Government Expenditure, Taxation Modes and Economic Growth

*Line Bastholm Helledi and Signe Høngaard Andersen*

University of Copenhagen
Department of Economics

Supervisor: Carl-Johan Dalgaard
Economic Seminar: Productivity Growth, autumn 2005
Handed in: The 28th of November 2005
Presentation date: The 5th of December 2005
1. Introduction .............................................................................................................. 3

2. Turnovsky – the model ............................................................................................ 4
   2.1 The model ............................................................................................................. 4
   2.2 Analysis of the model in the form of calibration by Turnovsky ......................... 7
      2.2.1 The uncompensated case ............................................................................... 7
      2.2.2 The compensated case - different financing modes ...................................... 9
      2.2.3 Tax substitution ............................................................................................ 10
      2.2.4 Structure of government expenditure ......................................................... 10

3. Revision of the model .......................................................................................... 12
   3.1. Leisure ................................................................................................................ 12
   3.2. Analysis of the revised model ............................................................................ 13

4. Level of taxation .................................................................................................... 14
   4.1 Congestion and productive government expenditure ........................................... 14
      4.1.1 Negative externality .................................................................................... 15
      4.1.2 Positive externality ..................................................................................... 15
   4.2 Is a high tax rate always bad for economic growth? ........................................... 16
      4.2.1 Barro’s model .............................................................................................. 17
      4.2.2 Empirical analysis of the size of governments and growth rates ................... 18
      4.2.3 Discussion of the impact of government size on economic growth ............ 20
   4.3 Brain drain and optimal taxation ....................................................................... 21

5. Developed Countries versus Newly Industrializing Countries (NIC) .................... 22
   5.1 The Turnovsky model in relation to labor intensive countries ............................ 22

6. Conclusion ............................................................................................................. 23

Appendix ..................................................................................................................... 25

References ................................................................................................................. 26
1. Introduction

In the recent years, one of the main issues in the political debate in Denmark concerns the effect of taxes on economic growth. The Scandinavian countries have some of the largest tax rates compared to other western world countries. Therefore, the discussion in Scandinavia has been centered on the issue, whether these high tax rates are optimal for the economic growth process.

Some of the European countries have lower tax rates and less economic growth. Of course a lot of other factors play a role in the slow economic growth in these countries, but it does indeed pose the question: What is the optimal taxation level in regard to economic growth? And how do changes in the tax rates affect economic growth?

The main contribution of this paper is how government expenditure financed by different taxation modes affects economic growth. We define economic growth as the growth in all economic variables. And we define government size as the tax rate.

The paper is based on Turnovsky (2004), thereby the paper offsets in some of the latest research in this area.

The issue of taxation policy is not addressed. That is, aspects as redistribution and inequality are excluded. The paper contains changes in fiscal policies that have an effect on economic growth. Welfare is considered in the paper as well, but is not the main subject.

The paper is organized as follows: Section 2 outlines the central aspects and the analysis of the model in Turnovsky (2004). Section 3 covers a possible revision of the model by introducing different definitions of leisure. Section 4 is a discussion about the optimal taxation level in relation to the model by Turnovsky (2004) and Barro (1990) and also contains an examination of empiric analyses. Section 5 discusses whether the results in Turnovsky (2004) differ, when a Newly Industrializing Country is considered. Finally, section 6 concludes.
2. Turnovsky – the model

2.1 The model

The model analyzes effects of fiscal policies in a non-scale growing economy with public and private capital. The author distinguishes between government expenditure on investment and government expenditure on consumption financed by four different taxation modes. The taxation modes are: Capital income taxation, labor income taxation, consumption taxation. The public sector allocates resources to a utility-enhancing consumption good. Owing to the definition of the economy as non-scale, the long-run growth effects are unaffected by changes in tax rates. Fiscal policy in this sense has accumulated effects on the per capita levels of the economic variables. Therefore, the focus lies on the transitional dynamics, because the growth rates may be affected by policy changes in periods of time during the transition from one equilibrium to another.

The model considers a one-sector economy, where output depends on private and public capital and on endogenously supplied labor. Public capital generates a positive externality on production, i.e. the production function contains increasing returns to scale in labor, private capital and public capital. Because of the distinction between public and private capital, there exist two-dimensional transitional paths. The convergence speed can therefore vary over time and across variables. Note, the production function has constant returns to scale in labor and private capital.

The production function:

\[
Y_i = \alpha (1 - l_i)^{1-\sigma} K_i^{\sigma} K_G^{\eta} \\
\sigma > 0, \eta > 0, \gamma > \sigma + \eta
\] (2.1)

where \( K_i \) is the individual’s stock of private capital, \( K_G \) is the stock of government capital, for example infrastructure, and \( l_i \) is leisure. Furthermore, it is assumed that government capital is not subject to congestion.

Turnovsky considers a representative agent with an infinite life horizon and perfect foresight. To measure welfare a utility function of the individual is defined. The representative agent has the following utility function:

\[
\Omega = \int_0^{\infty} \left( \frac{1}{\gamma} \right) (C_i l_i^\phi H_i^\theta) \gamma e^{-\theta} dt \\
\phi > 0, \theta > 0; -\infty < \gamma < 1; \gamma(1 + \phi) > 1 > \gamma(1 + \theta + \phi)
\] (2.2)
Government Expenditure, Taxation Modes and Economic Growth

where \( C_i \) is consumption of the individual at time \( t \). \( H \) is total consumption services received from the government. \( \theta \) and \( \phi \) measure the impact of leisure and public consumption on the individual’s welfare.

