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Financing an increase in public purchase of goods and services

Resumé:

The paper illustrates how the government may finance an increase in public purchase to make the long term effect on debt constant and investigates the effects of financing. As expected, there is a distinct difference between taxes on the one hand and government transfers to abroad on the other. Tax financing affects the private sector where as foreign transfer financing does not. The paper also illustrates the additional impact if taxes change the labor supply and points some obvious differences between direct and indirect   financing.

SEY

Key words: public purchase, public finance

1. **Introduction**

It is standard to illustrate ADAM properties by an experiment that increases the public purchase of goods and services permanently implying a continuous deterioration of public finances. In practice, you would not allow this outcome. This paper pays attention to neutralizing the long-term deterioration of the public net asset, which follows from an increase in the public purchase of goods and services. We supplement the public purchase with exogenous public finance shocks to make the long-term effect on public net asset constant and zero. We use taxes and public transfers to abroad as public finance instruments and the effects of the financed public purchase on value added, private consumption and employment are examined.

2. **Implementation and size of the shocks**

Public purchase, fvmo, is a fiscal variable which is directly included in total demand, and the public purchase experiment is often used to illustrate the properties of ADAM. We set the dummy dfvmo to one and shock the exogenized public purchase by 1% throughout the baseline period, which means that in all years, fvmo is 1% higher relative to the base. The experiment periods starts in 2011 and ends in 2110, a total of 100 years.

Fvmo =((fvmo (-1)*fyfo/fyfo (-1) +fvmox+jdvmo)*(1.0+jrfvmo))*(1.0-dfvmo) +dfvmo*zfvmo$

Fvmo= public purchase of goods and services from the private sector
Fyfo = gross value added in industries o
Fvmox= production value in public services
Jrfvmo= adjustment term changes in the relationship

3. **Effects of unfinanced public purchase on output and demand**

In this section, we review the results an unfinanced increased in public purchase in order to compare them with the effects from financed increase in public purchase.

As it is portrayed in figure 1, there is a permanent increase in investment, which reacts more in short run than in the long run, reflecting the accelerator effect on investment. Labour becomes more expensive relative to capital, which has a positive long term effect on investment. After the initial strong investment effect, investment starts to decline but remains above its baseline while private consumption increases and reaches maximum after 20 years. The positive impact on consumption reflects the permanent increase in terms of trade and hence in real income created by the higher wage. Higher wage results in the crowding out process and a permanent loss in market share. Export is below the baseline line in the

long run while the reverse happens to import shares. We observe a more sluggish response in exports than in investment and the loss of exports peaks after 35 years.

Figure 1: effects of public purchase on value added,consumption ,export and investment
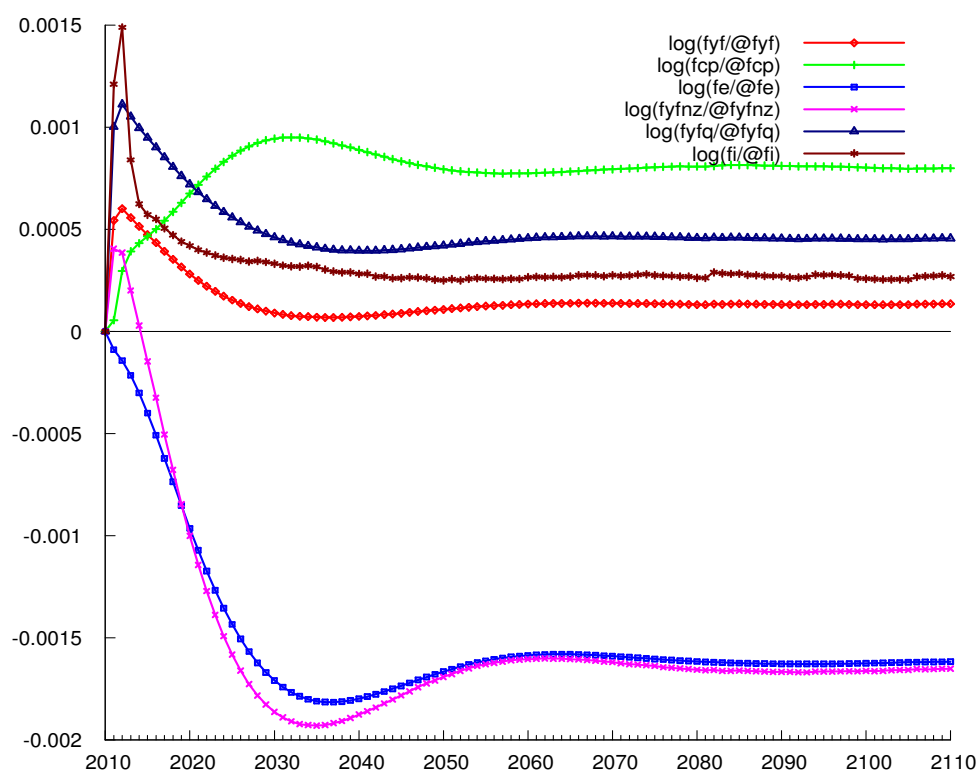
The first task of the study is :   to examine the impact of a permanent increase in public purchase of goods and services on key variables. Fvmo is made 1% higher relative to the base in all years, where 2011 and 2110 is the first and last years in the experiment period.   The mechanism is simple and easy. An increase public spending raises aggregate demand, which in turn increases production and there by employment. As a result of increase in factor demand, domestic wages is higher than wages abroad, and crowds out export and eventually, the pressure from aggregate demand dies out. In the SR , ADAM behaves as a kenesian model, where production is demand driven and In the LR , it behaves as a neo-classical model where wage and price react and crowd out the GDP effect resulting from aggregate demand. In the sr, price formation is important for dynamics of adam including the crowding out speed. Gdp peaks in 2013 and then after, decline toward the lr equilibrium, where the baseline growth rate equals the actual growth rate 0f 1.5%., see fig1 pp.3. There is a permanent increase in Labor productivity owing to the higher relative price of labor to machinery. We also see a permanent loss of competitiveness pertaining to a permanent increase in export price relative to competitors /foreign price   we show at the end of the paper that in any demand shock, the effect on employment evaporates in the long run. The wage compensation ratio determining structural unemployment   is unchanged due to

the wage indexation of benefits. Wage and price increases are unchanged from the baseline growth in the LR.

