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ROLLING BACK THE PUBLIC SECTOR – DIFFERENTIAL EFFECTS ON UNEMPLOYMENT, INVESTMENT AND GROWTH

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ABSTRACT

Rolling Back the Public Sector – Differential Effects on Unemployment, Investment and Growth

The macroeconomic effects of different ways of rolling back the welfare state are analysed. Cutting public spending on market goods induces a lower interest rate, a higher wage, a lower capital stock and a fall in employment. Cutting public employment or the labour income tax rate leads, in contrast, to a lower wage, a higher interest rate and a higher capital stock. Employment rises on impact. If the extra revenues of rolling back the welfare state are handed back via a lower tax rate rather than a lump-sum subsidy, both cutting public employment and cutting public spending on market goods induce an investment boom. Making the tax system less progressive by cutting tax credits and the labour income tax rate induces an investment boom as well. The effects of endogenous growth, adjustment costs for investment and non-Walrasian labour markets on these results are considered as well.

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1. Introduction

Many governments have during the past decade tried to trim the welfare state to permit cuts in tax rates on labour and improve incentives to work and produce. However, it matters very much *how* one rolls back the welfare state. One can do this by scrapping jobs for teachers, nurses and policemen, by cutting government spending on goods produced by the private sector, or by cutting the labour income tax rate. The first two methods raise public revenue, which can be handed back in the form of tax credits. The third method reduces public revenue, so tax credits must be cut. In effect, this makes the tax system less progressive. It is worthwhile to also consider scrapping public employment or cutting public spending on market goods if the saved public revenue is handed back to the people in the form of a lower labour income tax rate. Some argue that this is why one wants to cut back public spending and thus boost incentives to work and produce.

The effects of cutting back public employment on private employment, consumption, investment, wages and interest rates are very different from the macroeconomic effects of cutting back public consumption. Yann, Cahuc and Zylberberg (2002) show how changes in public employment affect unemployment without paying explicit attention to investment and growth. Alesina et al. (2002), however, find strong positive effects of cutting back public employment on private investment. A one-percentage point cut in the ratio of the public-wage bill to GDP boosts the ratio of investment to GDP by 0.48 percentage points on impact and by 2.56 percentage points cumulatively after five years. We show that this way of rolling back the welfare state reduces the demand for labour by more than the fall in labour supply induced by the boost in private wealth arising from the extra tax credits. The consequent fall in wages induces firms to substitute away from capital towards labour. The lower capital intensity gives a higher return on private investment and raises the equilibrium interest rate. This stimulates private saving and investment. Both the substitution and the output effect boost private employment. If the fall in public employment permits a cut in the labour income tax rate, we show that wages fall and the interest rate rises even further thus boosting private saving, investment and employment even more. However, we also show that the results are reversed if public employment releases more than proportionately labour for private sector employment. Firing public employees then pushes up wages and lowers the interest rate thus causing a drop in saving and a lower capital stock.

If the welfare state is rolled back by cutting back public expenditures on market goods, the story is very different. If the savings in public revenue are handed back to the public in the form of lump-sum subsidies or, alternatively, reductions in tax credits, we show that private wealth increases so labour supply and output fall. There is now no cut in public employment. To

ensure equilibrium in the labour market, the real wage rises. This chokes off labour demand and boosts labour supply. The rise in the wage encourages substitution away from labour towards capital. The higher capital-labour ratio depresses the interest rate. This chokes off private saving and boosts private consumption. Together with the boost to private consumption resulting from the increase in private wealth, the cut in public spending is more than fully offset. Hence, there is more than 100% crowding in. The fall in saving leaves less room for private investment, which contrasts sharply with the investment boom resulting from a cut in public employment.

If the saved public revenue is handed back via a lower labour income tax rate, there is an additional effect. Effectively, labour supply increases which pushes pre-tax wages down and interest rates up. This stimulates private saving and boosts private investment. The question is whether the direct positive effect of cutting back employment dominates the indirect negative effect of the lower tax rate on private investment.

Rolling back the welfare state by making the tax system less progressive, boosts labour supply. Since this reduces wages and raises the interest rate, private consumption is postponed and private saving is increased. Consequently, investment rises as well. Yet another method of rolling back the welfare state is to reduce transfers to the unemployed or pensioners. However, this may raise unemployment in economies with non-Walrasian labour markets – e.g., Atkinson (2002) and van der Ploeg (2003). This way of rolling back the welfare state lowers the penalty of shirking if benefits are conditional on not being fired for bad behaviour. In that case, firms need to pay workers more to boost discipline of workers but this may well lower employment.

The objective of this paper is to formally demonstrate these differential macroeconomic effects of rolling back the welfare state in a modified Ramsey model of economic growth with endogenous labour supply and mobility between private and public labour markets. The paper thus offers a differential expenditure analysis of the type advocated by Musgrave (1959). It allows a careful analysis of the impact, intermediate and steady-state effects of different ways of rolling back the welfare state.

Finn (1998), Ardagna (2001) and Pappa (2004) also distinguish the effects of changes in public employment from changes in public consumption of private goods. These papers address similar issues, but use numerical calibration rather than derive analytical results. For example, Finn (1998) is mainly concerned with how well the features of US business cycles are reproduced. Ardagna (2001) also uses a dynamic general equilibrium model to illustrate that an increase in public employment, in contrast to an increase in government spending on private goods, has a depressing effect on the economy, not unlike a rise in the tax rate. She is concerned with both the short-term and long-term effects of changes in different government spending items

and also attempts to give some welfare assessments after calibrating her model to recent data of ten European countries. Ardagna (2001) finds that the negative relationship between public employment and output can be reversed if public employment has a positive effect on the productivity of private capital. We differ from Ardagna (2001) in that balanced-budget rather than debt-financed changes in government spending items are studied. Pappa (2004) notes that empirical evidence on the effects of fiscal policy on the real economy does not deliver clear-cut results. She therefore calibrates a New-Keynesian and a standard real business cycle model to data on US states and characterizes a set of robust theoretical restrictions on the model for shocks to government consumption of private goods, government investment and government employment. In the New-Keynesian framework with monopolistic competition and sticky prices higher public spending typically aggregate demand and wages while in the real business cycle context wages fall. She nevertheless finds that the reaction of output to such shocks is almost always positive in both models. In particular, public employment seems to enhance productivity in the US.

In contrast to Ardagna (2001) and Pappa (2004), we abstract from the positive effect of public employment on the productivity of private capital. We focus on those components of public employment that are close substitutes for household production such as child care, education and house cleaning rather than those that directly raise private capital. This seems to capture the effect of public employment better than the idea that civil servants boost the productivity of private capital. In fact, one may even argue that more civil servants lead to more red tape and thus may hinder the productivity of private capital.

