces the concept of MCF and discusses its application in AGE modelling. Section 3 overviews the model used and introduces the extensions necessary to deal with labour-supply and saving-aspects of taxation. Section 4 reports the results and discusses the main channels that affect our estimates of MCF. Section 5 concludes.

2. The Concept of Marginal Cost of Funds

There are two reasons for an increased interest in tax reform in Finland at the moment. The first is the rapid change in the age structure of the population, which will lead to increasing costs in age-related spending in the very near future; this, in turn raises the question how the increased spending is to be financed with the revenue collected from a shrinking labour force, while at the same time creating tax stimuli for increased participation in the labour markets. The second reason can be found in the aftermath of the economic down-turn of the past two years or so, which have lead to increasing deficits and public borrowing, but which it is thought have to be limited in the near future.

The large literature on the excess burden of taxation suggests that the costs of raising revenue differ across tax instruments. But as argued by Creedy (2000), measures of excess burden are often concerned with comparisons of distortionary and non-distortionary (such as lump-sum) tax systems. In practice, however, changes in the tax system involve collecting increased revenue with an existing, distortive tax system to finance increased public spending, for example. Whether the spending takes the form of a public project or cash transfers, it is clear that it may affect the revenue collected from other taxes. The concept of marginal cost of funds, while related to excess burden considerations, is a broader concept that takes into account the type of effects that may rise when existing tax systems are modified.

MCF is usually defined as a money-metric measure of the loss of welfare resulting from the collection of extra revenue. Surprisingly, there seem to be several definitions for MCF. Here, we use the definition

$$MCF = -\left(\frac{EV - \Delta R}{\Delta R} \right)$$

Where EV is the equivalent variation resulting from the tax change and ΔR is the change in revenue.

The use of the equivalent variation to measure the effects of a tax change make the measure very broad indeed. Theoretically, it is possible to account for the welfare effects of a public spending project or an increase in public spending, for example. In an AGE application, however, also the set-up of the simulation has an effect on the interpretation of MCF.

An example of the application of the concept to a measuring the potential effects of a tax change is the article by Go et al (2005), which studies the effects of a value added tax

reform in South Africa. They compare the effects of an increase in VAT and income taxes on different household types, finding marked differences in MCF for different household types. Crucially, they assume no changes in factor supplies or government spending. Under these assumptions, any increase in revenue is re-distributed in a lump-sum fashion, whence, as they point out, MCF is more of a measure of the overall inefficiency of the economy than that of just the tax system[1].

The study by Cicowiez et al. (2007) study the impacts of the tax system under different regulatory systems under similar assumption to GO et al, finding MCFs ranging from 1.1. to 1.5 for income taxes, 0.9 to 1.13 for capital income taxes, and 1.127 to 1.206 for value added taxes.

In the AGE studies cited above, the determination of labour supply and saving is not at the centre of the analysis. This is somewhat surprising, because the theoretical literature on MCF considers the effects on labour-leisure choice extensively. As Dahlby (2009) shows, the labour markets affect the costs of taxation in several ways. First, the effects of income taxes will depend on the supply and demand elasticities for labour. It will also depend on labour/capital ratios, as part of the burden of labour taxes is actually borne by capital, depending on whether the price of labour inputs is affected. The latter, in turn, depends on the labour market specification, that is, whether wages are competitive, or whether there are wage rigidities.

The empirical literature on MCF also suggests that labour supply matters. A study be Kleven and Kreiner (2006) estimates MCFs from income taxes for several European countries, finding MCFs ranging from 1 to 1.32 for a proportional increase in income taxes, when they consider labour supply elasticities for the intensive margin (that is, for hours worked). Tax reforms have been also studied econometrically in several other European countries, but to our knowledge, the concept has not been introduced in recent European AGE applications.

This study is similar in spirit to the studies of South Africa and Argentine in the sense that it aims at evaluating the costs of different tax regimes for Finland. Where it differs from the earlier studies is that endogenous labour/leisure choice and endogenous saving decisions are introduced, allowing us to consider effects that are excluded from the earlier analyses by the model formulation.