The agent’s capital accumulation equation:

\[
\dot{K}_i = \left[(1 - \tau_k)r - n - \delta_K\right]K_i + (1 - \tau_w)w(1 - \ell_i) - (1 + \tau_c)C_i - T_i \quad (2.3)
\]

where \( \tau_k \) is capital taxation, \( r \) is the gross return to capital, \( \delta_K \) is the depreciation rate of private capital, \( [(1 - \tau_k)r - n - \delta_K] \) denotes thus the after-tax private return to capital, \( \tau_w \) is income taxation, and \( T_i = T/N \) is the agent’s share of lump sum taxes (or transfers).

The government capital accumulation equation:

\[
\dot{K}_g = G - \delta_g K_g
\]

where \( G \) is the gross rate of government investment expenditure, and \( \delta_g \) is the depreciation rate of public capital. The government finances its gross expenditure flows from aggregate tax revenues.

The government sets the amount of output, which will be spent on the consumption good and the investment good:

\[
H = hY \\
G = gY
\]

where \( G \) and \( H \) is the gross expenditure on government investment and government consumption, respectively.

It is assumed that aggregate output, private capital stock and public capital stock grow at the same constant rate in equilibrium, which means that output-capital ratio and the ratio of public capital to private capital remain constant. Furthermore, the fraction of time spent on leisure remains constant as well. Leisure is complementary to consumption in utility. This indicates that the consumption-output ratio increases with leisure.

The long-run growth rate of output, private capital and public capital:

\[
\psi = \left( \frac{1 - \sigma}{1 - \sigma - \eta} \right)^n
\]

(2.4)

where \( n \) is the growth rate of population. It is shown that for the dynamics to be stable \( \sigma + \eta < 1 \), which implies that \( \psi > 0 \).

In order to analyze the transitional dynamics about the economy’s balanced growth path, the scale-adjusted output is defined:

\[
y = \alpha(1 - I)^{1-\sigma} k^{\sigma} k_g^{\beta}
\]

(2.5)
The equilibrium dynamics:

\[ \frac{\dot{k}}{k} = (1 - c - g - h) \frac{y}{k} - \delta_k - \psi \]

\[ \frac{\dot{k}_g}{k_g} = g \frac{y}{k_g} - \delta_G - \psi \]

\[ \dot{l} = F(l)(\sigma - [1 - \gamma(1 + \phi)]\{\sigma(1 - c - g - h) + \frac{\eta g k}{k_g}\} \times \frac{y}{k} - \delta_k (1 - \sigma) [1 - \gamma(1 + \phi)]) + \delta_G \eta [1 - \gamma(1 + \phi)] - (\{(1 - \sigma) + \gamma\} n + \rho) \}

\[ c = \left( \frac{1 - \sigma}{\theta} \right) \left( \frac{l}{1 - l} \right) \left( \frac{1 - \tau_w}{1 + \tau_c} \right) \] (2.6)

where

\[ c \equiv \frac{C}{Y}, F(l) = \frac{l(1 - l)}{(1 - \gamma) - (1 - \sigma)[1 - \gamma(1 + \phi)]} - \theta \gamma (1 - l) \]

where the parameters \( \theta \) and \( \phi \) are the impact of leisure and public consumption on the agent’s utility, respectively.

The steady state equilibrium of the economy:

\[ (1 - c - g - h) \left( \frac{\bar{y}}{k} \right) = \delta_k + \psi \] (2.7)

\[ g \frac{\bar{y}}{k_g} = \delta_G + \psi \] (2.8)

\[ (1 - \tau) \sigma \left( \frac{\bar{y}}{k} \right) = \delta_k + \rho + [1 - \gamma(1 + \phi)] \bar{y} + \gamma \] (2.9)

The characterization of the steady state equilibrium also includes equations (2.5) and (2.6).

The system has two state variables, \( k \) and \( k_g \), and one jump variable \( l \).

In order to analyze the effects of different policies, it is necessary to define a welfare function, which contains both long-run and short-run welfare of the individual:

\[ W = \int_0^\infty Z(t)e^{-\sigma}dt = \int_0^\infty ((C/N)^l)^0 H^p \gamma e^{-\sigma} dt \] (2.10)

where \( Z(t) \) is the short-run welfare and \( C/N, l \) and \( H \) are on the equilibrium path. \( W \) denotes the long-run welfare.
Government Expenditure, Taxation Modes and Economic Growth

The amount of taxation necessary to finance primary deficit:

\[ V = -\int_0^\infty T(t) e^{-\int_0^t (u(1-\tau_k) du) dt} dt \]

\[ = -\int_0^\infty \left[ g + h - \tau_k \sigma - \tau_k (1-\sigma) - \tau_k (C/Y) \right] e^{-\int_0^t s(u)(1-\tau_k) du} dt \quad (2.11) \]

where \( s(1-\tau_k) \equiv r(1-\tau_k) - \delta_k \) is the equilibrium rate of interest.

2.2 Analysis of the model in the form of calibration by Turnovsky

The calibration is done in comparison to a benchmark economy. The parameters used are representative of the US economy. The calibration analysis is done by inserting parameter values in equation (2.5)-(2.11).

2.2.1 The uncompensated case

The fiscal changes are uncompensated (table A1, section A), which is reflected in the large changes in the long-run government fiscal balance. The comparative static is as follows:

An increase in government consumption, \( h \uparrow \), by 0.04 pct., causes long-run private and public capital stock and output to increase proportionately by 6.6 pct., and the long-run private consumption-output ratio is crowded out and reduced by 0.04. Leisure is reduced by 1.29 pctl points. Therefore, the marginal productivity of private and public capital is raised and thus output is raised as well. In accordance with equation (2.11) the surplus, \( V \), of the long-run government balance is reduced by 49.7 pctl. Short-run welfare gains are increased by 0.66 pctl., and long-run welfare gains are increased by 1.98 pctl.

