On the Relation between Government Size and Economic Development: Some Methodological and Econometric Remarks

by

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Summary

First, the problem of defining the government size and theoretical considerations about the relation between this size and economic growth are discussed. Then the international empirical literature is reviewed. It does not come to firm conclusions. One reason for this is that in international cross-section as well as panel analyses the simultaneity problem is extremely tricky. This holds even more if states in a federal country are investigated. Using two examples, and international panel and a panel of Swiss cantons, it is shown that taking account of the simultaneity by using long lags for the government share changes former seemingly significantly negative to insignificant results. The paper concludes with a summary and some remarks about possible consequences for economic policy.

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1 Introduction

The relation between government activity and economic development is a problem of scientific interest and at the same time of political relevance. This especially holds in a situation like the current Swiss one: Switzerland exhibits since the nineties rather low economic growth and at the same time an increasing government share. Those who want – for ideological reasons – reduce government activity have a personal interest in 'proving' a negative relationship,[1)] while those who want to extent government activity deny such a relation.[2)] As has been demonstrated by others and will be shown below again, with clever manipulations it is possible to 'prove' nearly any relation between government activity and economic development.

However, the political quarrel already starts with the definition of the government share. This is independent of whether we take revenue or expenditure as measure for economic activity. A government share which – compared with the ones of other countries – is high, suggests need for political action, a low one not. As an example: The OECD reports for Switzerland and the year 2001 a government share (general government total outlays) of 34.8 percent and a revenue share (total tax and non-tax receipts) of 35.6 percent, while J.-E. LANE (2002) presents for the same year estimates of 63.1 percent and 58.5 percent, respectively.[3)] Estimates of these shares can hardly be wider apart.

It is in fact rather difficult to construct an internationally comparable indicator of government activity. These difficulties mainly stem from the different constructions of the social security systems. Should, e.g., the second column of the Swiss old age pension system be counted in the same way as the German system. Both are mandatory insurances, but the German solution is a public insurance financed by a pay-as-you-go system, while Switzerland uses private, capital based insurances. And how is the health insurance system to be counted? The United Kingdom has a public tax financed system, Germany has a system with publicly regulated private insurances with income dependent premiums, while Switzerland also uses a system of publicly regulated private insurances but does not have a direct dependence of the premiums on income. Depending on whether you add the expenditure for these insurances to the government share or not you will get quite different values for the Swiss share.[4)]

Despite the fact that an ever increasing government share will destroy economic growth in the end, a high government share does not necessarily to be evaluated negatively. Even if most

1. See, e.g., P. BRINER, Den Schwung nicht abwürgen: Kontinuität in der Wirtschaftspolitik, FDP-Pressedienst Nr: 2 of January 11, 2001. (http://www.fdp.ch/page/content/index.asp_Q_Menu_E_2_A_Item_E_1.3.2_A_ID_E_1592_A_ConID_E_1592_A_View_E_ (11/11/05))
2. See, e.g., R. STRAHM (2005).
3. According to the OECD definition the government share (general government total outlays) contains total current and capital outlays. The revenue share (total tax and non-tax receipts) includes property income, fees, charges, sales, fines, capital transfers, etc. Data refer to general government; they consist of the consolidated accounts of central, state (cantonal) and local government as well as social security. See for this OECD, *Economic Outlook* II/2004, Appendix, Table 25f. (pp. 192f.).
4. For the problem of estimating the Swiss government share see also A. RAUNER (2002).

economists in the Anglo-Saxon and German speaking countries are advocates of a reduction of the welfare state and, therefore, support a reduction of the government's share, there are also reputable economists who attribute a positive effect on economic growth to the welfare state.[5)] Moreover, there is empirical evidence that economies with a higher government share exhibit less cyclical fluctuation.[6)] Moreover, the welfare-maximising government share might generally be higher than the growth maximising one.[7)]

Another aspect is the relation between social capital and economic growth. There is considerable evidence that social capital is an important factor favouring economic growth. Insofar as public expenditure encourages the building of social capital it will also contribute to economic growth.[8)]

How high the optimal government's share is, depends finally on the model of the welfare state which is accepted in a society. As the Scandinavian countries show, a high government's share might be accepted and compatible with reasonable economic growth if the government provides efficiently the corresponding services. Well developed and heavily subsidised public child care which better allows women to have children and to pursue a professional career can not only lead to higher birth rates (and, therefore, to a tempering of the demographic problem) but also to a higher participation rate of women.[9)] In such a situation citizens are willing to accept relatively high taxes. If, on the other hand, such services are not provided by the government the citizens will only accept a considerably lower tax burden and, therefore, only a lower government's share.