Figure 1 shows that value added is higher than its baseline. The substitution effect, where real wage increases relative to the   base, explains the increase in value added as the implied permanent increase in machinery per employee raises the value added relative to base.

4. **Effects of unfinanced extra public purchase on public net asset**

As displayed in figure 2, unfinanced fiscal shock creates a permanent downward movement in public net wealth. Initially, the automatic reaction of public finances will ease the negative effect on public finances through decreasing transfers to unemployed and increasing the tax base. However, this way of automatic financing the increase in public expense will not be adequate and nor sustainable because the increase in public purchase of inputs is permanent and not cyclical. Thus, we need to finance the permanent increase in public purchase.

Figure 2: Effect of permanent increase in public purchase on public net asset
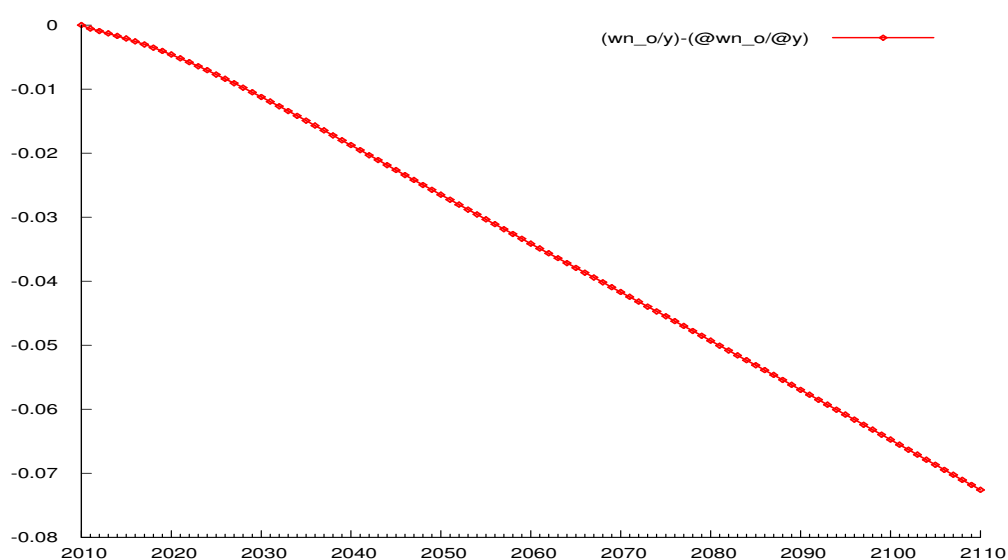
A permanent increase in public purchase of goods and services implies a permanent deterioration of public finance. As shown in fig. p.4. we observe a permanent down ward movement in public net asset as a share of GDP. The question is why we need to finance public purchase of goods and services? In Adam , funds are raised by issuing bonds: everything is financed by bonds. The way government pays back debt is not determined in the analysis. We do not have automatic budget stabilizing reaction function in ADAM. if public purchase is permanent and not cyclical, like the case we have, fiscal deficit grow indefinitely in the future. In practice, we do not allow this to happen. We need to finance the extra public purchase to ensure a balanced budget in the long run. The question is how do we finance it? Because different financing methods would affect the macroeconomic dynamic differently. The second question is do we need a permanent and temporary revenue instruments or only one of them to finance public purchase? The answer is   that we need both

permanent and temporary revenue instruments. In the standard ADAM, interest rate equals the general growth rate of 3.5% in the LR. Had the interest rate been higher than the general growth rate of 3.5%, all the present and future public deficit would have been discounted to get a finite amount and a one off increase in revenue at some point in time would be sufficient to finance this specific amount. In addition, public revenue and public expenditures are endogenous in ADAM and we need a permanent revenue instrument to finance a permanent change in public expenditure. To finance this fiscal shock, we require both a permanent and a temporary change in public revenue.

5. Financing the public purchase of goods and services

For instance, the public can finance the increased public purchase by increasing taxes or by decreasing public transfers to abroad.

In general we need both a permanent and a temporary revenue instrument to secure that the government debt ratio, debt/GDP, remains unchanged in the long run cf. the discussion in section 11.1.6 of the ADAM-book. The need for both permanent and temporary revenues can be compared to the use of a permanent revenue instrument in the case of a text book balanced multiplier, and to the use of one-off revenue-instruments the general equilibrium DREAM-model.

A simple balanced budget multiplier assumes that public expenditures and the public revenues are both exogenous. Thus, it is easy to match higher expenditures by higher revenues year by year, and there is no need for temporary revenue changes if the expenditure change is permanent. The DREAM model always assumes that the interest rate is higher than the general growth rate. With this assumption, it is possible to discount all present and future deviations between public expenditures and revenues to a finite amount. Thus, any lack of finance can be remedied by a one-off increase in revenues at some point in time.

In ADAM public revenues and also some expenditure variables are endogenous and respond to the business cycle. Consequently, it is difficult and not a good idea to neutralize the actual budget effect of expenditure shocks with revenues year by year. Instead, one can implement a permanent revenue shock that neutralizes the long-run effect on the public budget. This will secure that the long-run net-effect on public debt is constant, but not necessarily make it zero. The additional temporary revenue shock can make the long-run debt effect zero.

Moreover, we note that the standard ADAM baseline assumes that the interest rate equals the growth rate. Consequently, any one-off revenue, however big, will eventually be dominated by a permanently repeated expenditure. Thus, we

need a permanent revenue shock if we want to balance a permanent expenditure shock.

Summing up, to finance shocks to public finances in ADAM we need both a permanent and a temporary change in public revenues or expenditures. Several fiscal instruments may be applied. In the following, we look at financing instruments, namely value added tax, income tax, income tax in an altered ADAM and finally public transfers to abroad. The general technique is explained in the section on value added tax financing.