[1] The variation of MCF Go et al use is apparently $MCF = EV / \Delta R$, which is sometimes referred to as marginal welfare cost of taxation (Creedy, 2000).

3. An outline of VATTAGE

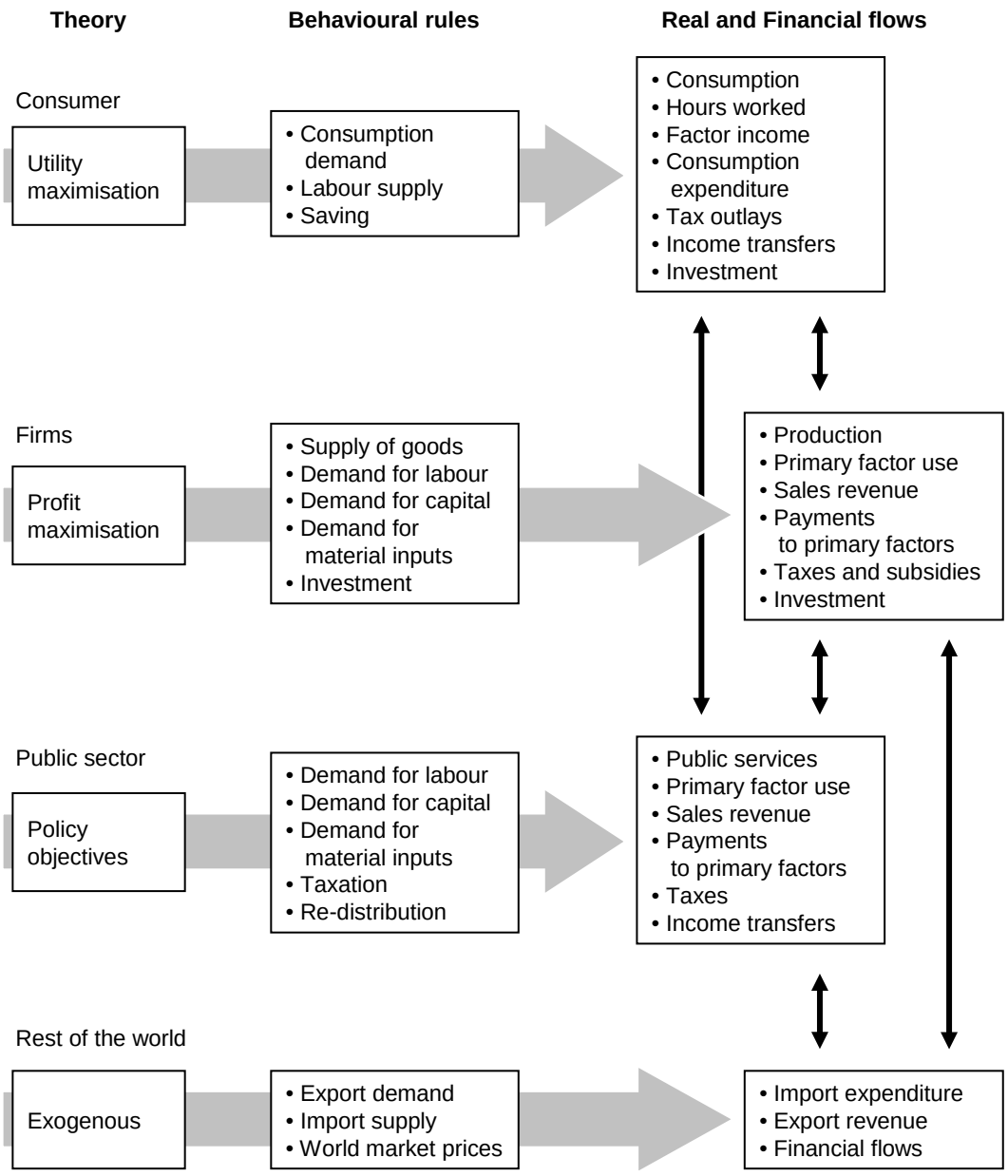
VATTAGE is a dynamic, applied general equilibrium (AGE) model of the Finnish economy. It can be applied to study the effects of a wide range of economic policies. The VATTAGE database contains detailed information about commodity and income taxes as well as the expenditures and transfers of the public sector and thus covers most policy instruments available to the government.