An increase in government investment, \( g \uparrow \), by 0.0396 pctl., causes private capital and output to increase proportionately by 44.6 pctl., and public capital more than doubles by 288 pctl., because government investments generate public capital directly. The larger demand for capital by the government crowds out investment in private capital. Therefore, the growth rate of private capital is reduced in the short run. Because of an increase in the relative scarcity of private capital, its productivity is increased. The high productivity of private capital raises its growth rate along with output and consumption. The consumption-output ratio is reduced by a little less than 0.04. Leisure is reduced by 1.23 pctl. points. The public capital-private capital ratio is increased by 199 pctl., because of the large increase in public capital. In regard to the long-run government balance, the surplus is also in
this case reduced by 51.3 pct. Short-run welfare gains is reduced by 2.90 pct. but is in the long-run raised by a whole 7.87 pct. The reduction of welfare in the short-run is ceteris paribus caused by the short-run reduction in the growth rate of private capital.

An increase in the tax on capital income from 0.28 pct. to 0.40 pct. reduces public capital and output proportionately by 16 pct., and reduces private capital more than proportionately by 30 pct. The output-private capital ratio and the public capital-private capital ratio are increased by 20 pct. The higher tax rate on capital reduces, on impact, the growth rate of private capital. The reduction in long-run private capital reduces productivity of labor and causes agents to choose more leisure and consumption. Leisure is increased by 0.69 pct., and the consumption-output ratio is increased by 0.023. The reduction in labor and private capital reduces output and the growth rate of public capital falls as well. As the private capital stock increase in relative scarcity its productivity increases, which induce investment in private capital. In turn, the relative scarcity in public capital increases, and likewise, the growth rate is restored through more investing. Because of the higher tax level the surplus, $V$, in the long-run government balance increases by 80.2 pct. Short-run welfare gains are increased by 3.98 pct. but are in the long-run raised by 3.56 pct.

An increase in wage taxation from 0.28 pct. to 0.349 pct., causes private and public capital and output to increase proportionately by 10 pct. Leisure is in this case increased by 2.02 pct, while there is no effect on the consumption-output ratio. Wage taxation has a direct effect on the consumers, such that they ceteris paribus will choose to supply less labor. $V$ in the long-run government balance increases by 55.1 pct. Short-run welfare gains are reduced by 1.81 pct. and are in the long-run reduced by 2.88 pct.

An increase in consumption taxation of 0.0638 pct. reduces private and public capital and output proportionately by 6.22 pct. Also consumption taxation has a direct effect on the consumers. Leisure is increased by 1.25 pct. and thus labor supply is reduced. $V$ in the long-run government balance increases by 52.4 pct. Short-run welfare gains is reduced by 0.45 pct. and is in the long-run reduced by 1.73 pct.

In conclusion, capital income taxation restrains economic growth the most in comparison to the other financing modes, in the sense that private and public capital accumulation and output is more reduced. Furthermore, primary deficit in this case experience a far larger increase. Consumption taxation is the most plausible mode of taxation in this respect. In the realm of structuring government expenditure, it is by far more plausible for a government to place government expenditure on investments rather than consumption, all though a myopic government would argue that welfare also in this case is reduced.
2.2.2 The compensated case - different financing modes

In the sequent section the fiscal changes are compensated, in the sense that current government deficits, $T$ in equation (2.11), remain unchanged (table A1, section B). The effects listed below can be compared to the effects of an uncompensated case described in the previous section.

An increase in government consumption, $h \uparrow$, by 0.04 pct. financed by a consumption tax, will leave the net effect unchanged in the sense that the expansionary effect from the increased consumption will absorb the contractionary effect from the consumption tax. On the other hand, if the government consumption is financed by a wage tax, private and public capital decrease proportionately by 3 pct. instead of an increase by 6.6 pct. as in the uncompensated case. Leisure increases by 0.61 pct. point. The surplus in the long-run government balance, $V$, increases by 1.24 pct. Short-run welfare gains are increased by 0.16 pct. and are in the long-run reduced by 0.46 pct. Finally, if the increase is financed by capital income tax, the contractionary effect dominates, and therefore, private and public capital decrease with a larger fraction than before in the uncompensated case. The surplus, $V$, increases by a whole 16.2 pct. And short-run welfare gains are increased by 4.77 pct. and reduced in the long-run by 1.34 pct.

An increase in government investment, $g \uparrow$, by 0.0396 pct. financed by a consumption tax increases public capital by 272.2 pct., because of the direct effect government investments have on public capital. Private capital and output increases as well, but at a lower rate at 36.1 pct. Private capital temporarily declines during the transition, because a crowding effect. Leisure is in this case unaffected. The surplus of the government balance, $V$, reduces by 5.23 pct. Short-run welfare gains are reduced by 3.17 pct. but are in the long-run increased by a whole 5.92 pct. Welfare gains in the short run is reduced, because an increase in government investment has no initial benefits on welfare. This can be seen in relation to the fact that capital is a state variable, i.e. capital is predetermined. On the other hand, if government investment is financed by a wage tax, leisure increases by 0.66 pct. point. The effect on the other variables is nearly the same as when consumption taxation was the finance mode, although the increase in private and public capital and output here is less. Financing an increase in government investment by a capital income tax will increase private
capital by only 2.67 pct. and increase public capital by 244.5 pct. Private capital is in the short run relatively scarce, which generates an increase in relative productivity of private capital. Therefore, in the long run private capital increases slightly. Output increases by 22.3 pct. The consumption-output ratio decreases slightly, and leisure decreases by 0.57 pct. point. The surplus, $V$, increases by 3.39 pct. Short-run welfare gains are increased by 0.69 pct. and are in the long-run increased by 3.77 pct.