5.1 Value added tax

The value added tax rate (tg) is used to finance one percent extra public purchase of inputs. First, we calculate by how much tg has to be raised to make the impact on long run debt ratio constant. This is a goal and instrument exercise. The rate tg is increased by different amounts and by experiment, it is found that increasing tg by 1.09%, i.e. from 25% to 25.27%, will make the debt ratio constant, cf. figure 3.

This way of calculating the necessary fiscal response corresponds to applying a fiscal reaction function with perfect foresight, where we are putting ourselves in the situation of say a ministry of finance using ADAM to assess and balance a fiscal package including the assessment of direct and indirect budget effects. The permanent shock to tg removes the downward sloping of public net asset as GDP share and produces a horizontal curve in the long run, where the public asset curve looks first cyclical and then constant, very different from the trended curve in figure 2.

The constant GDP share of the public net asset reflects that the negative impact on public budget has been removed.

To remove the long run effect on public net asset, we supplement the permanent increase in value added tax rate by a temporary increase in capital tax equal to 0.12% of GDP in 2011, cf. figure 3.

The size of the necessary tax changes have been calculated looking at figure 3 to check if the debt effect is as intended. We can summarize the calculation by the following, which comes close to a formal algorithm.

1) Run ADAM with the expenditure shock included. The simulation period should be long to enable the calculations that concern the long run effects of the model.

2) Consider the GDP ratio of public debt, i.e. Wn_o/Y. Use the model and the long simulation period to find out by how much the permanent revenue instrument should be increased to make the effect on the debt ratio horizontal in the long run.

Figure 3: Effect on public net asset from financing extra purchase with VAT and capital tax

wn_o/y- @wn_o/@y

finance with VAT ——— finance with VAT and capital tax
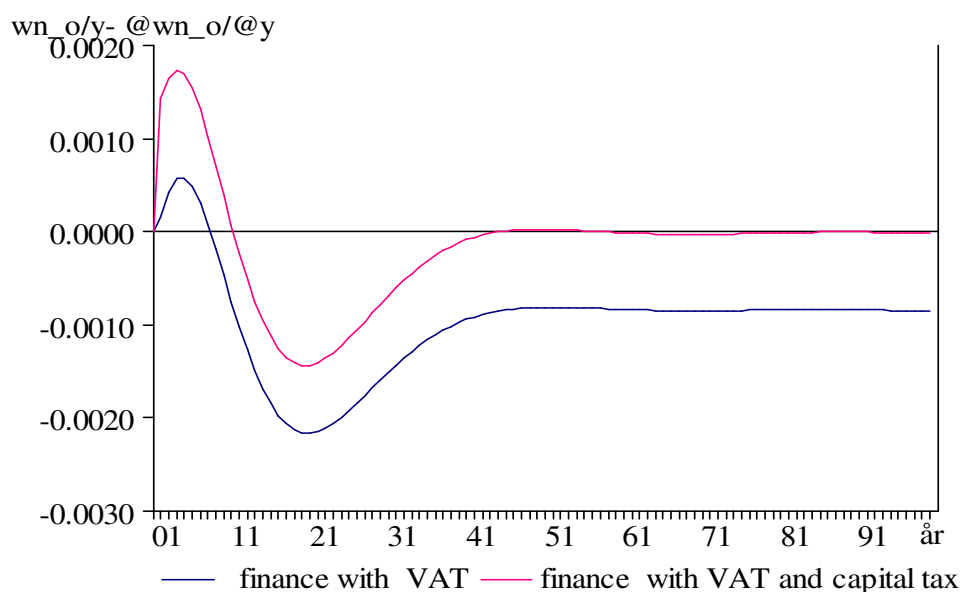
We choose 4 financing methods: value added tax, income tax, and public transfers to abroad and income tax with impact on labor supply i.e. Income tax in an altered ADAM. We allow labor supply to be a decreasing function of personal income taxes. Labor supply elasticity is set to 0.1. If you look at figure 3, e.g. page 7, we secure a balanced budget using VAT and capital tax. The procedure to calculate the necessary tax change for all financing method is the same   The size of the necessary tax change is calculated using two steps. First, we calculate by how much the tax revenue instrument, for instance. VAT rate has to be raised to make the long run effect on debt constant. The permanent shock removes the trended and downward sloping of the public net asset as share of GDP. Second, to remove the long run effect on public net asset, we use a temporary increase in capital tax. This type of technique corresponds to applying a fiscal reaction function with perfect foresight .we put ourselves in place of policy makers to asses and balance the fiscal packages. We put that people do not make systematic errors when predicting the future, and deviations from perfect foresight is random

3) Consider again the GDP ratio of public debt. Use the model and the long simulation period to find out by how much the temporary revenue instrument should be changed to make the effect on the debt ratio zero in the long run.

This step is roughly equivalent to including the variable LEVEL $(=Wn\_o[2110]/Y[2110])$, and setting the effect on LEVEL equal to zero using

the temporary revenue instrument chosen. In principle, the SLOPE and LEVEL variables may be included in ADAM by using lead.

5.2 Income tax

In place of the value added tax, we may use the income tax to finance the public purchase of goods and services. Income tax rates, tsysp1 and tsysp2, are increased by 1.47% relative to the base. This makes the long term effect on debt constant, cf. figure 4. The extra public purchase is balanced by the extra income tax.

Figure 4: financing the extra public purchase with income and capital taxes, effect on public net asset