Section 2 sets up our version of the Ramsey growth model modified. We allow for private and public employment and endogenous labour supply. We assume perfect substitutability between private and public provision of goods like child care facilities, education and security, so total leisure and work time for households increase if there is more public employment. Section 3 investigates the macroeconomic short-run and long-run effects of cutting public employment and cutting public expenditures on market goods if the saved public revenue is used to increase tax credits. The comparative statics depend crucially on whether public employment releases less or more than proportionately labour for private sector employment. Section 4 investigates the consequences of three different ways of rolling back the welfare state and cutting the tax rate: cutting public employment, cutting public spending on market goods, and making the tax system less progressive by reducing tax credits. Section 5 discusses the robustness of the results if firms face adjustment costs for investment, labour markets are non-Walrasian and growth is endogenous. Section 6 concludes.

2. A Ramsey growth model with private and public employment

We assume a closed economy with competitive goods and labour markets. There is no government debt, so financial assets of households consist of equity only. There is mobility between private and public labour markets, so employees get paid the same in each sector. We abstract from population growth and technological progress. Households live forever and have a concave utility function:

$$\int_0^\infty \ [U(C,1+\phi L_G - L)+V(L_G,G)]\exp(-\rho t)\,dt =$$

$$\int_0^\infty [(1-\Gamma)\log(C)+\Gamma\log(1+\phi L_G - L)+V(L_G,G)]\exp(-\rho t)\,dt,\ \ 0<\Gamma<1 \quad (1)$$

where C, L, L_G, and G denote private consumption, labour supply, public employment and public spending on market goods (public consumption), respectively, and ρ is the pure rate of time preference. We assume perfect substitutability between private and public provision of child care, health care, education and security. More public employment thus means that households spend less time on nursing, teaching and safe-guarding themselves and their next of kin, so that they have more time available for leisure and work ($\phi>0$). It may be possible that the public sector benefits from economies of scale in which case $\phi>1$. For example, one child minder may release three people to enter the paid labour force. People may also get direct utility from public employment. We assume that utility $U(.)$ is logarithmic in private consumption and leisure and separable in public consumption and public employment. Private saving of financial assets equals interest income plus after-tax wage income plus tax credits T minus private consumption, that is

$$dA/dt \ = \ RA \ + \ (1\text{-}\tau)\,WL \ + \ T \ \text{-} \ C \qquad (2)$$

where W and R denote the wage rate and the interest rate, respectively, τ stands for the labour income tax rate and tax credits, respectively, and A denotes financial assets held by households.

The tax system is progressive if $T>0$ and becomes less progressive if the labour income tax rate and tax credits are cut together. The coefficient of residual income progression S shows the percentage change in after-tax income resulting from a one per cent change in before-tax income It is given by $S = (1\text{-}\tau)/(1\text{-}\tau_A)$ where $\tau_A \equiv \tau\text{-}T/WL$ is the average tax rate and τt the

marginal tax rate. A progressive tax system has $\tau > \tau_A$, $T>0$ and $S<1$. Increasing tax progression by cutting both τ and T and leaving τ_A unaffected, reduces S.

Households maximize utility (1) subject to their budget constraint (2) taking public employment and public consumption as given. Dividing the marginal utility of private consumption by the marginal utility of money income λ, we find the marginal value of private consumption in terms of resource units. This must equal the relative price of private consumption goods, so that $(1-\Gamma)/C\lambda = 1$. Similarly, the disutility of labour in resource units must equal the marginal after-tax wage, that is $\Gamma/(1+\phi L_G - L)\lambda = (1-\tau)W$. Eliminating λ we find that households set the marginal rate of substitution between private consumption and leisure to the after-tax wage. This yields an expression for labour supply in terms of private consumption:

$$ U_{1+\phi L_G - L}/U_C = (1-\tau)W \;\Rightarrow\; L = 1 + \phi L_G - \gamma C/(1-\tau)W, \;\; \gamma \equiv \Gamma/(1-\Gamma) > 0 \quad (3) $$

Equation (3) is an unconventional expression for labour supply in that it depends on private consumption. It only captures the substitution effect in labour supply: a higher after-tax wage encourages households to substitute leisure for consumption and thus supply more labour. More public employment gives households more time and thus labour supply is larger as well. A higher level of private wealth or consumption implies more leisure and lower labour supply.

In steady state (2) gives $C=(1-\tau)WL+T+RA$, so a more conventional (steady-state) expression for labour supply is $L=[1+\phi L_G-\gamma(RA+T)/(1-\tau)W]/(1+\gamma)$. With Cobb-Douglas preferences the substitution effect exactly offsets the income effect, so the marginal after-tax wage does not affect labour supply directly. If households have income from interest or tax credits, households consume more leisure and work less. In that case a higher after-tax wage boosts labour supply.

Growth in private consumption is determined by the Ramsey rule, $dC/Cdt=-d\lambda/\lambda dt=R-\rho$, so a high interest rate relative to the rate of time preference induces households to save more. Private firms face a constant-to-returns production function $F(K,L_P)$, where K is the capital stock and L_P private employment. In contrast to Ardagna (2001) and Pappa (2004) we assume that public employment does not affect the productivity of private capital. Instead, we assume that more public employment makes it easier for households to spend less time working at home and more time working in the private labour market. Obviously, if public employment did boost the productivity of private capital, rolling back public employment is more likely to depress employment and output. Capital accumulation follows from $dK/dt=I-\delta K$, where I denotes private

investment and δ the depreciation rate. Firms choose employment and investment to maximize the stock market value of their firm, i.e., the present value of current and future profits, so the marginal productivity of capital and labour equal the user cost of capital and the producer wage, respectively. This gives the conditional demand for labour and the factor price frontier:

$$F_{L_P} = W \implies L_P = K l(W), \ l' < 0 \tag{4}$$

$$F_K(1, l(W)) \equiv g(W) = R + \delta \implies R = h(W) - \delta, \ h' < 0 \tag{5}$$

Both labour demand in the private sector and the interest rate fall if the wage rises.