In conclusion, government investment financed by a consumption tax is most plausible with regard to economic growth. In this case, private and public capital and output increase by a larger fraction than by the other tax financing modes. Also primary deficits are here decreasing by the largest percentage.

In the next section substituting one tax mode for another is analyzed. In this section, focus lies on the tax structure.

2.2.3 Tax substitution

An introduction of a consumption tax at 6 pct. can replace an income tax at 24.03 pct. and leave $T$ in equation 2.11 unchanged, that is, remain the initial government deficit. In this case, output and public capital increase by 5 pct., whereas private capital increases by 10.8 pct. Leisure is slightly reduced by 0.14 pct. The primal surplus, $V$, is reduced by 3.68 pct. The growth rate of private capital increases in the short-run by about 2.8 pct., which in turn stimulate public capital to accumulate as well, because of a temporary higher productivity in public capital. Initially, consumption drops 1 pct., and labor supply increases by 1 pct. Short-run welfare gains is reduced by 1.25 pct. and is in the long-run increased by 0.94 pct.

In conclusion, this change in the tax structure is evidently positive in view of economic growth and capital accumulation, however, this change does not have significantly large positive effects on welfare, but in any case, welfare is not reduced in the long-run.

In the next section focus lies on the structure of government expenditure.

2.2.4 Structure of government expenditure

If the government desires an increase in government investment from 4 to 8 pct. of output while remaining the initial deficit, $T$ in equation 2.11. This is possible by reducing public consumption expenditure from 16 to 11.9 pct. This change in the structure of expenditure increases public capital by 271.7 pct., while output and private capital is
increased proportionately by 35.9 pct. On impact, government investment crowds out private investment and private capital declines, which enhances the productivity of private capital, therefore, investment in private capital increases and the private capital stock increases as well. Leisure is slightly increased by 0.03 pct. The primary surplus, $V$, is reduced by 4.47 pct. Short-run welfare gains is reduced by 5.09 pct. but is in the long-run increased by 3.80 pct.

All in all, this change has large effects on capital accumulation and hereby economic growth. The change has a positive effect on long-run welfare as well.
3. Revision of the model

3.1. Leisure

In the Turnovsky model, there is no complete definition of leisure, only that leisure is the time not spent working, \( l_i \). In a paper by Milessi-Ferritti and Roubini (1998), leisure is defined in three different ways: ‘Raw time’, ‘home production’ and ‘quality time’. In order to extend the Turnovsky model, public capital needs a broader definition also including human capital. This seems to be a plausible definition, i.e. public expenditure is allocated to the education sector.

The definition ‘raw time’ is identical to the definition of leisure in the Turnovsky model, \( l_i \). Leisure equals the time not spent on working or studying.

In the definition ‘home production’, leisure is produced with a CRS technology that has the same inputs as the production function. In the Turnovsky scenario, the definition is:

\[
\mu l = (l_i^K K_i)^\mu (l_i^G K_G)^{1-\mu} \tag{3.1}
\]

where \( l_i^K \) is the fraction of private capital not spent on producing market goods. \( l_i^G \) is the fraction of public capital not spent on producing market goods. In the production function, leisure is now divided into two parts. The intuition of ‘home production’ is that there are two consumption goods: home-produced goods and market produced goods. These consumption goods are substitutes.

In the definition ‘quality time’, leisure only requires human capital, which means in the Turnovsky model that only public capital must be included in the definition:

\[
l_i = l_i^G K_G^\lambda \tag{3.2}
\]

where \( \lambda \leq 1 \). Note, that if \( \lambda = 1 \) and \( \mu = 0 \), then ‘quality time’ and ‘home production’ are identical definitions of leisure. The intuition of ‘quality time’ is that leisure time is spent on visiting theaters and restaurants etc.; therefore in this definition human capital is essential.

In the subsequent section the definition of leisure as ‘home production’ is considered. The model with the definition of leisure as ‘quality time’ generates identical results as in the Turnovsky model, section 2.2.1, that is, leisure considered as ‘raw time’.

---

1 In the paper of Milessi-Ferriti and Roubini (1998) human capital is included in the production function. In this presentation, with offset in the Turnovsky model, public capital and private capital are the inputs.
3.2. Analysis of the revised model

When leisure is defined as ‘home production’, a change in consumption taxation has no effect on private and public capital and output but makes the agents choose more leisure and less supply of labor. Leisure is here defined as time spent on producing goods at home, leaving total output\(^3\) unaffected. An increase in consumption taxation will simply affect consumer’s choice between market goods and home-produced goods. The intuition is that all labor, private and public capital is still being used in a productive activity. The ‘home production’ model has two consumption goods. The consumption good produced by home production is not being taxed, and therefore, with an introduction or an increase of consumption taxation will reallocate resources from one sector to another.

An increase in wage taxation has the same effect as when leisure is defined as ‘quality time’ or ‘raw time’. Agents will choose to supply more time on their home production, because this sector is not tax deductible. However, in this case, total output will be unaffected or reduced by less compared to the other definitions of leisure.

An alternative way to define leisure could be to include all three definitions in one model, meaning that when the agent is choosing leisure, he can decide how to distribute his leisure time between the three alternatives. One could also say that this would be a more realistic definition. The overall impact on output under this definition would depend on what share the agents would choose to spend on each type of leisure, when changes in fiscal policy is made.