wn_o/y -@wn_o/@y
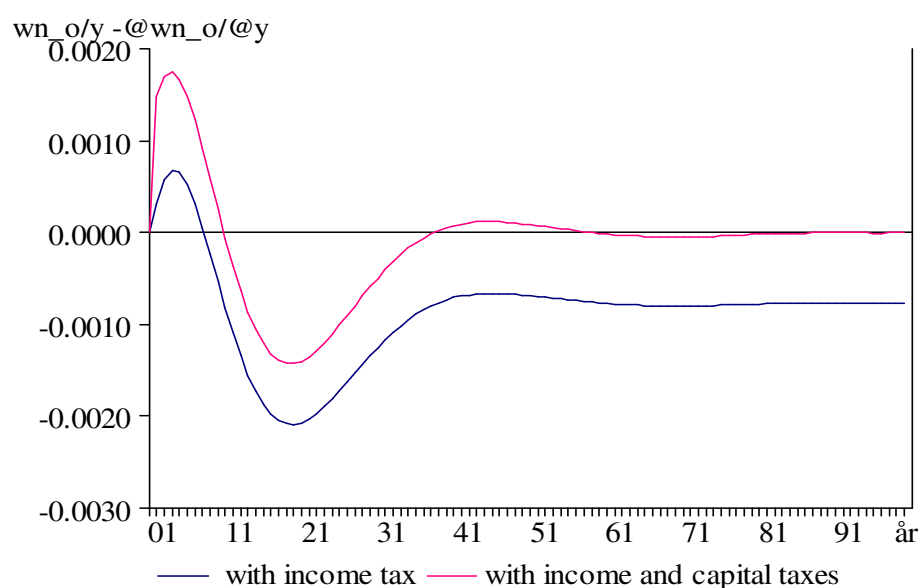
To remove the long run effect on public net asset, we use a one off increase in capital tax, which is 0.11% of GDP in 2011, cf. figure 4. The increase in public purchase is now fully financed and the long term effect on public debt becomes zero.

Note from figure 4 that, the short run effect on public net asset (for the first few years) of financed increase in public purchase is positive because the effect of public purchase on demand is more direct than the effect from increase in taxes. This is also the case with VAT financing, cf. figure 3 and corresponds to a standard text book result for the balanced multiplier.

5.3 Income tax with impact on labor supply

The labor supply is not affected by taxes in standard ADAM. However, it is possible to make labor supply a decreasing function of personal income taxes. Thus, unlike the previous experiment, the agreed hours of work will be

negatively affected by the increase in personal income taxes. The equation for the agreed working hours in ADAM is written as:

Log(ha) = (Log(ha(-1))) + 0.15*Dlog(dthaw)
        + 0.15*(Log(haw(-1))-Log(ha(-1))) + kha)*(1-Ddthaw)
        + Ddthaw*Log(zha) $

We update working hours, ha through the exogeneous target variable, zha. The dummy ddthaw is one, which implies that the baseline ha is equal to the baseline zha. Thus, what happens to zha will be directly reflected in ha. In all years, zha decreases as the personal income taxes increase and the pass through from change in hourly real wages to the hours of work depends on the elasticity of labor supply. Zha is updated every year as follow, where 2011 and 2110 are the first and last years.

zha= @zha*(1 + 0.1*((lnap-(ssysp-@ssysp)/hq)/pcp
      - @lnap/@pcp)/(@lnap/@pcp)),
where,
lnap= average hourly wages including ATP contribution
pcp= consumption price index
ssysp = total personal income taxes
hq = actual hours worked

We set the elasticity between agreed working hours and real wages to 0.1, which corresponds to the elasticity used in DREAM. The elasticity determines the response of working hours to the change in hourly real wage, where the change in nominal hourly wage comes from change in hourly personal tax rate and change in public purchase of inputs. For instance, if real wage decreases by x%, the hours of work decreases by 0.1*x %.

To make the long term effect on debt constant, we now have to permanently increase income tax rates by 1.487 %, cf. figure 5.

Figure 5: endogenous labor supply and income tax, the effect on public net asset

wn_o/y-@wn_o/@y

income tax with endogenous labor supply
income tax with endogenous labor supply plus capital tax
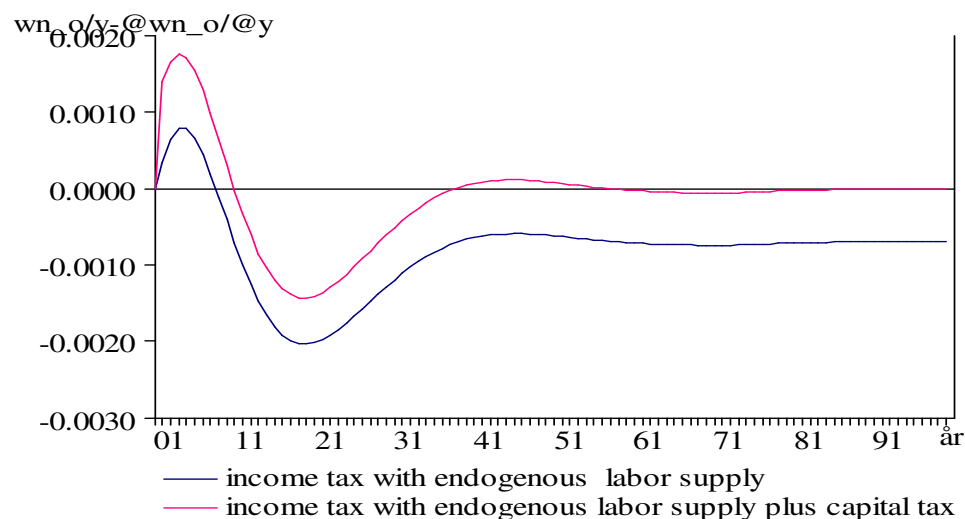
Moreover, we increase capital tax by 0.1% of GDP in 2011 to make the long run effect on public net asset zero and this is reported in figure 5 by the red line. Now, the long-term increase in public purchase is fully financed by the income tax and a one off increase in capital tax.

A number of iterations (it is 6 in this case) is required to solve the zha equation and standard ADAM simultaneously. This iterating between standard ADAM and the zha equation is equivalent to incorporating the zha equation in ADAM. Income tax reduces the working hours and the long term deviation of working hours from the base is constant in the steady state. Figure 6 shows what happens to the agreed and actual working hours.