We assume that the wage adjusts to clear the labour market, so that labour supply matches the sum of private and public demand for labour:

$$L = 1 + \phi L_G - \gamma C /(1-\tau)W = K l(W) + L_G \implies W = W(\overset{+}{K}, \overset{+}{C}, \overset{+}{L_G}, \overset{+}{\tau}) \tag{6}$$

where

$$W_K = l / \Delta > 0, \qquad W_C = \gamma /(1-\tau)W\Delta > 0,$$

$$W_{L_G} = (1-\phi)/\Delta > 0 \quad if \quad \phi < 1, \qquad W_\tau = [C /(1-\tau)]W_C > 0$$

and $\Delta \equiv -Kl' + \gamma C/(1-\tau)W^2 > 0$. If the steady-state expression for private consumption is substituted, the market-clearing wage depends on $RA+T$ (instead of C) as well as on K, L and τ. In particular, if income from interest and tax credits $RA+T$ increase, labour supply falls and the market-clearing wage rises in steady state. We use, however, the slightly unconventional expression for the market-clearing wage (6), which depends on the level of private consumption.

The following factors determine the market-clearing levels of the wage and employment. First, a higher capital stock pushes up private demand for labour and thus exerts upward wage pressure and boosts labour supply. Alternatively, a higher capital stock implies a greater 'ability to pay' and thus a higher wage. Second, higher private consumption depresses labour supply and pushes up the wage. Effectively, this corresponds to higher household wealth so people work less and the wage rises to clear the labour market. Third, if $\phi < 1$, more public employment induces excess demand for labour, which pushes up the wage. The rise in the wage is attenuated if public sector employment generates more private time for households and allows a bigger labour supply.

In that case, the initial excess demand for labour is smaller and thus the rise in the wage is smaller. Clearly, if $\phi>1$, an extra public employee releases more than one people into the paid labour force of the private sector and thus induces excess supply of labour. Consequently, the wage falls. If $\phi=1$, changes in public sector employment do not affect the market-clearing wage at all. Fourth, a higher labour income tax rate lowers the after-tax wage and thus lowers labour supply. The resulting excess demand for labour is choked off by a rise in the wage.

Public spending on market goods, public employment and tax credits must be financed by taxes on labour income:

$$G + W\,L_G + T = \tau\ W\,[1 + \phi L_G - \gamma\ C/(1-\tau)W] = \tau W\,L \tag{7}$$

Production equals total demand for goods by households, government and firms, $F(K,L_P)=C+I+G$. Household assets consist of equity only, $A=K$. With lump-sum finance of public spending, tax credits T adjust and follow residually from the government budget constraint. Alternatively, the labour income tax rate τ adjusts to balance the government budget.

3. Consequences of scrapping public employment and cutting public consumption

The macroeconomic effects of changes in public employment and public consumption with T as residual mode of government finance follow from the reduced-form dynamic system:

$$dK/dt = K\,F(1,l(W(K,C,L_G,\tau))) - C - G - \delta\,K, \quad K(0)=K_0 \tag{8}$$

$$dC/dt = [h(W(K,C,L_G,\tau)) - \delta - \rho]C \tag{9}$$

Since K is predetermined and C jumps, the system displays saddle-point stability and requires a negative determinant of the Jacobian. The steady-state interest rate equals the rate of time preference, so the wage rate and the labour-capital intensity are unaffected by government policy in the long run ($r^o=\rho$, $W^o=h^{-1}(\rho-\delta)$). Government policy impinges on the scale variables capital and private consumption. If the tax falls on capital income, the steady-state interest rate and wage also depend on government policy. The long-run effects on capital and private consumption can be calculated from the steady state of (8) and (9), that is by applying Cramer's rule to the equations $KF(1,l(W^o)) = C + G + \delta K$ and $W(K,C,L_G,\tau) = W^o$. This yields:

$$\partial K^o/\partial G = W_C/\Delta' > 0,\ \ \partial K^o/\partial \tau = -W_\tau/\Delta' < 0,\ \ \partial K^o/\partial L_G = -W_{L_G}/\Delta' < 0\ \textit{if}\ \phi<1$$
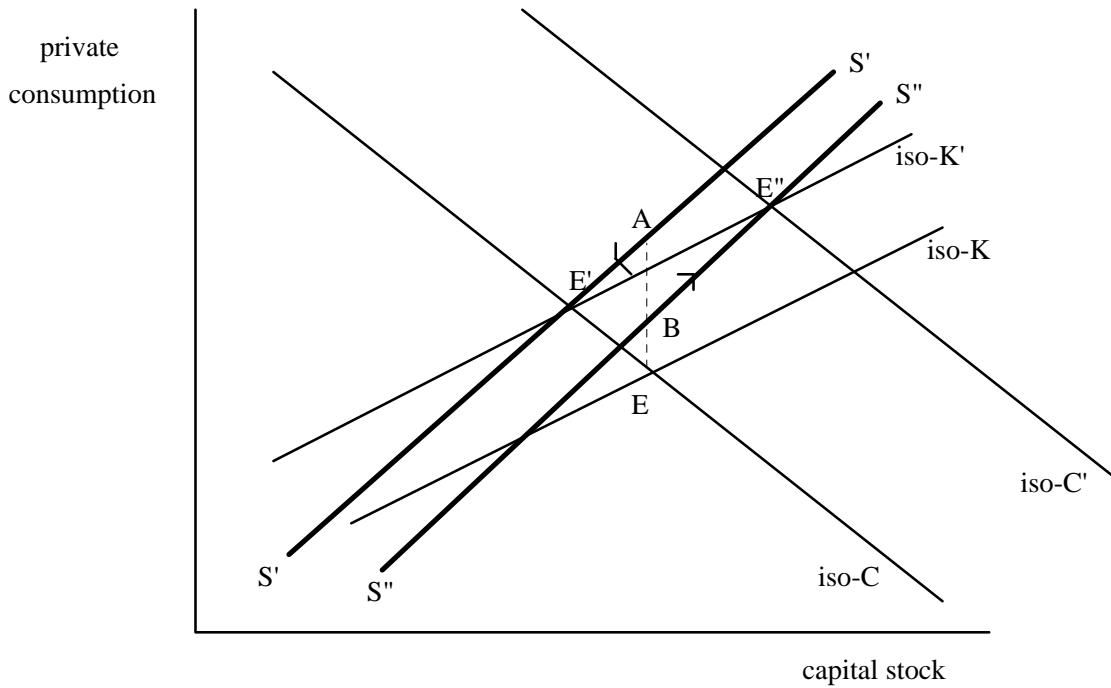
$$(10)$$

$$\partial C^{o} / \partial G = -W_{K} / \Delta' < 0, \quad \partial C^{o} / \partial \tau = -W_{\tau} Y / K \Delta' < 0, \quad \partial C^{o} / \partial L_{G} = -W_{L_{G}} Y / K \Delta' < 0 \; if \; \phi < 1$$

$$(11)$$

where $\Delta' \equiv W_{C} Y / K + W_{K} > 0$. Hence, higher public spending on market goods boosts the long-run capital stock and reduces private consumption but a higher tax rate depresses long-run capital and raises private consumption. If $\phi < 1$, higher public employment tends to push up the wage and thus depresses long-run levels of private consumption and capital. However, if $\phi > 1$, public employment releases more labour for the private sector and the wage tends to fall. In that case, steady-state levels of private consumption and capital will rise. If $\phi = 1$, public employment does not affect long-run levels of private consumption and capital.