All in all, the results in the Turnovsky model may be affected by changing the definition of leisure to ‘home production’. In particular, the effect on output in the model is affected. A definition of leisure including all three alternatives may be more plausible.

\(^2\) For more details on leisure as ’quality time’ see: Becker (1965) and Heckman (1976)
\(^3\) Total output = market goods + home-produced goods
4. Level of taxation

In the Turnovsky model, one of the main conclusions is that in general consumption taxation is the most desirable financing mode in regard to economic growth. On the other hand, taxation on capital income is the most distortionary financing mode and hampers economic growth the most.

Empirics show that there in fact is capital income taxation and wage income taxation in all OECD countries. The following figure shows the structure of taxation financing in different country groups.

Figure 1

![Figure 1](source: Doménech and Garcia (2002), figure 1)

The figure shows that consumption tax rates are at a relative low level in comparison to capital income tax rates and wage income tax rates, which in some ways contradicts the results of the Turnovsky model. Turnovsky’s model is focusing on changes in the taxation and does not consider the taxation levels. In this chapter taxation levels will be considered and discussed in comparison to the results of the Turnovsky model.

4.1 Congestion and productive government expenditure

The main purpose of this section is to discuss two effects on the economy, which are generated by congestion and productive government expenditure. In the Turnovsky model, congestion is assumed to be non-existent, and the effect of productive government expenditure needs a more detailed discussion than what is put forth in the Turnovsky paper.
4.1.1 Negative externality

Turnovsky mentions that congestion is disregarded in the model. In the numerical analysis he takes into account this congestion by lowering the elasticity of public capital compared to the value suggested by Aschauer (1989). Theoretically, congestion generates a negative externality on production. In market equilibrium, it may be Pareto optimal to tax production, because firms do not take into account this externality, which means there is too much capital accumulation.

4.1.2 Positive externality

In the Turnovsky model, public capital generates a positive externality on production. Because the government does not charge a fee, this externality can create a so-called residual income in production. Following this notion, the rate of return to private capital and labor will therefore not be equal the marginal products. The marginal products in the Turnovsky model are:

\[ r = \frac{\partial Y}{\partial K} = \sigma \frac{Y_i}{K_i} \]

\[ w = \frac{\partial Y}{\partial (N(1-l))} = (1-\sigma) \frac{Y_i}{(1-l_i)} \]

When productive public capital enters the production function, the rates of return are higher than the marginal products. In order to eliminate the residual income in production, Doménech and Garcia (2002) argue that it is necessary to make an assumption about the distribution of total income between these two private factors. In this sense, an optimal tax on the private factors should exactly equal the difference between the rate of return and the marginal product stemming from the positive externality of public capital.

The optimal tax on capital and income is, in this sense, not equal to zero. Hence, taxing these private factors has a positive effect on growth and welfare, if the taxes are financing public expenditure, which is spend on investments that is growth enhancing. The intuition is that the firms maximize profits without considering the externality and invest less than what is optimal from a social planner’s view point. Capital accumulation could in this case be larger, if a social planner intervened. In this sense, the social planner would be able to increase growth by increasing capital income taxation and a wage income taxation, such that

---

4 The idea of a residual income is from Doménech and Garcia, 2002.
the respective taxation level is equal to the difference between the rates of return and the marginal product.

Assuming both congestion and productive public expenditure in the Turnovsky model there will be two contradictory effects at play, a positive externality and a negative externality. These effects may cause capital accumulation in market equilibrium to be equal/close to the level of capital accumulation, which is social optimal.

In conclusion, Turnovsky’s model may not be affected if both congestion and productive public expenditure is included. The arguments in this section partly explain why most countries do have (positive) taxes on capital income and wage income, cf. figure 1.

4.2 Is a high tax rate always bad for economic growth?

The main results from the Turnovsky model are that an increase in government consumption will lead to both a proportionate increase in the two capital stock and output. On the other hand an increase in government investment leads to proportionate increases in private capital and output, but to a relative larger increase in public capital. An increase in tax on capital reduces public capital and output proportional, and leads to a relative larger relative decline in private capital. A higher wage or consumption tax reduces both types of capital and output proportional. These results will in this section be discussed.

Most studies on taxation shows, that lowering tax on for example income and capital have a positive impact on economic growth. But this might not always be the whole story. What happens if the tax revenue is used again for example government investments as education, health care systems etc.? Could the impact of a tax-cut be ambiguous?

People’s state of health and level of education is crucial for a country to develop and create growth. Therefore we think it can be heroic to assume, that a tax-cut will always have a negative effect on growth. We think that it definitely has something to do with what state of development the country is in, on what level the initial tax rate is on and what the taxes are reused for.

In the next section a model by Barro is considered to discuss size of government in relation to economic growth.
4.2.1 Barro’s model

In Barro (1990) he considers the role of public services as an input to private production, and therefore creates an important linkage between government and growth.

Barro sets up a model with infinitely lived households, where the households have a certain amount of time to spent on work. Therefore there is no labour-leisure choice in this model, contrary to Turnovsky’s model. Barro incorporate a public sector by letting $g$ be the quantity of public services provided to each household producer. The public service per labor unit $g$ is assumed to be provided without user charges and is not subject to congestion. He sets up a production function.

$$ y = k \cdot \phi \left( \frac{g}{k} \right) $$

(3.1)

He assumes, that $\phi \left( \frac{g}{k} \right) = A \cdot \left( \frac{g}{k} \right)^{\alpha}$. There are constant returns to scale in $k$ (private capital per labor unit) and $g$ together, but diminishing return to scales in $k$ separately.