Figure 6: labor supply effect of increased income tax rate to finance extra purchase
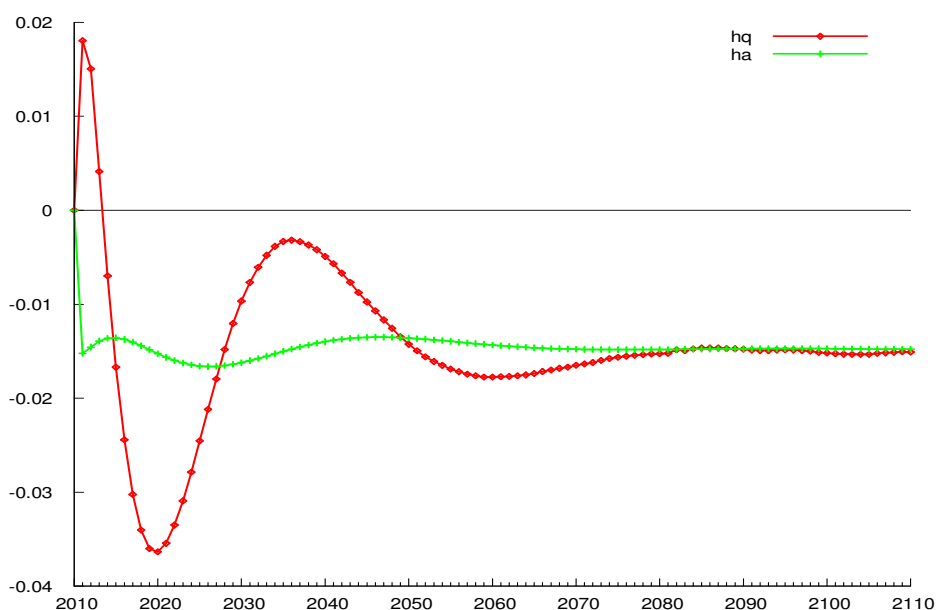
5.4 Public transfers to abroad

The last financing method discussed here is to decrease the exogenous public transfers to abroad**.** They are permanently decreased by 24.7% to make the long run effect on public debt constant, cf. figure 7

Figure 7: finance with public transfers to abroad and capital tax, effect on net asset

wn_o/y-ⱳwn_o/ⱳy
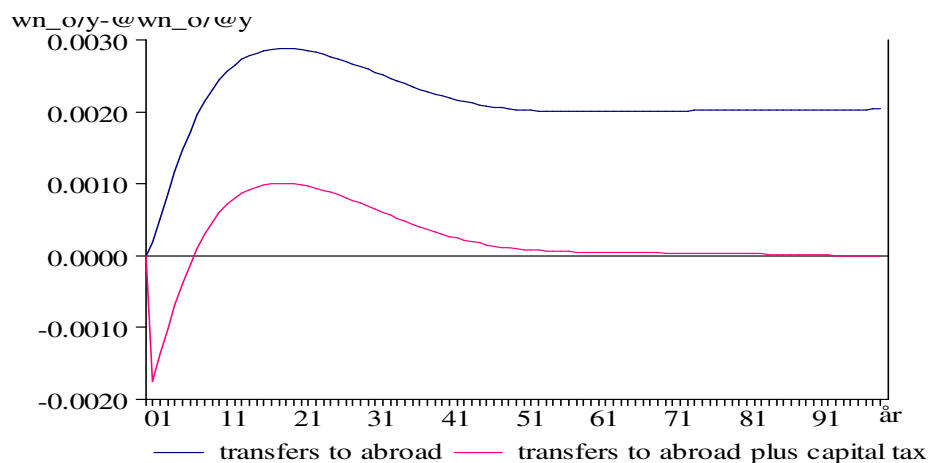
To make the long run debt effect zero, as the red line in figure 7 shows, we supplement by a one off increase in public transfers to abroad, specifically by 0.09% of GDP in 2011.

6 Comparing the methods of financing the public purchase

Section 6 on comparison consists of two subsections. First subsection gives the big picture, and second subsection deals with some specific differences between the experiments.

6.1 The experiments fall into two groups

We have already illustrated the main effects of an unfinanced increase in the public purchase of goods and services cf. figure 1. In figure 8 to 11, we

illustrate the main effects of the four financing methods. There is a clear difference between the unfinanced effects shown in figure 1 and the tax-financed effects in figure 8 to 10. In the latter three figures private consumption decreases when the public purchase increases and there is only little impact on exports in figure 8 to 10. In figure 1, export is crowded out by the increase in public purchase. The crowding out works via the wage formation and private consumption increases due to the higher real wage. Thus, the result for exports and consumption are quite different with and without tax-financing.

Figure 8: Financing the public purchase with value added tax and capital tax and the effect on consumption ,value added and export
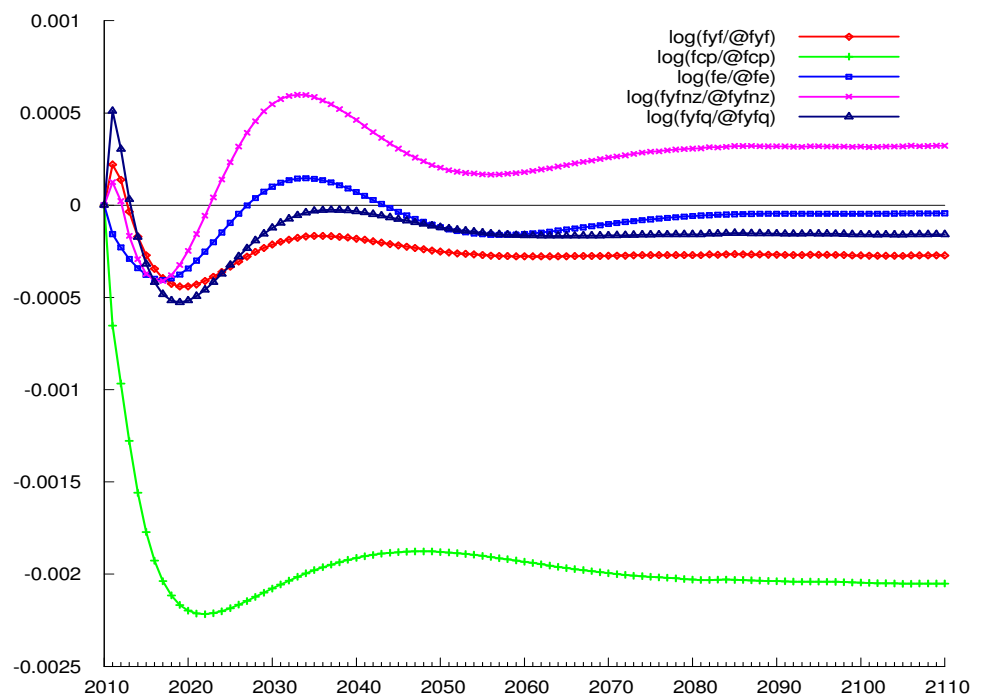