In the following, firstly some theoretical considerations on the relation between the government's share and economic growth are presented (*Section 2*).[10)] *Section 3* gives a survey of the empirical literature about this relationship. In *Section 4* empirical and econometric problems are discussed using firstly the results of an international panel and, secondly, some estimates for Switzerland. The paper concludes with a summary and some remarks about possible consequences for economic policy (*Section 5*).

2 Some theoretical considerations

It seems to be trivial and is also to be found in endogenous growth models like, e.g., R.J. BARRO (1990), that there can hardly be a linear relation between the government's share and economic growth which would allow statements like – ceteris paribus – that economic growth is the higher the smaller the government's share is. A government's share of zero would im-

5.See, e.g., A.B. ATKINSON (1995, 1995a), J. SLEMROD (2003) or P. LINDERT (2004).

6. See for this J. ANDRÉS, R. DOMÉNECH and A. FATÁS (2004) as well as the references given there.

7. See for this, e.g., S.-H.P. LAU (1995).

8. See, e.g., R.E. HALL and CH.I. JONES (1997, 1999) or M.S. CHIN and Y.K. CHOU (2004).

9. See, e.g., P. APPS und R. REES (2004).

10. A survey of the theoretical approaches is given in M. ZAGLER and G. DÜRNECKER (2003).

ply anarchy which would hardly be favourable for economic growth. The latter also holds for a government's share of 100 or even more percent.[11)] Somewhere between these two extremes the 'optimal' government's share is located, i.e. the one which maximises economic growth.[12)] Thus, we have a kind of a Laffer-curve for the relation between government size and economic growth.[13)] The question which (only) can sensibly be asked is whether the actual share of a country is higher or lower than the optimal one. In the first situation we had a negatively sloped, in the second one a positively sloped relation. The answer to the question which relation holds can only be given by empirical research.

Ceteris paribus it can be assumed that government expenditure have a positive, at least not a negative impact on economic development. This holds for public investment but also for publicly provided services which are substitutes for insurances and which are not offered privately because of market failure.[14)] This also holds for income redistribution which, at least to a certain extent, can be seen as a productivity enhancing measure.[15)] The problem is, however, that such measures have to be financed, usually by taxes. This has – again ceteris paribus – a dampening effect on economic growth, even if such taxes (like user charges) can be interpreted as direct compensations for publicly provided services. The relevant question is the sign and the size of the net-effect. Do the positive or the negative consequences dominate? Because of the usual assumptions of decreasing marginal utility (and increasing marginal costs) it can be assumed that the negative effects dominate the more the larger the amount of publicly provided services is.

This can be illustrated by using income redistribution as an example. Part of the redistribution can be interpreted as voluntary redistribution.[16)] It would be provided even if the government would pursue no redistributional activities at all. Such redistribution might be, e.g., the results of altruistic preferences: my utility increases when the utility of others increases. It might be combined with a self-interest motivation if giving some money to others is providing a warm-glow for the donator or if there is some prestige related to the act of giving. Voluntary redistribution has, however, not to depend on the existence of altruistic preferences. High-income people might have a self-interest in a more equal distribution as it is produced by the 'pure' market. Even high-income people might be negatively affected by an income distribution which is too unequal if this leads, e.g., to increased criminal behaviour (against which they have to take additional measures) or even to an endangering of the democratic political system.

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11. A government's share of more than 100 percent compared to GDP is – theoretically – possible whenever – as usually – government expenditure include transfers.
12. Theoretically, there might also be an optimal range. This is, however, hardly plausible for theoretical reasons. It might nevertheless be the case that the curvature is rather flat near to the optimal point.
13. See for this also J. SLEMROD (1995, p. 381ff.).
14. According to H.-W. SINN (2003, pp. 66ff.) many of the publicly provided services have this character.
15. See for this G. KIRCHGÄSSNER (1995).
16. On the different motives for income redistribution see ibid, pp. 178ff.