Fig. 1 gives the phase-plane diagram. The iso-K locus slopes upwards, since higher aggregate demand induced by more private consumption requires higher aggregate supply induced by more capital. The iso-C locus corresponds to $R = \rho$ and slopes downwards. Effectively, a higher capital stock implies a higher wage and lower interest rate. This requires lower levels of private consumption and private wealth, so that labour supply is boosted and the wage is pushed down again to maintain constant W and thus constant R and C.
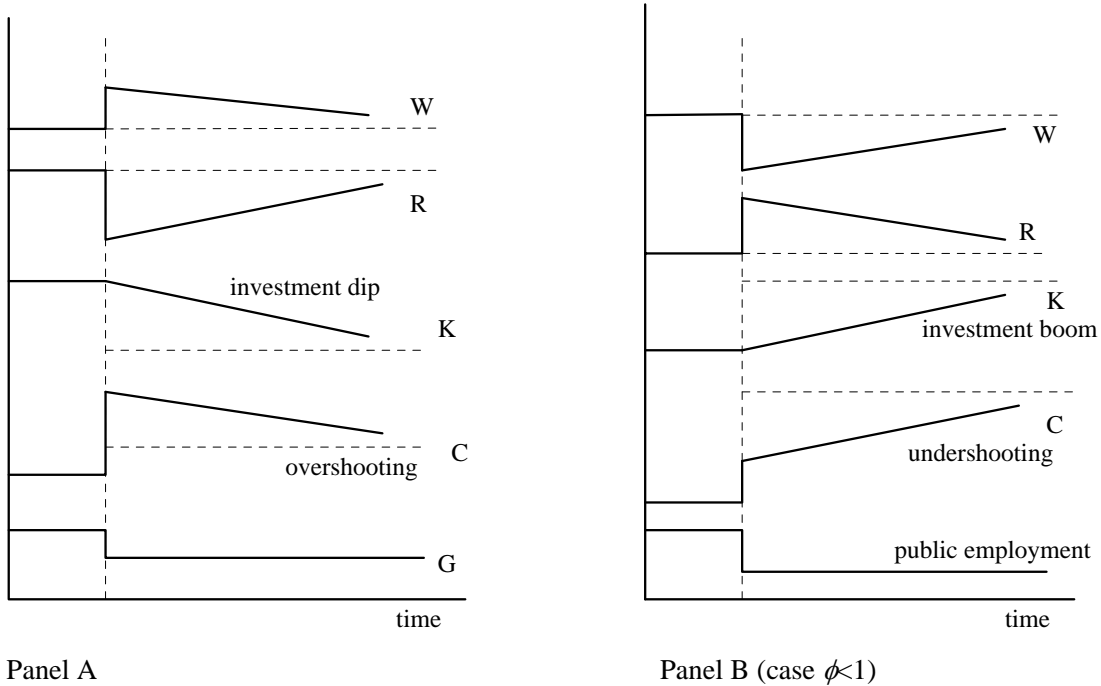
A cut in public spending on market goods gives rise to the path EAE' in Fig. 1. The associated boost to tax credits gives households more to spend, so private consumption rises on impact. In fact, Fig. 1 shows that private consumption overshoots its steady-state value on impact and subsequently falls. The short-run boost to private consumption thus exceeds the long-run boost. Since households prefer consumption now to consumption tomorrow and dissave in the transient phase, there is a temporary dip in the interest rate and an associated temporary hike in the wage rate. This induces firms to lower their capital intensity and to invest less, so the boost to private consumption exceeds the cut in public consumption. The short-run rise in the wage depresses labour demand. Labour supply on impact falls, since households become wealthier due to the extra tax credits. Employment falls both on impact and in the long run.

Key: Cut in public consumption gives the path EAE′ and cut in public employment gives for the case $\phi<1$ the path EBE″

Fig. 1. Phase diagram for Ramsey growth model with public and private employment

The effects of a cut in public employment for the case $\phi<1$ are given by the path EBE″. If the government withdraws from the labour market, it causes excess supply of labour and induces downward wage pressure. The increase in tax credits raises private wealth, and depresses labour supply by less than the fall in public employment. The remaining excess supply of labour is choked off by a lower wage. As a result, firms prefer to use relatively more labour and lower their capital intensity. This pushes up the marginal productivity of capital and the interest rate, which induces firms to invest and households to save. The transient effects are as follows: private consumption rises further to its new steady-state value and the capital stock rises also until the interest rate and the wage rate are back to their old equilibrium values. Private employment rises both in the short and long run. Labour supply falls, since private consumption and wealth increase and less time is available as people now have to spend time on matters the public sector previously provided for. Hence, in the long run the increase in private employment is insufficient to offset the fall in public employment and total employment falls.

Panel A   Panel B (case $\phi<1$)

Fig. 2. Contrasting a cut in public consumption with a cut in public employment

if saved public revenues are handed back as extra tax credits

The effects of cuts in public consumption and public employment are contrasted and summarized in Fig. 2. A cut in public spending on market goods thus leads to a fall in investment and employment – see panel A. In contrast, scrapping public employment induces an investment boom and extra jobs in the private sector (but not as many as are lost in the public sector) – see panel B. The case where a cut in public employment leads to a more than proportionate withdrawal of labour for the private sector, $\phi>1$, leads to a complete reversal of the results in panel B of Fig.2. There is thus a temporary rise in the wage and fall in the interest rate leading to a fall in investment and a lower steady-state capital stock. Private consumption falls on impact and falls subsequently further to its new equilibrium value.

If labour supply is inelastic, $\gamma = 0$, $L = 1 + \phi L_G$ so that the market-clearing wage $W(.)$ and the equilibrium interest rate do not depend on private consumption or the labour income tax rate. Hence, the iso-C locus is vertical (as in the standard Ramsey growth model). Since labour supply is inelastic, a cut in the labour income tax rate associated with lower tax credits (a less progressive tax system) does not affect real outcomes. A cut in public spending on market goods is immediately offset by a corresponding 100% increase in private consumption, so the real wage, the interest rate, employment and investment are unaffected. However, if labour supply is

inelastic, a cut in public employment still leads to a boom in saving and investment, a larger capital stock, extra private sector jobs and higher private consumption provided $\phi < 1$. Of course, if $\phi > 1$, there is a fall in capital, private consumption and private sector employment. The effects of changes in public employment are thus 'first order', but those of public spending on market goods are 'second order'.