The government expenditure is assumed to be financed by a flat-rate income tax. If we look at the aggregated economy, this can be stated in the following equation.

$$ g = T = \tau \cdot y $$

(3.2)

This equation also tells us, that the government is running a balanced budget.

From the production function we can find the marginal product of capital. This gives us:

$$ \frac{\partial y}{\partial k} = \phi \left( \frac{g}{k} \right) \left( 1 - \phi' \cdot \frac{g}{y} \right) = \phi \left( \frac{g}{k} \right) \cdot (1 - \eta) $$

(3.3)

The marginal product of capital is calculated by varying $k$ in (3.1) and holding $g$ fixed. This correspond to the producers believing that if the amount of his capital and output changes it doesn’t lead to a change in the amount of public good he receives. $\eta$ is the elasticity of $y$ with respect to $g$, for a given value of $k$.

The growth rate of private consumption is given by the following equation:

$$ \gamma = \frac{\dot{c}}{c} = \frac{1}{\sigma} \left( (1 - \tau) \cdot \frac{\partial y}{\partial k} - \rho \right) = \frac{1}{\sigma} \left( (1 - \tau) \cdot \phi \left( \frac{g}{k} \right) \cdot (1 - \eta) - \rho \right) $$

(3.4)

The part $(1 - \tau) \cdot \frac{\partial y}{\partial k}$ is the private marginal return to capital, as it will look with a flat income tax. As can be seen from equation (3.4) the income tax $\tau$, which also reflect the size of government see equation (3.2), have a negative impact on the consumption growth rate.

---

5 By excluding congestion it can mean that the productivity of public capital is higher than it would be if the model included congestion (cf. section 4.1).
Barro states that different sizes of governments, which mean a greater size of the amount of public services and the tax on income, have two effects on the growth rate $\gamma$. First of all, when the income tax $\tau$ increases, the growth rate $\gamma$ is reduced. This is the disincentive effect, because in this case an increase in $\tau$ creates no incentive for the agents to increase investments. The second effect is, when there is an increase in tax and the amount of public service rise, this will have a positive impact on the marginal product of capital $\frac{\partial y}{\partial k}$. This effect is called the productive effect, because one more unit of private production will have a positive effect on output and thereby the growth rate.

He finds that the first effect usually dominates when the government initially is large, and the second effect dominates when the government is small.

4.2.3 Empirical analysis of the size of governments and growth rates

In general there is high uncertainty about how to test this relationship, and therefore also a lot of different results. Here is a short summary of a few of the results on this topic.

Barro (1991) sets up a cross-section analysis on 98 countries for the period 1960 – 85, measuring among other things how the government consumption expenditure ratio affects economic growth. He finds a significant negative relationship on 0.12 (s.e. = 0.03) between the government consumption expenditure ratio and the real growth rate. When he includes the government investment ratio in the regression, he finds a insignificant positive effect from investments to growth on 0.13 (s.e. = 0.10).

Fölster and Henrekson (2001) find a robust negative relation between the size of government, which they define as public expenditure, and economic growth. They use a panel dataset to estimates this effect. In the sample they include 23 of the richest OECD countries and taking the years 1970 – 1995. The robust estimated coefficients imply that an increase in government expenditures by 10 pct. will lead to a decrease in the growth rate by 0.7 – 0.8 percentage points. OECD members must satisfy certain criterias about growth performance, existence of democracy etc. Therefore they extend the dataset with non-OPEC non-tax haven countries. When they extend the sample with non-OECD countries, the robust negative relation between both tax and growth rate and government consumption and growth rate remains.

---

6 averaged over the period 1970 – 85
loizides et.al (2005) uses cointegration to analyze the relationship between government expenditure and economic growth in Ireland, UK and Greece. They use data from the period 1969-95. Their analysis shows no evidence that an increasing expenditure should lower economic growth.

Table 1 summarizes the result of the three analyses.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Countries</th>
<th>Data period</th>
<th>Econometric method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-OPEC Countries</td>
<td>1970-95</td>
<td>Panel</td>
<td>Robust neg. effect from both tax and gov. exp. on growth.</td>
</tr>
<tr>
<td>Loizides et. al. (2005)</td>
<td>Greece, UK and Ireland</td>
<td>1960-95</td>
<td>Co-intergration</td>
<td>No significant effect from gov. exp. on growth.</td>
</tr>
</tbody>
</table>

As the latter show there is not a clear empirical answer to the question whether government expenditure has impact on economic growth. This clearly depends on what econometric method there is used to answer the question, and how the data sample is restricted and selected.

One of the reasons that the effect can be very difficult to measure, is that it is not possible to measure the before and after effects of a change in tax/size of government. If a country lowers its tax rate and there is a positive effect on economic growth, it can be difficult to interpret whether the positive effect origins from the tax decrease or another omitted variable.

One way to measure an effect caused by fiscal changes, could be to use the matching estimator. Here you need a treatment group, which in this case would be countries that have had a change in their tax rate, and a control group which would be a group of countries that have not had a change in the tax rate, but have the same characteristics as the countries that have been "treated". This way you would be able to compare two almost similar
countries, one that have been treated and one that have not and thereby measure the effect of the treatment.
To be realistic it would not be possible to use this estimator when you look at countries. It is close to impossible to find two countries that are similar, and therefore nearly impossible to measure the actual effects of fiscal changes in a country.