The insurance motive might also lead to voluntary redistribution. Individuals accept to pay an insurance premium in the form of taxes if they can expect that they could profit from this kind of insurance if – for whatever reasons – their own labour or wealth income is drastically decreasing and if private insurance is impossible, e.g. because of moral hazard.[17)]

While all citizens can – in principle – agree to voluntary redistribution, this does not hold for all measures which are decided on in the democratic process (usually) by simple majority rule. And while the fiscal burden of voluntary redistributional measures has no or at best a rather small negative allocative effect, this effect can be considerable if a large minority is outvoted. Even stronger negative effects are to be expected stemming from redistribution as a result of rent-seeking activities of (small but efficient) interest groups. Such groups which do not have a chance to convince a majority of the citizens in the democratic process can try getting influence on bureaucratic or parliamentary processes and seeking in this way for rents they cannot receive on the market.[18)]

Whether the positive or negative aspects of government activity dominate finally depends on how the necessary revenue is received and to what extent this leads to distortions. There, it mainly holds that consumption taxes are less distortionary than income taxes, and that corporate income taxes are more distortionary than personal ones. Thus, the design of the tax system plays a crucial role for the economic effects of government activity.[19)]

Finally, it is open whether government activity has a long-run impact on economic growth. Neo-classical growth theory assumes that the long-run rate of economic growth is exogenously given. In such a situation, government activity has 'only' an impact on the size of GDP (per capita) but not on its long-run growth rate. Following the more recent theory of endogenous economic growth which started with P. M. ROMER (1986) government activity might also have an impact on long-run growth. How far actual economic growth is endogenous in this sense is disputed.[20)]

3 On the relation between government activity and economic growth: A survey of the empirical literature

If the effect of economic policy instruments is theoretically open, it is reasonable to look at empirical investigations. Starting point of the more recent empirical studies is R.J. BARRO (1991). He investigates the relation between the growth rate of real GDP per capita on the one hand and public consumption and public investment as a share of GDP on the other hand in a cross-section for 98 countries. He finds a negative impact of public consumption on economic

17. See for this, e.g., H.R. VARIAN (1980).

18. See for this the classical papers of G. TULLOCK (1967), A.O. KRUEGER (1974) and R. POSNER (1975), as well as the surveys of S. NITZAN (1994) and R.D. TOLLISON (1997).

19. See, e.g., Y. LEE and R.H. GORDON (2005).

20. See for this, e.g., P. EVANS (1997) or the empirical results of E.G. MENDOZA, G.M. MILESI-FERETI and P. ASEA (1997) or J.U. KIM (2003).

growth, but no relation between public investment and economic growth. Moreover, political stability supports economic growth according to his results, while market distortions hamper it.

While there have been some earlier studies on this topic,[21] this paper was the starting point of a lot of additional investigations. They did, however, not lead to an unambiguous result.[22] The first ones to show this were R. LEVINE und D. RENELT (1992).[23] As J. AGELL, TH. LINDT and H. OHLSON (1997, p. 33) show in a survey, these studies do not allow a statement whether the relation between the extent of the public sector and economic growth is "positive, negative, or not existent". They demonstrate this by showing that a clever choice of the explanatory variables can lead to any result you like. The same is shown by G. KIRCHGÄSSNER (2001) with reference to B. HEITGER (1998). The frangibility of the empirical results is also mentioned in the survey by V. TANZI and H.H. ZEE (1997, pp. 186ff.) and by J. TEMPLE (1999, p. 145). To evaluate the robustness of possible results X.X. SALA-I-MARTIN (1997) performed "millions of regressions". Among the robustly significant variables he did not find an indicator of total government activity.[24] For methodological reasons, his procedure has been criticised by C. FERNÁNDEZ, E. LEY and M.F.J. STEEL (2001) who used a Bayesian approach and by K.D. HOOVER and S.J. PEREZ (2004) as well as by D.F. HENDRY and H.-M. KROLZIG (2004) who applied the general-to-specific methodology which is the core of the LSE approach in econometrics.[25] In neither of these studies the government's share had a significant impact on economic growth.[26]

Finally, the ambiguity of the results for government activity is also shown in the meta-analysis performed by P. NIJKAMP and J. POOT (2004) who take into account 93 papers with altogether 123 meta-observations. 22 out of 41 studies which ask for it do find unambiguous results for the impact of government activity on economic growth, 7 studies find a positive impact and 12 a significantly negative one. The other results are less unambiguous, but the samples are much smaller. 11 out of 12 studies show a significant positive impact of educational expenditure, 28 of 39 studies find a positive impact of infrastructure expenditure, 6 out of 10 studies a negative impact of taxation, and 11 of 12 studies a negative impact of military expenditure.