VATTAGE is based on the MONASH-model developed at the Centre of Policy Studies in Monash University. MONASH-type models are used in countries ranging from China and South Africa to the United States (Dixon and Rimmer, 2002) In Europe, models based on MONASH have been developed for Denmark, Finland, and the Netherlands.

In VATTAGE, there are three types of inter-temporal links connecting the consecutive periods in the model: (1) accumulation of fixed capital; (2) accumulation of financial claims; and (3) lagged adjustment mechanisms, notably in the labour markets. Different fiscal rules for the balancing of the public sector budgets can also be specified.

The VATTAGE database collects information about the structure of the Finnish economy derived from the national accounts, arranged in a presentation reflecting the theoretical structure of the model. The database also contains the behavioral parameters that are used to operationalise the behavioral assumptions made in the model. National accounts collect data on the use goods and services by industry and by product, but it also contains accounts for production as well as financial positions by institutional sector. (Eurostat 1997, 1.) The institutional sectors are viewed as independent decision-makers (Statistics Finland 2000, 11.), and it is the behaviour of these decision-makers that the model parameters and coefficients derived from the data describe and control.

Figure 1. The structure of VATTAGE



A large part of the database consists of input-output data that captures the structure of demand for intermediate goods and primary factors by industries, the final good consumption by consumers, the public sector, and the rest of the world. However, input-output data does not contain data on income flows, which must be obtained from other sources in national accounts.

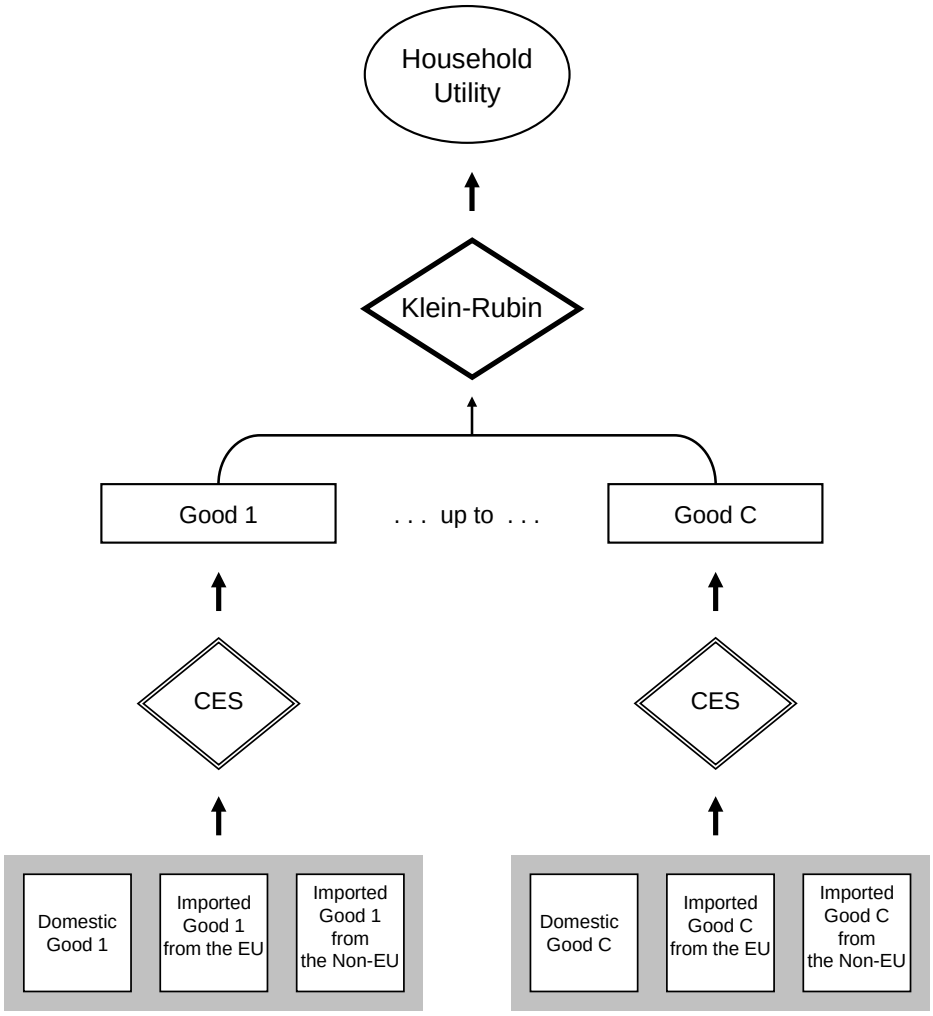
Furthermore, the data base also presents the transactions in the economy taking place between the institutional sectors of the economy. In the database, transactions take place both between domestic sectors, and between domestic and foreign sectors. The domestic sectors are divided into three domestic subcategories whereas the foreign sectors represent foreign countries and multinational and international organizations. These institutional sectors are mutually exclusive and their role in the economy can thus be unequivocally presented. For example, export demand is final demand for domestic goods and services by the foreign sectors.