Figure 9: Financing the public purchase with income tax and capital tax and the effect on consumption, value added and export
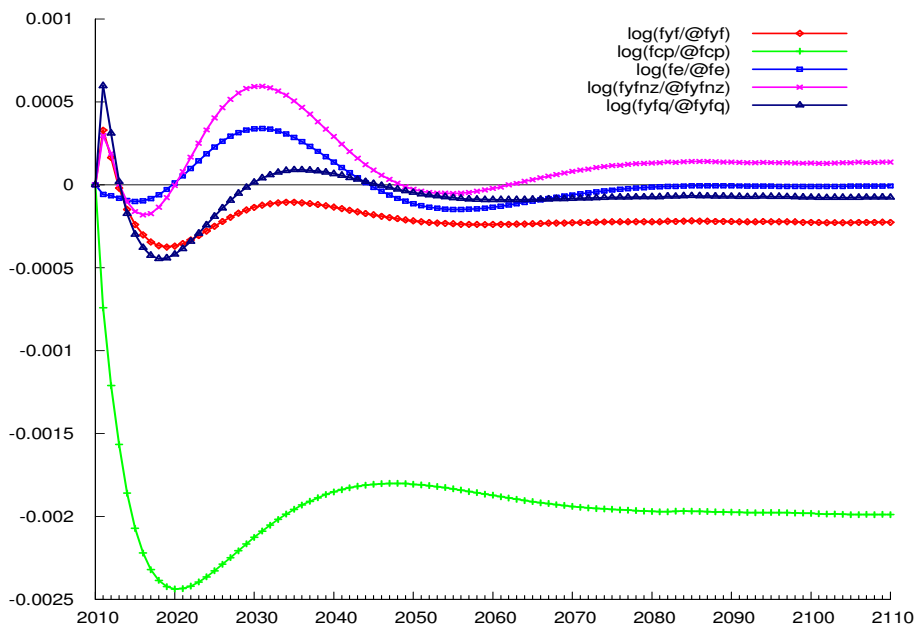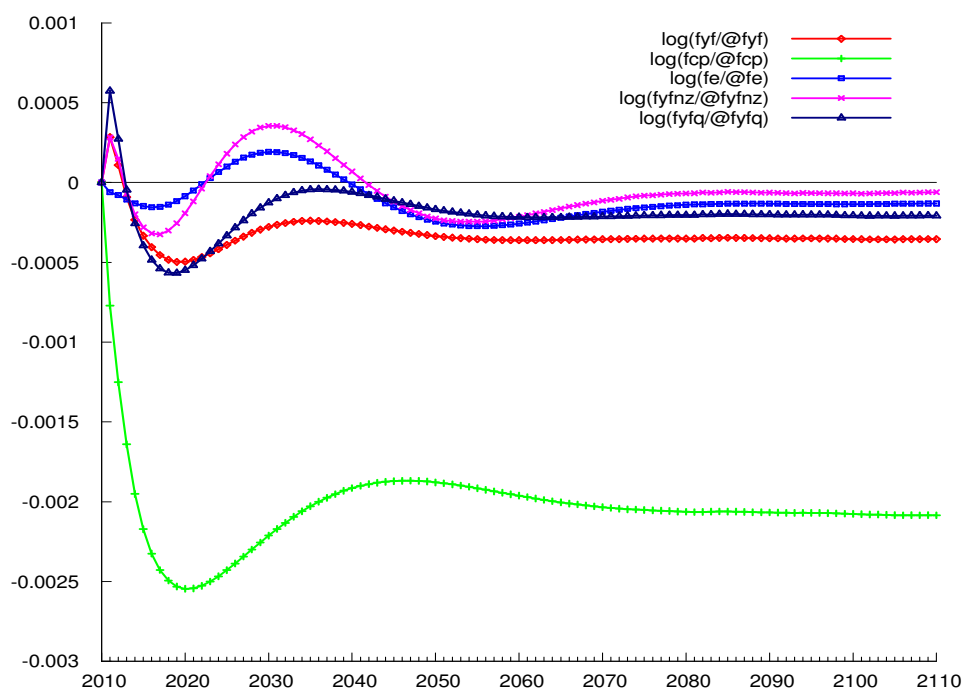
Figure 10: income tax and public purchase (for endogeneous working hours), effect on consumption, value added and exports

In figure 11, we do not use taxes but finance the extra public purchase by reducing transfers to abroad. This type of financing should not affect the private disposable income and there is no impact on private consumption from

the decrease in public transfers to abroad. The small private consumption effect can be referred to technical composition effects.

Figure 11: Public transfers to abroad and public purchase, effects on consumption, value added and export
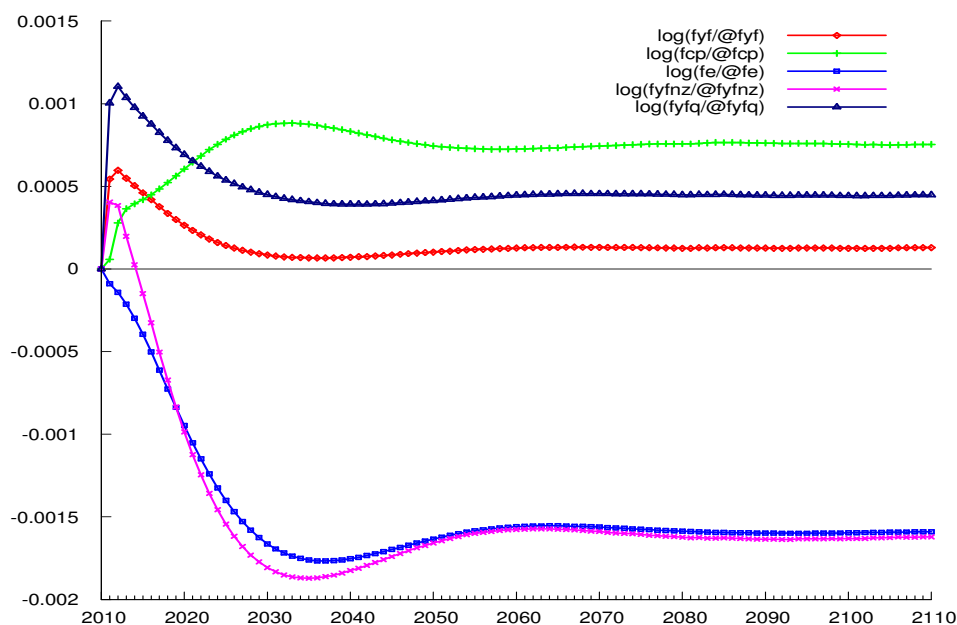
Thus, foreign transfer financing in ADAM is basically equivalent to no financing.