The paper of J. AGELL, TH. LINDT and H. OHLSON (1997) has been criticised by S. FÖLSTER and M. HENREKSON (1999). They suspect that studies with international cross-sections do not

21. See for this, e.g., P.C. AFXENTIOU (1982), D. LANDAU (1983) as well as R. RAM (1986).

22. While R.J. BARRO (1991) or S. FÖLSTER and M. HENREKSON (1999, 2001) get significantly negative results, L GONG and H.-F. ZOU (2002) find a significantly positive impact of current government expenditure and S. BERALDO, D. MONTOLIO and G. TURATI (2005) of welfare expenditure on economic growth.

23. See for this also J. SLEMROD (1995).

24. S. 182. This also holds for P. KALAITZIDAKIS, T. MAMUNEAS and T. STENGOS (2002).

25. S. 182. – For description of the LSE approach see, e.g., A. PAGAN (1987) or J. CAMPOS, N.R. ERICSSON and D.F. HENDRY (2005).

26. For a critique of this paper see also J.-E. STURM and J. DE HAAN (2000). – Further econometric Problems are discussed in J. TEMPLE (2000).

find significant results because the same linear relation is supposed for rich countries with a high and poor countries with a low government share. If one takes up the idea presented above of a non-linear relation like a Laffer-curve poor countries might exhibit a positive and rich countries a negative relation. Consequently, they restrict their investigation to rich countries. However, J. AGELL, TH. LINDT and H. OHLSON (1997) only investigated OECD countries which – in an international comparison – can be considered as being rich ones. They did nevertheless not find a significant relation. S. FÖLSTER and M. HENREKSON (2001) add to their sample some other (non-OECD) countries which – according to the criteria of the authors can also be considered as rich ones, and they find the significant negative relation they search for. Such a procedure is, however, highly problematic, as especially 'influential' observations are added to a data set in order to get the empirical results which are striven for. Moreover, J. AGELL, TH. LINDT and H. OHLSON (1999) correctly mention that S. FÖLSTER and M. HENREKSON (1999) do not give sufficient consideration to the simultaneity problem between economic growth and government activity.[27)] In doing so, they mention one of the basic problems which has to be solved whenever this relation is investigated with cross-sectional, but also with panel data: How is it possible to empirically separate the relation between the government's share on economic growth from the reverse relation? To do this, instrumental variables estimators are usually employed. This is also true for their later paper in 2001. In the latest contributions to this debate J. AGELL, H. OHLSON and P.S. THOURSIE (2006) employ theoretically valid instruments and present instrumental variables estimates. They "find that the estimated partial correlation between size of the public sectors and economic growth is statistically significant and highly unstable across specifications" (p. 211). S. FÖLSTER and M. HENREKSON (2006) respond that they have never claimed to prove a causal effect and only used "the terms correlation, relationship and association to describe the link between public expenditure and GDP growth fond in the regressions" (p. 220). They also criticise that J. AGELL, H. OHLSON and P. SKOGMAN THOURSIE (2006) use extremely weak instruments, a fact, which has already been acknowledged by them. Thus, it is still questionable whether instruments are available which are really suited for this purpose.

The perhaps most interesting paper is by R. LA PORTA et al. (1999). As it might hardly be questionable that 'good' governance supports economic growth they concentrate on the quality of the government and ask for its main impact factors.[28)] Using bivariate analyses they find that a higher government share which has to be financed by higher taxes goes along with less corruption, less bureaucratic delay and a better supply of public goods. They state that "countries with more government consumption, transfers, and labour are less corrupt, they have fewer bureaucratic delays and better provision of public goods, but also higher tax rates" (p. 239). The point, however, to the fact that this result does not imply that it is generally desirable to extent government activity.

27. It is interesting to note that W.J. HENISZ (2000) finds a (sometimes significantly) negative relation between government consumption and economic growth if he estimates his growth equations for an international panel with up to 84 countries with OLS or GSL but that he gets highly significantly positive results if he employs GMM.

28. To the quality of public finances and economic growth see also A. AFONSO et al. (2005).

This paper has been criticised by P. GORDON and L. WANG (2004). They take up the simultaneity problem mentioned above. To go along with it they estimate a simultaneous equations model with indicators for economic development, the quality of political institutions and the extent of government activity as commonly endogenous variables. They find a significantly positive feedback relation between the quality of the political institutions and economic development, while the extent of government activity exhibits a positive, but far from being statistically significant impact on economic development.