VATTAGE models production with conventional, nested production functions. The idea behind industrial classification is to group activities whose production processes or the products they make are similar. However, VATTAGE also allows for multi-production of commodities. The VATTAGE database uses the national industrial classification TOL 2002, basing on NACE 2002 and ISIC Rev. 3.1, to classify industries, and the CPA-classification to group products. The detailed data on commodities allows us to study the production of goods almost at a process level.

We next turn to the specification of consumption and labour supply in VATTAGE.

In VATTAGE, households are assumed to be the recipients of factor incomes. They also possess assets and liabilities abroad and domestically, which implies that a part of domestic incomes will be channeled abroad. A Keynesian consumption function then determines the level of household expenditure as a function of household disposable income, while the demands for individual goods are modeled as a utility maximization problem subject to a household expenditure constraint. In a policy application, the propensity to consume is typically exogenous. The structure of the utility function in the base VATTAGE model is shown in figure 1.

Figure 1. The structure of household demand in VATTAGE



VATTAGE allows for different treatments of the labour markets. The labour market equations relate population and population of working age, and define unemployment rates in terms of demand and supply of labour. In dynamic simulations, labour supply is typically taken as exogenous, while wages adjust only gradually and unemployment is determined endogenously.

To study MCF, the basic model is extended by allowing both the choice of demand for leisure/supply of labour and the saving decision to be endogenous. The simplest approach for doing this is simply to treat leisure and saving as two more goods in the consumer's choice. The consumer's problem has to be amended slightly, though, to allow for the treatment of full income, that is, income inclusive of the value of leisure.

The consumer's maximization problem is then

$$\max \quad \sum_{i=1}^{n} \beta_i \ln\left(X_i - \gamma_i\right) \tag{1}$$

subject to

$$\sum_{i=1}^{n} P_i * X_i = Z \tag{2}$$

where Z is full income defined by

$$Z = Y + P_0 * H \tag{3}$$

with H being potential hours of work, P_0 being the wage rate, and Y being non-wage income. The resulting demand functions for consumption, leisure, and saving are of the form

$$X_i = \gamma_i + \frac{\beta_i}{P_i} * \left(C - \sum_{j=1}^{n} P_j * \gamma_j \right), \quad i = 1, ..., n, \tag{4}$$

where good 0 is leisure and one of the goods n, e.g. s, is saving. It is readily apparent that changes in the taxation of commodities, for example, will have an effect on both saving and labour supply.

In specifying the demand functions 4), we assume that the relevant price for leisure is the nominal after tax wage rate, that is, after tax real wages indexed to changes in CPI. For saving, the choice of a price level is more complicated. The extension does not introduce forward-looking behaviour in the sense that saving, being just another good, is not affected by the expected rate of return on assets. This is obviously a cause for some concern. We resolve the problem by linking the price of saving to a price that does reflect expected returns, by assuming that the price of saving to equal the price of capital, which will be affected by expected rates of return.