4.2.3 Discussion of the impact of government size on economic growth.7

It can be difficult to interpret how taxes and government expenditures affect economic growth. The negative effect of government expenditures on growth may especially occur when the expenditures is financed by capital and labor taxation. Distortionary taxes can have a negative effect on incentives to work and start new businesses, which are two of the things that are crucial for a country to obtain long run stable growth in the economy.

From figure 1 we can see that all countries are imposing capital tax on their citizens, which does not seem logical in comparison with the results from Turnovsky’s article. This could maybe be related to the so-called Wagner's law, which states that government expenditure, as a share of GDP, tends to rise with living standards, reflecting income-elasticity demand for government services. In other words, when the wealth of the population increases, it will generate higher demand for public services. To finance this high demand for public services the government must choose a financing mode, which means that in general the taxation level rises. Therefore, it can be assumed that the distortionary effects will mostly occur in high-income countries.

On the other hand, it could be stated that government expenditure can have positive effects on economic growth if the tax revenue is invested in areas that are more closely related to growth such as education, infrastructure, health care and research and development. This could especially be assumed to occur at a low level of total government expenditures,

Numbers from OECD shows that the member countries spend in the range of 40-50 pct. of GDP on government expenditure. The numbers also show that out of this, the member countries only use one fifth of the total government expenditures on the areas that is closely related to growth.

The above discussion indicates that there are two contractionary causalities between economic growth, taxes and income. In turn, economic growth can generate higher
income, which will generate a higher demand for public services and therefore creating higher tax rates. On the other hand, higher taxes can generate a higher stock of human capital, which will ceteris paribus result in higher economic growth and thereby higher income.

All in all the empirical results on how government size and economic growth is related seems to be ambiguous. It should be remarked that in the three articles we refer to, there is used different econometric methods. This is definitely one reason that the results differs. We question if it is at all possible to measure the effect of government size on economic growth. One way to measure this could be by using the matching estimator, but it could be argued that this is an unrealistic method to use on countries.

4.3 Brain drain and optimal taxation

In a Developed Country with high levels of taxation (for instance Denmark or Canada), it is worth considering the possibility that there is some upper bound of the level of taxation. If the initial taxation level is very close to this upper bound, then high income agents will ceteris paribus choose to immigrate to another country, where the taxation level is lower. The loss of human capital could in the long run result in less innovation and therefore a reduction in the economic growth. Also the speed of convergence towards the steady state equilibrium may be slower due to lower efficiency of labor.

In relation to the Turnovsky model, if the country in question has a taxation level very close to this upper bound, then an increase in either one of the taxation modes could cause well-educated agents to immigrate to another country, i.e. the country could end up being brain drained. If the benchmark economy in the model processed very high tax levels, the outcome of the analysis may be different. For instance, an increase in government investment financed by an increase in the taxation of wage income may not at all have the positive effect, which is put forth by Turnovsky.

Collins (2004) shows that the effective tax rate has an impact on the migration pattern. He looks at Canadian and US first time university graduates. The tax system in Canada and US are very different. The graduates in Canada face a much higher effective tax rate than their counterparts in the US. He shows that the Canadian graduates have greater incentives to migrate to the US due to lower effective tax rates. The Canadian graduates hereby increase their rates of return.

---

7 OECD (2003)
In conclusion, by determining the optimal taxation, the *initial taxation level* in the country is of great importance. If the tax level is too high brain drain is a distinct possibility. Choosing the optimal tax level differentiates between countries as the initial level differ.

5. Developed Countries versus Newly Industrializing Countries (NIC)

5.1 The Turnovsky model in relation to labor intensive countries

In the Turnovsky model, one of the main conclusions in section 2.2.1 (the uncompensated case) is that capital income taxation reduces growth more than wage taxation and consumption taxation. The point of this section is to enlighten that for NIC, the result of the analysis could look different. In the subsequent section, the conclusive results in the Turnovsky model, section 2.2.1, will be discussed in comparison to a model by Wang and Yip, 1995.

The model by Wang and Yip distinguishes between a NIC and a Developed Country. It is argued that in NIC most of the production technologies are highly *labor-intensive* and labor income share is relative higher than in developed countries, where the economy generally is capital-intensive. Moreover, in NIC it is expected that labor is very elastic, and therefore, the labor income tax may have greater effect on economic growth.

The authors test the hypothesis by regressing the growth rates of physical capital and effective labor on capital and labor income tax rates, respectively. The regression is done using annual data for Taiwan in the period 1954 to 1986. The results are as follows: An increase in the capital tax by one percent lowers the rate of physical capital growth by 0.25 pct. However, an increase in labor tax lowers the rate of effective labor by 3.78 pct. These results indicates that in NIC an increase in capital income taxation will be more growth enhancing than an increase in wage income taxation. This is certainly not the case in the Turnovsky model.

In this context, it is important to bear in mind that an increase in the wage income tax initially reduces labor supply. However, if this tax increase is compensated by a reduction in capital income taxation, labor supply may increase. The intuition is that marginal productivity of labor is increased by the increase in the private capital stock. However, if labor intensity is very high, the net result on labor supply will be negative.
All in all, it seems to be important to take into account at which stage in the developing process the country currently is at. In the Turnovsky model, the analysis is based on data for the US economy. The qualitative effects of capital and labor taxation in developed countries and NIC are identical, but there exist quantitative differences. In NIC, wage income taxation is more growth dampening than capital income taxation. And thus, the conclusive results in the Turnovsky model may be quite different, if the model is used to analyze NIC, like Taiwan.

6. Conclusion

In this paper we have analyzed how government expenditure financed by different taxation modes affects economic growth.