There is another reason why a recent paper of D. ROMERO DE ÁVILA und R. STRAUCH (2003) is interesting. If they include both, government expenditure and taxes, as explanatory variables into their growth equation, they often find for direct taxes a significant or even highly significant positive impact on economic growth, as well as for public investment, while public consumption and transfers show a significantly negative impact. Their data set is a panel of EU member countries for the period from 1960 to 2001. Especially the results for taxes are – at a first glance – rather surprising and clearly contradict all theoretical considerations. As will be discussed below with reference to the paper by CH.A. SCHALTEGGER (2004), such results seem to indicate a dominance of the reverse causal relation from economic growth to the government's share. This again indicates that the simultaneity between these two variables might be the most important methodological problem which has to be solved whenever such relations are to be empirically investigated.

It is somewhat astonishing that there is not more attention on the non-linearity of the relation described above. Of the papers discussed so far, only the distinction between rich and poor countries by S. FÖLSTER and M. HENREKSON (1999, 2001) points to a non-linear relation. This hypothesis has, however, especially been investigated by G. KARRAS (1993, 1997). In a panel analysis for 18 countries and the period from 1968 to 1984, he comes to the conclusion that government consumption is productive, but – of course – with decreasing marginal return. Thus, the optimal rate for which it is equal to the marginal return of private consumption is about 20 percent of GDP. In G. KARRAS (1997) he considers 20 European countries for the period from 1950 to 1990. There he finds an optimal rate of government consumption of 16 percent of GDP ± 3 percent. S. MITTNIK and T. NEUMANN (2003) perform a similar analysis for Germany. They find evidence for the non-linearity hypothesis for public consumption with an optimal rate of about 18 to 19 percent of GDP. However, they do not find a significant relation between public investment and economic growth.

According to R. KNELLER, M.F. BLEANEY und N. GEMMELL (1999), the different results of the various estimations are due to the fact that the government's budget constraint is not correctly captured in most studies. Actually, only expenditure or revenue/taxes are included into the estimation equation. If the above reasoning is accepted that government expenditure should – ceteris paribus – have a positive and government revenue a negative impact on economic development and if, as it is the case, both are highly correlated, then any sign of the estimated coefficient might come up. Using a panel of 22 OECD countries from 1970 to 1995 with 5 years-intervals they show that distortionary (direct) taxes have a negative impact on economic growth, while less distortionary (indirect) taxes do not have such an effect. On the other hand,

productive government expenditure support economic growth, non-productive ones not. Of all papers presented so far these are the results which come closest to what we expect from theoretical considerations.

Whatever the effect of the size of the government share is, it is hardly disputed that high volatility of public expenditure is harmful for economic growth. A. BRUNETTI (1998) shows for different measures of monetary and fiscal policy that their volatility has a negative and often significant impact on economic growth. It holds, however, for this paper as well that the results are sensitive to the specification of the growth regressions as well as to changes of the included countries.

The result of A. BRUNETTI (1998) is largely corroborated by L. GONG und H.-F. ZOU (2002). Using a cross-section with for (depending on the specification of the model) up to 96 countries averages over the period from 1970 to 1994, they find a significantly positive impact of government expenditure on economic growth, and also a positive impact of public investment, which is, however, never significant and economically meaningless, as well as significant negative impacts of the variances of both, current public expenditure and public investment. If public expenditure are, however, divided into different sub-categories the significances vanish in most cases, and some of the signs are even reversed.

4 On the Fragility of Empirical Results

As not only the discussion between J. AGELL et al. (1997, 1999, 2006) and S. FÖLSTER and M. HENREKSON (1999, 2001, 2006) shows, the most important and perhaps also most difficult to solve problem this is the one of simultaneity: between government activity and economic growth. However, at least as long as individual countries are considered or panel analyses with fixed effects are performed, in a regression from the growth rate on the government share the (unexpected) short-run effects from the growth rate to the government share, which are negative, dominate. Take the following regression equation which is employed, e.g., in CH.A. SCHALTEGGER (2004) or CH.A. SCHALTEGGER and B. TORGLER (2004),

$$(1) \qquad y_{i,t} - y_{i,t-1} = \beta_0 + \beta_1 (g_{i,t} - y_{i,t}) + \beta_2 y_{i,t-1} + \sum_{j=1}^{k} \left(\beta_{j+2} X_{j,i,t} \right) + \delta_t + \omega_i + \varepsilon_{i,t} ,$$