Fig. 1 can also be used to derive the consequences of an expected future cut in public consumption or public employment combined with a corresponding expected future cut in taxes. What happens is that in the announcement period before rolling back the public sector people expect a future tax cut and thus private consumption rises in anticipation. It is also possible to use Fig. 1 to investigate what happens if cuts in taxes and spending are temporary. Private consumption then jumps on impact only part of the way. To analyse the effects of unbalanced budget changes in taxes and government spending requires taking account of the dynamics of government debt and is beyond the scope of our analytical approach.

4. Three ways of rolling back the welfare state and cutting the labour income tax rate
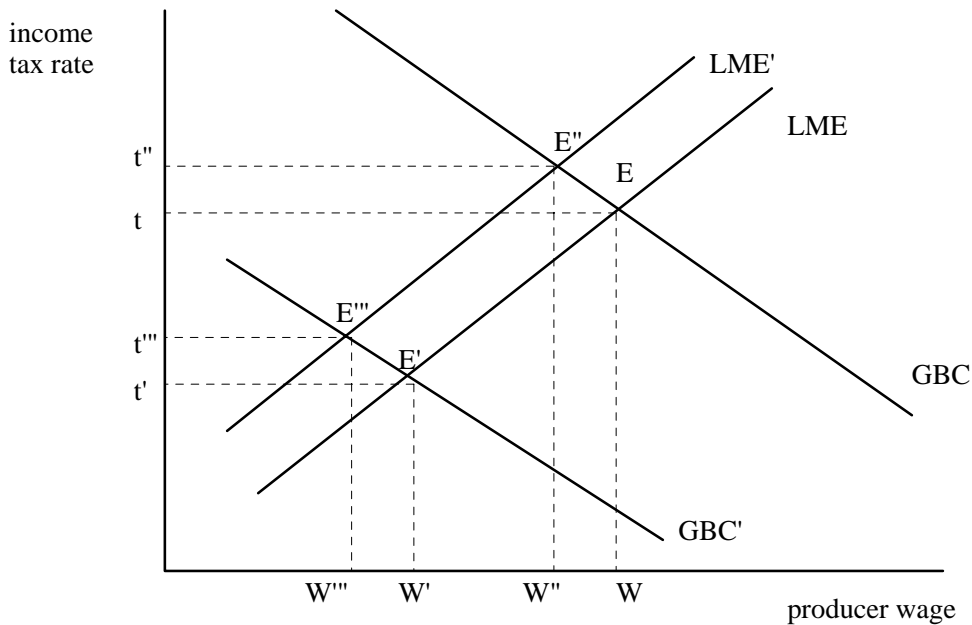
Many politicians want to roll back the welfare state to permit cuts in tax rates and thus improve incentives to work and produce. Three ways of doing this are: (1) cutting public spending on market goods; (2) reducing public employment; and (3) cutting tax credits and making the tax system less progressive. In each case the savings in public spending are handed back to the public by lowering the labour income tax rate. To obtain the macroeconomic effects, we solve for τ and W simultaneously from the government budget constraint or GBC (7) and the market-clearing wage (6) – see Fig. 3. The LME-locus described by $W=W(K,C,L_G,\tau)$ slopes upwards, because a high tax rate implies low labour supply and thus requires a high wage to get rid of the excess labour demand. The LME-locus shifts up if private demand for labour falls (lower K), if public employment falls and $\phi < 1$, and if labour supply rises when private wealth (and C) falls. A lower wage or a higher tax rate must then choke of the excess supply of labour. If $\phi < 1$, lower public employment leads to a more than proportionate withdrawal of labour from the private sector and thus the LME-locus shifts down.

Total differentiation of the government budget constraint (7) yields:

$$d(G+T) + (1-\phi\tau)W\,dL_G = WL(1-\tau'\varepsilon)\,d\tau + (\varepsilon\tau WL + G + T)\,dW/W - \gamma\tau'dC \qquad (12)$$

where $\tau' \equiv \tau/(1-\tau)$. The (compensated) wage elasticity of labour supply for a given level of private

consumption can be calculated from (3), that is $\varepsilon \equiv \mathrm{dlog}(L)/\mathrm{dlog}((1-\tau)W) = (1+\phi L_G - L/L > 0$. The left-hand side of (12) shows changes in the costs of public spending on market goods, tax credits and public employment, *minus* the effect of tax base erosion due to lower labour supply caused by higher public employment. The first term on the right-hand side of (12) shows the direct tax rate effect *minus* the indirect effect of tax base erosion due to the adverse effect of a higher tax rate on labour supply. The second term on the right-hand side of (12) gives the direct tax base *plus* indirect tax base (due to higher labour supply) *minus* the labour costs of public employment of a rise in the wage rate on public revenues. The third term shows the negative effect of higher private wealth and consumption on labour supply and tax revenues.

Key: lower *G* or *T* gives E′; lower *K* gives E″; lower *C* gives E‴; and lower L_G gives E‴ if $\phi<1$

Fig. 3. Solving for the labour income tax rate and wage rate

We assume that the economy is on the upward-sloping part of the Laffer curve, so that tax revenues are increasing function in the tax rate. This requires that the tax rate and the uncompensated wage elasticity of labour supply are not too large (i.e., $\tau' \varepsilon < 1$). In that case, the GBC-locus representing (12) slopes downwards. The GBC-locus shifts down if public consumption, public employment or tax credits are cut back. Effectively, a lower tax rate or a lower tax base then meets the lesser need for public revenue. The GBC-locus also shifts down if private consumption falls. The resulting boost to labour supply raises the tax base and thus

permits a cut in the tax rate.