Consequently, we can divide the 5 figures with main experiment effects into two groups. One group is formed by figure 1 and 11 that are almost identical, while the tax-financing related figures 8-10 are rather similar and form the other group.

In the next subsection we take a closer look at some of the main effects.

6.2 Comparing main effects

We start by presenting the employment effect of financed and unfinanced increase of public purchase of goods and services. The results are reported in figure 12.

The figure shows that in the long run employment returns to the baseline where standard ADAM is used. This result is expected as we have an unchanged Philips curve and a constant exchange rate for a small open economy. The initial response of employment reflects that the crowding out process takes time. In the long run, ADAM acts as an equilibrium model.

Figure 12: Employment effect of financing the public purchase of inputs
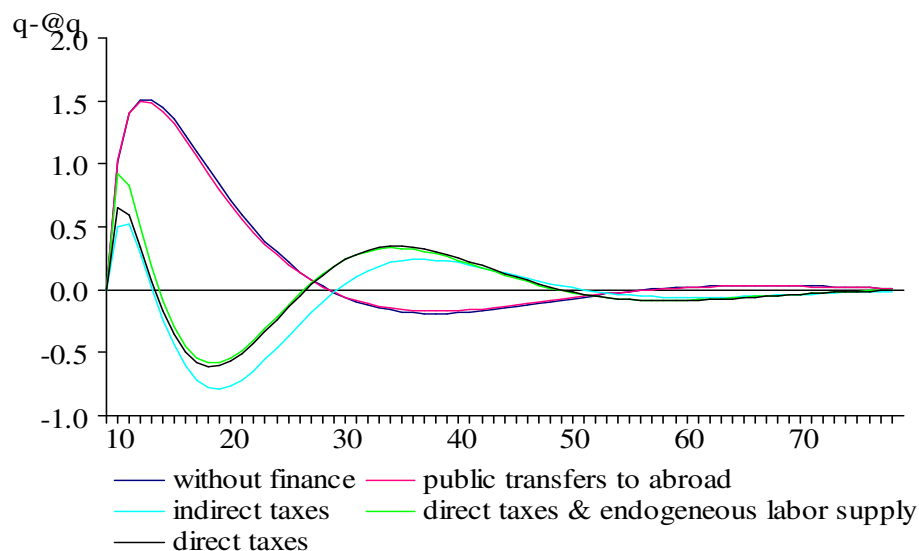
However, there are big differences between the unfinanced and tax-financed effects on employment dynamics and speed of adjustment. For the three tax-financed experiments it takes only 4 years before the initial positive employment effect crosses the x-axis. The adjustment patterns are similar for the three experiments, but we note that the short-run effect on employment is larger when the supply effect is included. This reflects the short-run effect of reducing working hours per employee. In the short run labour input is demand driven, and a larger number of employees are required to produce the same input of hours if working hours are reduced.

One also notes that indirect taxes seem to have the strongest negative employment effect in the medium term where the blue curve is lower than both curves relating to direct tax financing. This particular medium term effect of indirect taxes is mainly related to a negative effect on exports reflecting a price impact from indirect taxes on the price pet, which foreign tourists pay. Besides, there is a modest price effect on materials reflecting that some enterprises cannot deduct the VAT on their purchase.

In the long run the export effects for all three tax-financed experiments look modest compared to the unfinanced and foreign-transfer-financed experiments, cf. figure 13. However, we note that introducing the negative supply effect of taxes produces the lowest export in the long run among the three tax-financed experiments.

Figure 13: effects on export from financing public purchase of inputs

pct, from baseline
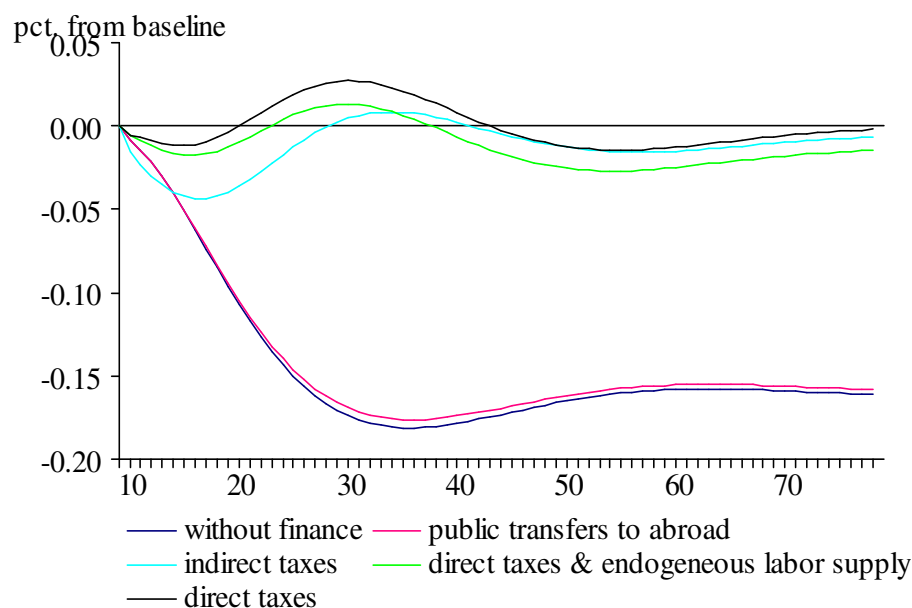
Let us compare the main effects: figure 13 and 14, page 14 and 15,

The main experiment effects fall into two groups: unfinanced and financed with public transfer form one group. Because, public transfers to abroad do not affect disposable income and has no impact on private consumption. Thus, foreign transfer financing in ADAM is basically equivalent to no financing. In fact, we observe small difference, which can be attributed to technical composition effects. The 3 tax financed form the other group because they resemble the same. The macroeconomics dynamics between the two group is quite different. The result for export and consumption with and without tax financing is quite different. Tax decreases Fcp and thereby decreases aggregate output. This in turn increases unemployment. There will be less crowding out of export by wage formation. With tax finance, private consumption decreases while export decreases by a little. When labor supply decreases with income tax, the negative impact on consumption and export is a bit stronger compared to the effect from a direct tax. This is because of a bit higher income tax increases in an altered adam.