where $y_{i,t}$ is the logarithm of real GDP per capita in country (canton) i in year t, $g_{i,t}$ the logarithm of real government expenditure per capita, and, correspondingly, $(g_{i,t} - y_{i,t})$ the logarithm of the government's share. $X_{j,i,t}$, $j = 1, \ldots, k$, are several other explanatory variables like the participation or the unemployment rate, δ_t is a dummy variable for year t, ω_i the corresponding dummy variable for country (canton) i, and $\varepsilon_{i,t}$ a stochastic term. If the lagged value of GDP, $y_{i,t-1}$ is given and real government expenditure correspond to the budget planned in the year before, a (unexpected) increase (decrease) of GDP will reduce (increase) the gov-

ernment's share and, therefore, produce a negative estimate of β_1.[29] This can only be avoided if an instrumental variable estimator is used with theoretically valid an statistically reliable instruments. However, the so far hardly successful search for reliable instruments and the empirical results with them call into question whether such instruments exist at all. Using OLS and neglecting the simultaneity problem may, on the other hand, lead to seemingly significant results which are just a statistical artefact.

In the industrialised countries the last century has shown strongly rising per capita income as well as a rising government's share. This corresponds to the relative version of WAGNERS law. Together with the catch up hypothesis this leads to a situation where on the one hand the government share and GDP per capita are positively correlated, while on the other hand the growth rate of GDP per capita is negatively correlated with the government's share. These are stylised facts which are well known and often documented,[30] but they do not tell us anything about the impact the government's share has on economic growth.

Moreover, contrary to what is intended, model (1) does not provide a long-run relation between the government's share and economic growth. A simple reformulation leads to

$$(1') \qquad y_{i,t} = ß_0 + ß_1 (g_{i,t} - y_{i,t}) + (1 - ß_2)\, y_{i,t-1} + \sum_{j=1}^{k} \left(\beta_{j+2}\, X_{j,i,t}\right) + \delta_t + \omega_i + u_{i,t}\,.$$

Given the GDP value of the previous period, a constant government's share, however high it might be, has no effect at all on the current value of GDP per capita and, correspondingly, on its growth rate, it is just part of the constant term. Only changes of the government's share have an impact on economic growth. This holds as long as $ß_2$ or $(1 - ß_2) \neq 0$, respectively. Given a constant government's share, economic growth is exogenous in this model, it is driven by the predetermined variables X_j and/or by the exogenous time dependent dummy variable δ_t.[31]

Finally by including fixed effects for the cross section domain, the estimated coefficients only capture short-run deviations of the mean values of the countries (cantons). Thus, the really interesting question is taken out: Do countries with a higher (equilibrium) government's share have a lower long-run average growth rate. To answer this question we need an international cross section analysis or a panel analysis without country fixed effects, but with time fixed effects to account for common economic developments. In both cases it is, nevertheless, indispensable to addressing the simultaneity problem to derive economically meaningful results.

29. As public revenue reacts faster (more pro-cyclically) on GDP changes than public expenditure, this also explains why in some studies the tax share is less significant than the expenditure share (or even has a positive sign). See, e.g., D. ROMERO DE ÁVILA und R. STRAUCH (2003) or CH.A. SCHALTEGGER (2004).

30. For the positive relation between GDP and the expenditure and tax ratios see, e.g., J. SLEMROD (1995), for the negative relation between the growth rate of GDP A. AFONSO et al. (2005, p. 22).

31. In a theoretical paper, P.F. PERETTO (2003) shows that even in an endogenous growth model public expenditure might (only) have an impact on the level of GDP but not on its growth rate.

In the following, the problems are demonstrated using two concrete examples, an international panel analysis by B. HEITGER (2001) which is a follow-up of an earlier paper[32)] and results for the Swiss cantons by CH.A. SCHALTEGGER (2004) and CH.A. SCHALTEGGER and B. TORGLER (2004).

4.1 Results with an International Panel

B. HEITGER (2001) uses a panel of 21 OECD countries to estimate model (1). In order to eliminate short-run impacts he uses averages over four decades, starting with the sixties. Contrary to other studies, he correctly does not use country dummies. However, he does not even consider the simultaneity problem. This is the more problematic as even if there would be no such problem existing using annual data, averages over ten years necessarily mix both causal relations. This renders a causal interpretation of such results impossible.