Using the LME-locus (6) and the GBC-locus (12) to solve for the wage and the tax rate:

$$W = W *(\overset{+}{K}, \overset{+}{C}, \overset{+}{L_G}, \overset{+}{G+T}), \qquad \tau = \tau(\overset{-}{K}, \overset{?}{C}, \overset{(+)}{L_G}, \overset{+}{G+T}) \qquad (13)$$

where

$$W_K^* = W_K WL(1-\tau'\varepsilon)/\Delta" > 0, \quad W_{L_G}^* = [(1-\phi\tau)WW_\tau + W_{L_G}WL(1-\tau'\varepsilon)]/\Delta"(>)0$$

$$W_C^* = W_C WL[1-\tau'\varepsilon + \gamma\tau'C/(1-\tau)WL]/\Delta" > 0, \quad W_{G+T} = W_\tau/\Delta" > 0$$

$$\tau_K = -W_K(G+T+\varepsilon\tau WL)/\Delta"W < 0, \quad \tau_{L_G} = [(1-\phi\tau)W - (G+T+\varepsilon\tau WL)W_{L_G}/W]/\Delta"(>0)$$

$$\tau_C = \gamma[\tau' - (\varepsilon\tau WL+G+T)/(1-\tau)W^2\Delta]/\Delta", \quad \tau_{G+T} = 1/\Delta" > 0$$

and $\Delta" \equiv [\tau L(1+\varepsilon)-L_G]W_\tau + WL(1-\tau'\varepsilon) > 0$. Cutting back tax credits T or public consumption G shifts back the GBC-locus. It permits a cut in the labour income tax rate τ which boosts labour supply. To clear the labour market, the wage falls (shift from E to E′). A lower capital stock K shifts up the LME-locus. The implied fall in labour demand pushes down the wage, which depresses labour supply and the tax base. The tax rate must thus rise to balance the government budget (shift from E to E″).

A fall in private wealth and consumption boosts labour supply and has two effects. First, it requires a lower wage or a higher tax rate to clear the labour market, so the LME-locus shifts up. Second, the bigger tax base yields more public revenue and thus permits a cut in the tax rate or a lower wage to balance the government's books again. Consequently, the GBC-locus shifts back. Although the wage falls unambiguously, the net effect on the tax rate is unclear. If the shift in the GBC-locus dominates the shift in the LME-locus, the result is a cut in the tax rate (shift from E to E‴). Lower public employment L_G also shifts back the GBC-locus and, if $\phi<1$, shifts up the LME-locus. It then causes an excess supply of labour, which is removed by a lower wage and a higher tax rate. The saved public revenue, however, permits a lower tax base, i.e., lower wage, and a lower tax rate. The net result is that the wage rises and, provided $G+T$ and t are not too large, the tax rate falls.

With $\phi>1$ cutting public employment means that more than proportionally private labour supply is withdrawn. This exerts upward pressure on the wage, that is $W_{L_G} < 0$. The tax base will

be bigger, so the tax rate can be lower. In other words, with $\phi>1$ the LME-locus shifts down so that the wage will fall less and may even rise while the tax rate will unambiguously fall – see also the partial derivatives of expression (13). For the sake of exposition only, we will assume, even if $\phi>1$ and $W_{L_G} < 0$, that $W^*_{L_G} > 0$. In other words, the wage will fall less than with $\phi<1$ but will not rise after a cut in public employment. The main effect is thus the downward wage pressure arising from the lower tax rate made possible by the cut in public employment rather than the upward pressure from the induced excess demand for labour.

The general equilibrium comparative dynamics follow from the reduced-form system:

$$dK / dt = K\, F(1, l(W^*(K, C, L_G, G+T)) - C - G - \delta\, K \qquad (14)$$

$$dC / dt = [h(W^*(K, C, L_G, G+T)) + \delta - \rho]C \qquad (15)$$

This system exhibits saddle-point stability, so the determinant of the Jacobian matrix of the above system Δ''' must be negative. Cramer's rule gives the comparative statics of the steady state:

$$\partial K^o / \partial i = -\,h'C W^*_i\, / \Delta''' < 0, \;\; i = L_G, T \qquad (16)$$

$$\partial K^o / \partial G = -\,h'C(W^*_{G+T} - W^*_C)/\Delta''' \; = \; -[h'C W_C /(1-\tau)\Delta''\Delta''']\,(RA + T + \varepsilon\tau WL) < 0 \quad (17)$$

$$\partial C^o / \partial i = -h'C W^*_i Y / K\Delta''' < 0, \;\; i = L_G, T \qquad (18)$$

$$\partial C^o / \partial G = -h'C[(Y / K)W^*_{G+T} + W^*_K]/\Delta''' < 0 \qquad (19)$$

Use has been made of the correspondence principle, that is saddle-point stability helps to sign the comparative statics results. To assess the steady-state effects of changes in public consumption on steady-state capital, one needs to use the partial derivatives of $W^*(.)$. This leads to

$$\partial K^o / \partial G = -\,\Omega\,[C - (1-\tau)WL] < 0, \;\; \partial K^o / \partial T = -\,\Omega\,C < 0 \qquad (20)$$

where Ω is a positive constant. Armed with these results, we derive the comparative dynamics

from the phase diagram. The qualitative difference with section 3 is that a cut in public spending on market goods now also leads to an investment and employment boom. The investment boom induced by the cut in the tax rate thus more than fully offsets the fall in investment caused by the cut in public consumption. Also, a cut in public employment yields a bigger investment boom if the saving in public revenue is handed back through a cut in the tax rate instead of higher tax credits. Making the tax system less progressive boosts investment as well.

If labour supply is inelastic, reducing tax progression has no real effects. Also, it does not matter whether a cut in public spending on market goods or public employment is associated with a rise in tax credits or a cut in the tax rate. Hence, the effects are as in section 3.

5. Extensions

5.1 Adjustment costs for investment

We assume zero depreciation and inelastic labour supply (i.e., $\delta=\gamma=\phi=0$). To avoid infinite investment rates, we assume convex adjustment costs $\zeta I^2/2$ where $\zeta>0$. Private investment thus rises with Tobin's marginal q, i.e., $I=(q-1)/\zeta$. Also, the marginal productivity of capital has to equal the user cost of capital, i.e., the rental charge minus capital gains:

$$F_K(1, l(W)) \equiv h(W) = R q - dq/dt \qquad (21)$$

This replaces the factor price frontier (5). Production minus adjustment costs matches aggregate demand: $h(W) - \zeta I^2/2 = C + G + I$. This gives $q = q(C+G, K, W)$ with $q_{C+G}=-\zeta<0$, $q_K>0$ and $q_W<0$. A higher wage or a lower capital stock depresses production, so leaves less room for investment and requires a smaller q. A higher aggregate demand from households or the government also leaves less room for private investment and thus demands a smaller Tobin's q.

Since conditional labour demand and the government budget constraint are unaffected, the market-clearing wage is given by $W(K, L_G)$. Upon substitution into the expression for marginal q, we obtain $q=q^*(C+G,K,L_G)$ where $q^*_{C+G}= -\zeta < 0$, $q^*_K=\zeta(Y-WL_P)/K>0$ and $q^*_{LG}>0$. Hence, Tobin's q and private investment fall if the other components of aggregate demand rise and the capital stock falls. A boost to public employment boosts wages and lowers q, so private investment is cut back. Ramsey and capital accumulation rules are unchanged.