To implement the new formulation, we use demand elasticities for leisure derived from Kleven and Kreiner (2006), that is, 0.2 for Finland. We assume an income elasticity for saving of 0.1.

The model also establishes a link from leisure demand to wage rigidities, in that the equation for wage adjustment can be formulated in the form that takes changes in labour supply into account, namely,

$$\left(\frac{W_t}{W_t, old} - 1 \right) = \alpha_1 \left(\frac{W_{t-1}}{W_{t-1}, old} - 1 \right) - \alpha_2 \left(\frac{E_t}{E_t, old} - \frac{LS_t}{LS_t, old} \right) \tag{5}$$

As is apparent from the demand equations, consumption of commodities, leisure and saving are now interrelated, whereas in the old formulation, labour market specification drives the reaction of employment to taxes, and saving is affected by taxation only to the extent household disposable income changes. It is not a priori clear how large an effect these differences will make and thus the experiments below also illustrate the differences in model specifications.

The differences between the new and old model formulation can be summarized by comparing the effects of changes in income and prices on demands in the old and new expenditure functions. From Table 1, it can be seen that the new formulation introduces several new channels for taxes to have an effect. In the table, the negative cross-price effect calls for a comment. The effect is apparent from equation (4), whence it can be seen to reflect the effect of subsistence demands for commodities, leisure, and saving on the demand for other goods. Its magnitude depends on the consumption shares of the other goods as well as the levels of subsistence demands.

Table 1. The expected effects of income and prices on demands

Model	Demands for	Disposable income	CPI	RW	PCAP
OLD	Consumption	+	-		
NEW	Consumption	+	-	-	-
	Leisure	+	-	-	-
	Saving	+	-	-	-

4. Evaluating the effects of tax increases with old and new model specifications

The experiments considered in this section involve the collection of revenue by raising either wage income taxes, capital income taxes, or all commodity taxes. For illustrative purposes, we assume an extra 1 billion euros as the revenue target, to be implemented 2010. The tax bases for the three taxes are unequal, with wage income taxes estimated to raise about 14.3 billion in our baseline for 2009, capital taxes about 12.9 billion, and commodity taxes about 23.4 billion euros. The choice of magnitude for the experiment will affect the results, since MCF depends on the scale of the change.

In a dynamic setting, it is not immediately obvious what is meant with a balanced budget. Fixing a deficit will affect the accumulation of debt by the government; but assuming lump-sum redistribution of revenue involves more of a redistributive tax change analysis than an evaluation of the costs of specific taxes. Here, we assume that the extra revenue is spent exhaustively by the government. To keep the three tax scenarios as comparable as possible, we assume the revenue is used to cut the government deficit. This implies that the revenue in the first hand is used to paying back government debt. However, since any of the taxes will affect the ability of other taxes to raise revenue, we allow for the use of lump-sum taxes when necessary to hit our target for the deficit.

We consider two labour market specifications in each of the model formulations, a perfectly competitive one and one with wage rigidities. In the old specification, the former implies fixed employment and fully flexible wages, whereas in the new formulation, an equilibrium condition for labour supply and labour demand allows employment to change with fully flexible wages establishing equilibrium. In the case of wage rigidities, equation 5) applies under both specifications, but in the old model, labour supply is exogenous whereas in the new, it is endogenous.

Table 2 below shows the results for the main macro variables under the old specification. The results are reported for 2010 only, since it is difficult to interpret MCF over a longer time period. It is clear however, that if the post reform tax structure were to remain after 2010, curbing deficit growth would not necessarily be accomplished. For the purpose of a reform analysis this is seldom a disadvantage.