Of the many equations which are presented in B. HEITGER (2001) we only take one as an examples: his basic relation determining GDP growth, which is also close to his basic relation published in HEITGER (1998). He estimates the following relation for a balanced panel of 20 OECD-countries: .[33)]

$$(2) \qquad gry_{i,t} = \beta_0 + \beta_1 \ln(grl_{i,t} + 5) + \beta_2 \ln(INV_{i,t}/GDP_{i,t}) + \beta_3 \ln(HUMCAP_{i,t}) + \beta_4 \ln(RGDP_{i,t}) + \beta_5 \ln(GEXT_{i,t}) + u_{i,t} ,$$

with:

gry	average growth rates of GDP per capita
grl	average annual growth rate of the labour force, (5 percentage points are added to account for technical progress (3 percent) and depreciations (2 percent)
INV/GDP	Share of investment as percent of GDP,
HUMCAP	Accumulation of human capital, measured by secondary school enrolment rates,
RGDP	relative GDP per worker in international prices of 1985 relative to the U.S., (US 1960, 1970, 1980 1990 = 100),
GEXT	average annual government expenditure as percent of GDP.

ln(·) denotes the (natural) logarithm. The relations are estimated using OLS for the coefficients and GLS for the standard deviations to take account of interdependencies between the residuals. Possible simultaneities are not taken into account.

32. B. HEITGER (1998), see also IfW/RWI (1996).

33. The countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Canada, United States, Japan, Australia. – See the description of the data in B. HEITGER (2001, Table 3, p. 14).

Table 1: Estimated Equations for the GDP Growth Rate per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	20.472*** (3.29)	14.783*** (4.82)	10.868** (3.35)	11.122** (3.56)	8.512** (3.00)	8.587** (2.92)
investment share	0.654 (1.10)	0.711 (1.31)	0.463 (0.74)	0.440 (0.84)	0.760 (1.35)	0.701 (1.40)
Growth of labour force	-2.103* (2.62)	-1.121 (1.17)	-0.864 (0.96)	-0.916 (0.90)	-0.630 (0.68)	-0.696 (0.69)
proxy for human capital	0.181 (0.71)	0.072 (0.26)	0.022 (0.13)	0.034 (0.22)	-0.067 (0.44)	-0.056 (0.34)
relative income per capita in the starting period	-2.796*** (6.22)	-2.619*** (5.33)	-2.157*** (4.38)	-2.172*** (4.25)	-2.223*** (4.51)	-2.229*** (4.43)
government expenditure	-1.480** (3.08)	-0.254 (0.54)	0.016 (0.04)	-0.003 (0.01)	0.462 (1.17)	0.536 (1.29)
D70		-1.561*** (8.39)				
D80		-1.368*** (5.35)		0.047 (0.22)		-0.024 (0.11)
D90		-1.413*** (3.71)		-0.024 (0.08)		-0.135 (0.46)
$\overline{R}^2$	0.674	0.774	0.407	0.385	0.418	0.399
standard error of regression	0.917	0.764	0.702	0.715	0.695	0.707
Jarque-Bera statistic	0.465	2.671	4.463	5.197(*)	3.871	4.841(*)
number of observations	80	80	60	60	60	60

The numbers in parentheses are the absolute values of the estimated t-statistics, with observations clustered according to the country. '(*)', '*', '**' or '***' denotes that the corresponding null hypothesis can be rejected at the 10-, 5-, 1- or 0.1-percent significance level. Source of the data: B. HEITGER (2001).

Relation (1) in *Table 1* presents a re-estimate of the basic equation in B. HEITGER (2001).[34)] It shows a highly significant negative effect of government expenditure on economic growth. This leads him to the conclusion that total government expenditure have in the OECD countries a significantly negative impact on economic growth: "a reduction of government's share by about 10 percentage points … would be associated with an increase of the average growth rate of about 0.5 percentage points per year" (p. 20). Moreover, he interprets the fact that the coefficient of private investment is insignificant in equation (1) but significant as soon as

34. It is relation (2) in *Table 3* of B. HEITGER (2001, p. 14). – The negligibly small deviations of our results from the results presented there might be due to roundings of the data in the tables of his paper where we took the data from.

government expenditure is excluded as an indication of crowding-out of private investment by public expenditure.

To re-estimate this equation, we use also OLS for the coefficients and we cluster the observations according to countries to calculate the standard errors.[35] However, besides other possible criticisms,[36] this result is far from being robust. Including the time dummies which are highly significant increase the adjusted multiple correlation coefficient by about 10 percentage points, but renders the coefficient of government expenditure insignificant. As the size of the three dummy variables is quite similar, the suspicion is that the result concerning the impact of government expenditure is driven by the difference between the sixties and the time after 1970. In the sixties, we generally had high growth rates and comparatively low government shares, whereas after 1970government shares grew and economic growth rates declined. Thus, if we exclude the sixties from the data, the coefficient of government expenditure become totally irrelevant and insignificant. This is independent whether we include the time dummies (equation (4)) or delete them (equation (3)).