For a close illustration of the consumption effects, we refer to figure 14, which contrasts the consumption effects of the five experiments, one unfinanced plus four financed public purchase of goods and services. Obviously, there is a clear difference both short and long term in the consumption response between not financing and say VAT financing the public purchase.

Figure 14: Financing public purchases and the effect on consumption

pct from baseline
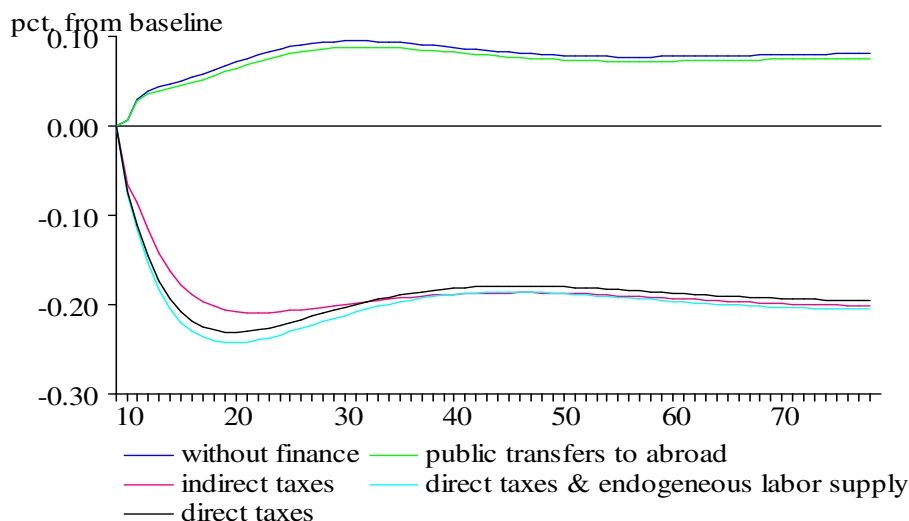
When the increased income tax is assumed to reduce the labour supply, the necessary tax increase becomes a little higher and the negative impact on consumption is a little larger when ADAM is altered to include a labor supply effect.

Figure 15 reports the effects of taxes or public transfers to abroad on private consumption, which is to describe the extent by which private consumption changes in response to change in taxes(direct or indirect) or change in public transfers to abroad. Endogenous hours of work and direct taxes produce a slightly stronger long term effect on private consumption compared to the effect from changes in direct taxes alone.

Figure 15: the effects of taxes and transfers to abroad on private consumption

pct from baseline
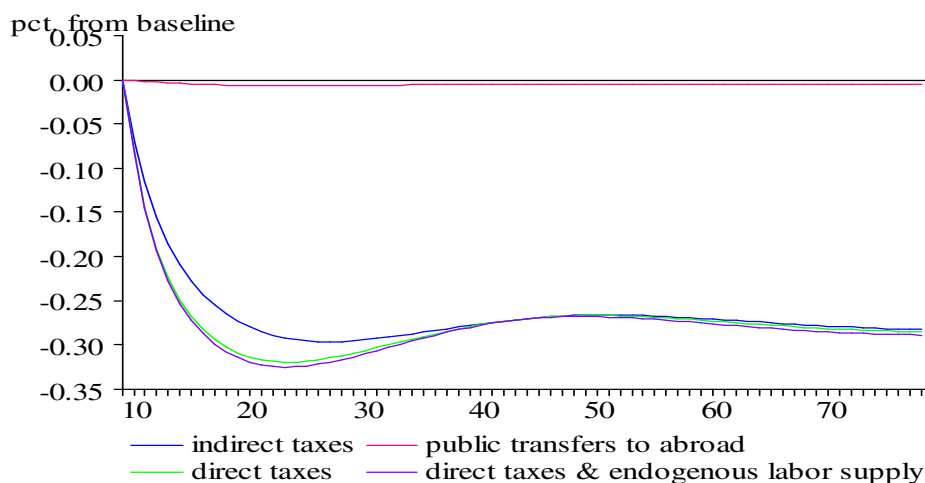
In the long run there is very little difference between the reaction in consumption to VAT and direct taxes respectively. However, the figure shows that in a more intermediate run, consumption tends to overshoot its long-run fall in the case of direct taxes while there is no overshooting in the case of indirect taxes.

It is of interest to see how a change in foreign price elasticity affects the response of private consumption in the case of direct and indirect taxes. The experiment suggests that the negative effect of indirect tax on consumption is slightly higher than the negative effect of direct tax if foreign price elasticties are larger. This impact of higher foreign trade elasticties reflects that indirect tax affects export prices and the impact on real income depends on the elasticties of the demand for export.

7. Conclusion

The paper examines the difference between financed and unfinanced increase of public purchase of goods and services and between various ways of financing the increase. The export and consumption effects of financing the extra public purchases with public transfers to abroad are quite similar to the effects of no financing. On the other hand, the results for consumption and export are quite different with and without tax financing. Thus, the overall results fall in two blocks: tax related financing the extra purchases on the one hand and the unfinanced and foreign transfer financing on the other hand. Among tax-related financing schemes, the negative effect on consumption and export is higher when labour supply is affected by direct taxes. In addition, the negative effect of indirect taxes on the medium term employment is quite high compared to the effect from the other two tax-financing methods. This is explained by the medium term effect of indirect taxes on export as indirect tax increases the price which foreign tourists pay.