From the table, it can be seen that the MCF is affected by the specification of the labour markets. Under perfect competition – or fixed employment – the effects on GDP are small. This is naturally due to almost fixed factors, with employment being tied down by the labour market assumption, and capital being tied down by the time-to-build-assumption. The only channel for the effects to transmit to GDP is via the effects of commodity and product taxes, which explains most of the GDP change. Despite this, there is a cost to taxation and the MCF lies between 1.3 and 1.34, with commodity taxes involving the largest additional cost. This is partly explained by the incidence of the commodity tax increases. Roughly a third of the taxes are collected from industries, with taxes on consumption making up most of the rest. Most of the increase in revenue stems from the industries however, as the fall in consumption off-sets part of the effects of the tax rise. For consumption, the negative income effect explains most of the fall. It is also notable that investment falls by more than one per cent compared to the baseline, which leads to dynamic effects during the consecutive periods.

Under the assumption of wage rigidity, employment will respond to changes in taxes, which explains why GDP responses are larger. The extra cost of collecting revenue is largest with income taxes at 1,54 and lowest with capital taxes at 1.28. The effects of capital taxes have a smaller effect on investment than under perfect competition. The reason for this lies in the labour market specification. Since the increase in taxes on capital incomes affects the price of capital, there is a substitution of labour for capital, which helps to keep up the expected returns on capital, and thereby investment. Commodity taxes increase the costs of production and, with wage rigidities, the adjustment falls mainly on capital. They also have an effect on the price level, reducing purchasing power. Finally, the effects on real saving reflect the fall in disposable income and a fall in the price of capital.

Table 2. Results for 2010 under the original model specification

	GDP	Employment	Cont tax	Investment	Consumption	Real saving	Disposable income	MCF
Income taxes (Fixed E)	-0,06	0,00	-0,06	0,11	-0,69	-0,88	-0,68	**1,30**
Commodity taxes (fixed E)	-0,10	0,00	-0,08	-0,53	-0,77	-1,09	-0,77	**1,34**
Capital taxes (Fixed E)	-0,07	0,00	-0,08	-1,02	-0,70	-0,84	-0,70	**1,31**
Income taxes (Fixed RW)	-0,53	-0,76	-0,12	-0,34	-1,21	-1,75	-1,20	**1,54**
Commodity taxes (fixed RW)	-0,34	-0,39	-0,12	-0,77	-1,04	-1,53	-1,04	**1,46**
Capital taxes (Fixed RW)	-0,02	0,09	-0,07	-0,96	-0,64	-0,74	-0,64	**1,28**

Table 3 gives the results under the new model specification. It is immediately apparent that MCFs are larger for all of the taxes than under the original specification. Under the assumption of perfect competition in the labour markets, the effects of an income tax increase on employment are still small, as wages adjust, but there is an effect on labour supply and employment stemming from a fall in real wages that increases the demand for leisure (which is getting relatively cheaper), despite an increase in the nominal wage rate. This tends to magnify the negative GDP effect, which is still mostly accounted for by the effect on commodity and product tax revenues on GDP. Saving is also affected, since the nominal price of capital is rising because of the negative effect on employment. The effect on consumption stems from the negative income effect but also from a rise in the relative price of consumption goods. Finally, investment is affected by a rise in the price of investment goods.
Commodity taxes reduce real wages via the effect on CPI. As a consequence, demand for leisure increases and nominal wages fall. The price of capital also falls, causing the positive effect on saving.
Capital income taxes have the largest effect under this specification. Capital taxes tend to raise the price of capital, which spurs an increase in demand fro labour that in turn raises the real wage level. Employment effects are negligible with flexible wages, but the increase in employment does compensate some of the loss of commodity tax revenues.
The rise in the price of capital affects saving negatively. Finally, the fall in consumption is mostly due to the negative income effect, and to a smaller extent, to the rise in the prices of leisure and saving.