In the Turnovsky model the conclusive result is that capital income tax dampens the economic growth the most, and consumption taxation is the most plausible. In regard to the structure of government expenditure, government investments generate higher economic growth in comparison to government consumption. In the short run, choosing government investment creates negative welfare, but in the long run the welfare turns out to be highly positive. Allocating government expenditure into public capital via investments generates higher capital accumulation, and thereby larger output. Turnovsky finds that the best solution for a compensated expenditure is investment financed by consumption taxation.

In the revision of the Turnovsky model, three different definitions of leisure is introduced: raw time, quality time and home production. It is considered that Turnovsky regard leisure as raw time. If the definition of leisure in the Turnovsky model is home production instead of raw time, it could generate a different result in the analysis. If home production is included the relative decrease in output will be smaller or disappear in certain instances.

In the model the productive government investments generates a positive externality on the private input factors, labor and capital. Therefore it is concluded that it is optimal to have positive tax rates on these private input factors.

Barro (1990) states that government size is negatively correlated with economic growth. Three empirical analyses using three different econometric methods and data samples give us ambiguous results on this correlation.

Two contractionary causalities between government size and economic growth are at play. Economic growth generates higher income levels which in turn may create a
higher demand for public services financed by higher taxes. On the other hand higher taxes create a higher stock of human capital, which in turn may generate higher economic growth and therefore higher income levels.

By determining the optimal taxation level it is important to consider the *initial taxation level*. If the taxation level reaches a certain upper bound the possibility for *brain drain* arises.

The conclusive result in the Turnovsky model may be different when looking at NIC. Because of labor intensive sectors in NIC, wage income taxation can be more dampening on economic growth compared to capital income taxation.
## Appendix

### Table A1

<table>
<thead>
<tr>
<th>A. Uncompensated Standardized Changes</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Short-run welfare gain percent</th>
<th>Long-run welfare gain percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increase in h from 0.16 to 0.20</td>
<td>-1.29</td>
<td>-0.04</td>
<td>0</td>
<td>0</td>
<td>6.57</td>
<td>6.57</td>
<td>6.57</td>
<td>-49.7</td>
</tr>
<tr>
<td>2. Increase in g from 0.04 to 0.0796</td>
<td>-1.23</td>
<td>-0.0396</td>
<td>0</td>
<td>199.0</td>
<td>44.6</td>
<td>287.7</td>
<td>44.6</td>
<td>-31.3</td>
</tr>
<tr>
<td>3. Increase in τg from 0.28 to 0.40</td>
<td>0.69</td>
<td>0.0229</td>
<td>20.0</td>
<td>20.0</td>
<td>-30.2</td>
<td>-16.2</td>
<td>-16.2</td>
<td>80.2</td>
</tr>
<tr>
<td>4. Increase in τg from 0.28 to 0.349</td>
<td>2.02</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-10.0</td>
<td>-10.0</td>
<td>-10.0</td>
<td>55.1</td>
</tr>
<tr>
<td>5. Increase in τg from 0.349 to 0.0638</td>
<td>1.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-6.22</td>
<td>-6.22</td>
<td>-6.22</td>
<td>32.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Compensated Standardized Changes</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Δ(%)</th>
<th>Short-run welfare gain percent</th>
<th>Long-run welfare gain percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tax Substitution τg = τe = 0.2403, τg = 0.06</td>
<td>-0.14</td>
<td>-0.0076</td>
<td>-5.23</td>
<td>-5.23</td>
<td>10.8</td>
<td>5.01</td>
<td>5.01</td>
<td>-3.68</td>
</tr>
<tr>
<td>2. Restructuring Government Expenditure</td>
<td>0.05</td>
<td>0.0100</td>
<td>0</td>
<td>200.0</td>
<td>35.9</td>
<td>271.7</td>
<td>35.9</td>
<td>-4.47</td>
</tr>
<tr>
<td>3. Increase in h, Financed by τg, h = 0.20, τe = 0.0642</td>
<td>-0.04</td>
<td>-0.0400</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-0.04</td>
</tr>
<tr>
<td>4. Increase in h, Financed by τg, h = 0.20, τe = 0.3433</td>
<td>0.61</td>
<td>-0.0400</td>
<td>0</td>
<td>0</td>
<td>-3.03</td>
<td>-3.03</td>
<td>-3.03</td>
<td>1.24</td>
</tr>
<tr>
<td>5. Increase in h, Financed by τg, h = 0.20, τe = 0.3582</td>
<td>0.57</td>
<td>-0.0400</td>
<td>0</td>
<td>19.0</td>
<td>19.0</td>
<td>-24.6</td>
<td>-10.2</td>
<td>16.2</td>
</tr>
<tr>
<td>6. Increase in h, Financed by τg, h = 0.08, τe = 0.0642</td>
<td>0</td>
<td>-0.0400</td>
<td>0</td>
<td>200.0</td>
<td>36.1</td>
<td>272.2</td>
<td>36.1</td>
<td>-5.23</td>
</tr>
<tr>
<td>7. Increase in g, Financed by τg, g = 0.08, τe = 0.3449</td>
<td>0.66</td>
<td>-0.0400</td>
<td>0</td>
<td>200.0</td>
<td>31.6</td>
<td>263.2</td>
<td>31.6</td>
<td>-4.03</td>
</tr>
<tr>
<td>8. Increase in g, Financed by τg, g = 0.08, τe = 0.3552</td>
<td>-0.57</td>
<td>-0.0180</td>
<td>19.0</td>
<td>238.1</td>
<td>2.67</td>
<td>244.5</td>
<td>22.3</td>
<td>3.39</td>
</tr>
</tbody>
</table>

References

- OECD, "The sources of economic growth in OECD countries", 2003