The steady-state interest rate (ρ), investment rate (zero), Tobin's q (unity) and the wage rate ($h^{-1}(\rho)$) are unaffected by government policy. In steady state labour market clearing requires $W(K^o, L_G,) = h^{-1}(\rho)$, hence the steady-state capital stock K^o decreases if public employment goes

up or if households become more impatient. Clearing of the goods market requires in steady state $q((C^o+G)/K^o, h^{-1}(\rho))=1$, which gives C^o. This yields the same steady-state results as in sections 3 and 4. Rolling back the welfare state, in order to cut the tax rate by cutting public spending on market goods or cutting tax credits, thus depresses both steady-state private consumption and the capital stock. However, cutting back public employment lowers private consumption and raises the capital stock in the long run. Upon differentiation of $q=q^*(C+G,K,L_G)$ with respect to time and substitution into the arbitrage condition for equity, we solve for the interest rate and obtain the dynamic system:

$$dK/dt = [q^*(C\overset{-}{+}G, \overset{+}{K}, \overset{+}{L_G})-1]/\zeta \tag{22}$$

$$dC/dt = [(Y-WL_P)(q-1)/K + h(W(K,L_G)) - \rho q^*(C+G,K,L_G)]C/(q+\zeta C) \tag{23}$$

where $h(.)$ denotes the reduced-from marginal productivity of capital. The system displays saddle-point stability and the adjustment speed near steady state equals:

$$\frac{1}{2}\sqrt{\rho^2 - 4h'CW_K/(1+\zeta C)} - \frac{1}{2}\rho \tag{24}$$

The adjustment speed is smaller if the rate of time preference is larger, i.e., if consumers are more impatient and save less, and if costs of adjustment for investment are larger. Adjustment costs for investment thus reduce the adjustment speed. The qualitative insight that cutting back public spending on market goods reduces employment, capital and output is unaffected.

5.2 Non-Walrasian labour markets

Alesina et al. (2002) note that more public employment makes it easier to find a job if one cannot find a job in the private sector and that a higher public sector wage makes this option more attractive. Since the outside option improves, trade unions demand a higher wage. This induces a higher capital-labour intensity and a lower marginal productivity of capital and thus reduces private sector investment. Again, the effects of public consumption are less clear. Calmfors and Horn (1986) study one union covering both private and public sector employees and Holmlund (1997) considers two separate unions, but neither studies the effects on capital and investment. Van der Ploeg (1987) discusses credibility issues if unions have an incentive to renege and

demand higher wages once firms have invested in capital and are locked in.

Typically, the wage mark-up is high if the demand for labour is relatively inelastic. Consequently, if public employment is exogenous and does not depend on the wage, the effective wage elasticity of labour is low if public employment is high relative to private sector employment. In that case, the wage mark-up is high. Also, cutting public employment has the additional effect of reducing monopoly power in the labour market. The result is a further reduction in the wage and rise in the interest rate, thus giving rise to an even larger investment boom.

Non-Walrasian labour markets may arise from efficiency wages if firms pay more than the market-clearing wage to recruit, motivate, discipline and/or retain workers - e.g., Shapiro and Stiglitz (1984). They also arise from costly search and imperfect matching on the labour market - e.g., Pissarides (1990). In that case, a reduction in tax progression *raises* the pre-tax wage and reduces employment – see Lockwood and Manning (1993) and van der Ploeg (2003). Under a progressive tax system it is not attractive to bargain for higher pre-tax wages, because part of the gain will be taxed away. Since the higher pre-tax wage implies a lower interest rate, less tax progression reduces saving and investment as well. This further reduces employment.

Atkinson (2001, Chapter 4) and van der Ploeg (2003) show within the context of a shirking model of efficiency wages that cutting *conditional* unemployment benefits lowers employment and increases unemployment – also see Atkinson and Micklewright (1991). This surprising result occurs, because unemployed are only entitled to benefits if they have been dismissed without fault of their own and not if they have been sacked for shirking or other forms of misconduct. In that case, a lower level of conditional benefits reduces the penalty for shirking and other forms of misconduct so firms need to pay more to discipline and motivate workers. Rolling back the welfare state by cutting conditional unemployment benefits thus harms employment. In contrast, cutting unconditional benefits (e.g., welfare assistance) can lower unemployment.
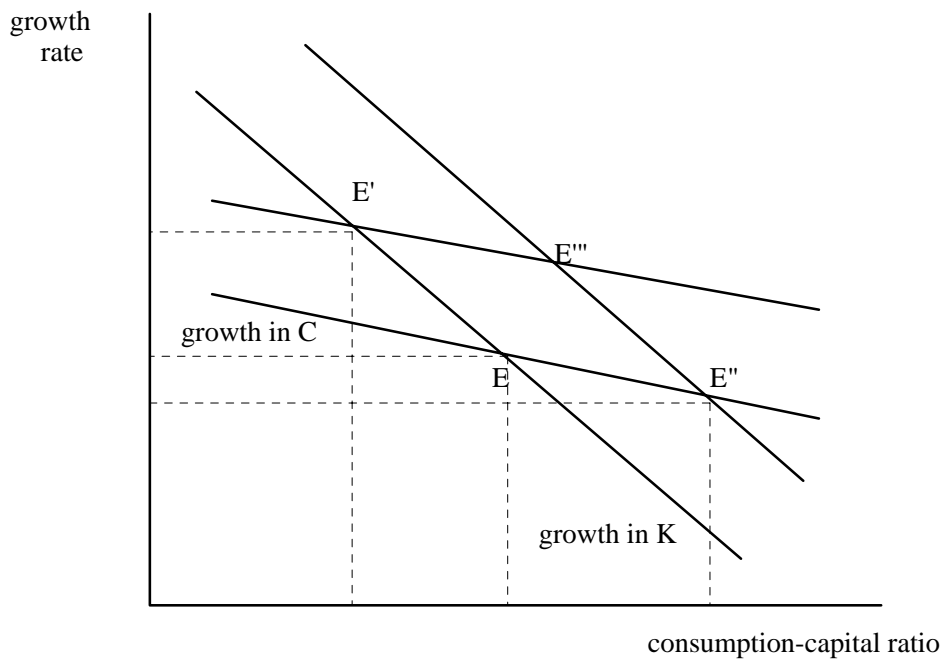
5.3 Endogenous growth