Under the assumption of wage rigidities, the ranking of the taxes in terms of CMF changes. Labour income taxes still involve the largest MCF, but now, commodity taxes appear to be more costly than capital taxes. Furthermore, wage rigidities appear to increase the MCF of labour taxes and commodity taxes, but lower those of the capital tax. The reason is by and large the same as in the original model – wage rigidities adjustment to take place via employment instead of wages, which in the short run alleviates the effects of the capital tax as it makes the substitution of labour for capital (initially) cheaper. The income tax puts pressure on nominal wages because of the real wage rigidity; this drives employment down and explains the fall in GDP and the consequent fall in full income, which, in turn, is the main reason for the fall in consumption and

saving. However, the fall in employment also drives the price of capital down, which offsets most of the effect stemming from a fall in income. The demand for leisure falls because of the negative effect on income although the falling price of leisure and saving off-sets part of the income effect. The commodity tax has a large effect on consumption via the fall in full income, but this is partly off-set by the positive effect stemming from a fall in the prices of leisure and saving. Again, the incidence of the tax falls on intermediate-intensive industries more than any other sector of the economy, which drives the demand for labour and capital down. The effect is larger under wage rigidities than under perfect competition since the real wage rigidity rules out the adjustment via wages.

Table 3. Results for 2010 under the new model specification

	GDP	Employment	Cont tax	Investment	Consumption	Saving	Labour supply	Full income	MCF
Income taxes (Competitive)	-0,08	-0,01	-0,08	-0,08	-0,96	-0,003	-0,006	-0,84	**1,84**
Commodity taxes (Competitive)	-0,10	0,00	-0,08	-0,08	-0,70	0,001	-0,002	-0,76	**1,63**
Capital taxes (Competitive)	-0,09	0,01	-0,10	-0,10	-0,99	-0,003	0,010	-0,42	**1,88**
Income taxes (Fixed RW)	-0,52	-0,72	-0,14	-0,14	-1,36	-0,001	0,004	-1,02	**2,22**
Commodity taxes (Fixed RW)	-0,34	-0,40	-0,11	-0,11	-0,91	0,002	0,003	-0,88	**1,83**
Capital taxes (Fixed RW)	-0,01	0,15	-0,09	-0,09	-0,92	-0,003	0,008	-0,39	**1,80**

5. Conclusions

This paper has studied the costs of different taxes in an AGE-setting. We have introduced the concept in a model of the Finnish economy, which has then been extended to cope with endogenous labour supply and saving choices, as is customary in the theoretical literature on MCF.

Our targets have been two-fold. The concept of MCF can be used in the evaluation of tax reforms, since it can be thought of as a (broad) measure of the excess burden of taxation. However, it can also be used in the analysis of the welfare effects of public projects and public spending. Here, we have deliberately ruled out any direct effects from public spending and defined the "exhaustive" project (Creedy, 2000) as a reduction of government deficits. The concept can easily be used to evaluate the effects of, say, increased age-related spending, however, with the welfare measures used here then capturing the effects from increased public demand on welfare, even if they do not consider the direct benefits from such spending as such.

Our estimates here are larger in magnitude than those of e.g. Cicowiez et al (2007) for Argentina, which may be partly explained by the fact that MCF is not scale-independent. Thus, the generally higher level of all forms of taxes in Finland may be the reason for our finding higher MCFs than Cicowiez et al. found for Argentina. Furthermore, while our commodity tax experiment is not directly comparable with their VAT example, one of our model specifications makes essentially the same assumptions as their's, and finds a similar ranking for income and capital taxes than their study did.

We also find that wage rigidity makes MCF more of a concern for income taxes than it is under perfect competition. This is broadly consistent with empirical literature and the effects of imperfections in the labour markets on MCF are also pointed out by Kreiner and Klevens (2006).

Since the use for the concept we have in mind relates to the evaluation of the costs and benefits of actual policies, the magnitude of the MCF estimate is important. Typically, the C/B-ratios of any public project tend to be very low, even when they make no reference to the costs of raising the funding. In this respect, the comparison between the extended model and the original specification is disconcerting, since we find a considerably higher MCF for all taxes than in the original specification. With the new specification, we also find that capital taxes have the highest MCF when perfectly competitive labour markets are assumed, which is contrary to the original specification's results. Yet the unsoundness of capital taxes seems to have become a dictum for policy makers all over the world. On the plus side, with wage rigidities, the results of the original model are qualitatively in line with the extended model. Remains the concern of magnitudes, which is obviously a case for sensitivity analysis.

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