With a broad definition of capital, including human capital and knowledge spillovers in production, the effectiveness of labour increases with the economy-wide capital stock K' - e.g., Barro and Sala-i-Martin (1999, chapter 4). The production function is then $F(K, K' L_P)$. Individual firms take the economy-wide capital stock as given and still face constant returns to capital and labour. Equilibrium requires $K=K'$. Labour demand, the interest rate and the output-capital ratio are now negative functions of the ratio of the wage rate to the capital stock: $L_P=l(W/K)$,

R=h(W/K)-δ and *Y/K=F(1,l(W/K))*. The wage that clears the labour market can be written as *W/K=Π(C/K,L_G,t)* with *Π_i > 0*, all *i* and *Π_{C/K}<1*. The dynamics is described by one unstable differential equation for *C/K*, since *C/K* is a jump variable. For unanticipated permanent changes in policy the economy immediately moves to its new steady state. The growth rate of the economy *γ* and the equilibrium consumption-capital *C/K* ratio follow from the expressions for the growth rate in capital (goods market equilibrium) and the growth rate in private consumption (the Ramsey rule), respectively:

$$\frac{dK/dt}{K} = F(1,l(\Pi(C/K,L_G,\tau))) - C/K - \delta - G/K = \frac{dC/dt}{C} = h(\Pi(C/K,L_G,\tau)) - \rho$$

(25)

Fig. 4 shows the comparative statics. More impatience (higher *ρ*) boosts private consumption, depresses employment and lowers economic growth (shift from E to E'). The interest rate falls and the wage-capital ratio rises. A cut in public spending on market goods relative to the capital stock leads to a bigger ratio of private consumption to financial assets and lower economic growth (shift from E to E"). The rise in the wage-capital ratio and the corresponding fall in the interest rate depress saving, investment and economic growth and lower private employment. These are, in contrast to before, permanent rather than temporary effects.

Key: more impatience gives E′; lower *G/K* gives E″; and lower L_G gives E‴

Fig. 4. Endogenous growth and rolling back the welfare state

A cut in public employment induces very different results. It leads to a fall in the wage-capital ratio, a rise in the interest rate and thus to a boost to saving, investment and the growth rate (shift from E to E‴). Private sector employment increases, but is insufficient to make up for the loss of jobs in the public sector. A less progressive tax system also reduces the wage-capital ratio and raises the interest rate, hence leads to a boost to the growth rate and employment.

6. Concluding remarks

It matters how *one* rolls back the welfare state. If labour supply is inelastic, cutting public expenditures on market goods leads to immediate 100% crowding out of private consumption and thus leaves investment and capital accumulation, on the one hand, and wages and employment, on the other hand, unaffected. If labour supply is elastic, there is a temporary wage hike and a corresponding dip in the employment-capital ratio. The associated dip in the marginal productivity of capital and the interest rate depress saving and private investment. In the short run there is more than 100% crowding out of private consumption. In the long run the lower capital stock depresses labour demand and the extra wealth of households reduces labour supply, hence long-run employment falls.

Firing public employees leads to temporary wage moderation and a lower capital intensity provided the fall in public employment induces a less than proportionate increase in private labour supply. The temporary hike in the interest rate boosts private saving and investment, thus raising capital in the long run. In the short run there is less than 100% crowding out of private consumption. In the long run the output effect boosts private-sector labour demand while the wealth effect depresses labour supply. The fall in public sector employment is in the long run thus not fully offset by the rise in private sector employment. Attempts to hire more nurses, teachers and police personnel in a tight labour market contribute to higher wages and lower interest rates, thus reducing incentives to save and depressing private investment. In the end employment increases, because the fall in private employment does not fully offset the gain in public employment. These results for changes in public employment hold even if labour supply is inelastic. This suggests that changes in public employment have 'first-order' welfare effects, but changes in public spending on market goods have 'second-order' welfare effects. Cuts in public employment, in contrast to cuts in public spending on market goods, produce non-Keynesian

effects in the sense that a fiscal contraction induces higher growth and more private sector employment. Note that if the fall in public employment releases enough labour from child care, cleaning, etc. to induce a more than proportionate increase in private employment, the results for cutting back public employment are reversed. There will be a temporary fall in the interest wage and boost in the wage and a fall in private saving and investment. The result is a lower capital stock and lower private employment. Also, if cuts in public employment were to lower the productivity of private capital, there is more likely to be a fall in economic activity.

If the savings in public revenue are handed back to the public in the form of a lower tax rate rather than lower tax credits, there is a further fall in the pre-tax wage and rise in the interest rate. This strengthens the investment boom resulting from a cut in public employment and attenuates the fall in saving and investment resulting from a cut in public spending on market goods. If a cut in public spending on market goods is associated with a cut in the tax rate, there is now also an investment boom and increase in capital. The positive effects of the tax cut outweigh the negative effects of a cut in public spending on market goods. Reducing tax progression by cutting both the labour income tax rate and tax credits, lowers the pre-tax wage and pushes up the interest rate. This results in a short-run and long-run gain in employment and a boost to saving and investment.

Adjustment costs of investment do not alter the steady-state comparative statics, but do slow down the adjustment speed towards the steady state. If there are economy-wide knowledge spillover effects in production, the possibility of endogenous growth arises. In that case, cuts in public employment and a more progressive tax system give rise to permanent boosts to the rate of economic growth. Conversely, cuts in the ratio of public spending on market goods to capital depress economic growth. The optimal ratio of public spending to capital declines if society becomes more patient and attaches less preference for such spending. In the latter case, public employment rises and the tax rate falls. The resulting upward wage pressure lowers private employment. It also reduces the interest rate and thus lowers incentive to save and invest. The net effect on the rate of economic growth is, however, positive due to the fall in the tax rate on capital.

With imperfect labour markets the differential effects of cuts in public employment and public spending on market goods are qualitatively unchanged. However, the qualitative effects of a reduction in tax progression are markedly changed. Now unions have less of an incentive to moderate wages and thus employment falls. The resulting boost to the pre-tax wage induces a fall in the interest rate, so that saving and investment fall. The resulting reduction in the capital stock further reduces employment.

To understand the macroeconomic effects on growth and employment of fiscal contractions one must be specific how it is done. Rolling back the welfare state by cutting public employment induces non-Keynesian booms to employment and investment. However, cutting public expenditures on market goods depresses employment and investment unless the saved public revenue is used to cut the distortionary tax rate on labour income. Making the tax system more progressive and cutting conditional unemployment benefits boost employment and growth in a Walrasian labour market, but can lower employment and growth in non-Walrasian labour markets.

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