While the impact of economic growth on the government size is more a short-run phenomenon, the reverse relation has more importance in the long-run. Thus, a possibility to account for the simultaneity problem between economic growth and government size may be by using lagged values of the latter as explanatory variables. However, a lag of one year is hardly sufficient. As J. SLEMROD (1995, p. 401f.) with reference to A. LINDBECK (1995) argues, it takes a long-time, perhaps even one generation, before disincentive effects of increased taxation become fully effective. To take account of this, we lag government expenditure one decade and re-estimate the model. Due to this lag, we can now only use the data from the seventies onwards. The results are relations (5) and (6) in *Table 1*. The coefficients are now still insignificant but clearly positive.

The results do hardly change if we use government consumption or government disbursements, consisting of final consumption expenditure, transfers, interest payments and subsidies, as explanatory variables. Then we get t-statistics of 0.85 or 0.72, respectively. Moreover, considering the data from 1970 onwards, insignificance of the estimated coefficient of private investment is independent whether we include government expenditure as an explanatory variable or not. Thus, there is no indication of any crowding-out of private by public activity. The only constitently significant variable is in this model the relative per capita income at the beginning of the decade: the estimated coefficients are always significantly different from zero even at the 0.1 percent level, and the estimated coefficients are rather stable across the different specifications. Thus, taking into account simultaneity gives, at least in this data set, no indication of a negative impact of a high government share on economic growth.

35. Using Newey-West or White corrections produces quite similar results.

36. It is, e.g., far from obvious why the logarithm of the growth rate of the labour force and not the growth rate itself is used. Moreover, the data for human capital do not seem to be very reliable. It is, e.g., hard to believe that U.S. human capital was shrinking by more than 20 percent between the sixties and the nineties of the last century.

4.2 Results for Swiss Cantons

One of the major problems mentioned above was that different welfare systems result in different optimal values for the size of government. This might lead to insignificant results. This could be avoided if different countries had the same welfare system (or at least quite similar ones). Another possibility is to look at the states in a federal system. Along this line, quite recently, CH.A. SCHALTEGGER (2004) presented an analysis for Swiss cantons.[37)] Using a panel with annual data from 1981 to 2001 and estimating model (1), he investigates whether the government's share of the 26 cantons, measured as the share cantonal and local expenditure or tax revenue of GDP, has a significant impact on cantonal economic growth. For this, he employs the following estimation equation. He includes fixed effects for the time as well as the cross section domain, the estimated coefficients only capture short-run deviations of the mean values of the cantons and of the general economic development.[38)]

CH.A. SCHALTEGGER (2004) comes to the conclusion that the government's share has a highly significant negative impact, while the tax share had at best a marginally significant negative impact on Swiss economic growth. This is demonstrated by equations (1) and (2) in *Table 2* which show re-estimations of the perhaps most important one of his results.[39)] The tax share is, however, no longer even marginally significant; its t-statistic is far away from any conventional significance level. The difference to the results in CH.A. SCHALTEGGER (2004, p. 5) is due to the fact that we have used the Newey-West procedure for correcting the estimated variances for the effects of possible autocorrelation and heteroscedasticity. If we use a cross section over the whole period, i.e. if we capture the relation between the mean values of the 26 cantons which are blended out in the panel analysis with cantonal fixed effects, the estimated coefficients remain negative but lose their significance.

The very large values of the Jarque-Bera statistic indicate that the residuals are far away from a normal distribution. This might have an impact on the test statistics. To check this, we eliminated in both equations outliers so that the null hypothesis of normality of the residuals could no longer be rejected even at the 10 percent significance level. As the results in *Table A1* in the *Appendix* show, this leads only to minor changes with respect to the expenditure and tax shares.[40)]

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37. See also CH.A. SCHALTEGGER and B. TORGLER (2004). An earlier paper with Swiss data is R.J. SING and R. WEBER (1997).Results for Switzerland can also be found in G. KARRAS (1997) and A. BASSANINI und S. SCVARPETTA (2001).

38. See for this CH.A. SCHALTEGGER (2004, p. 4). – He mainly uses OLS, without taking into account possible simultaneity and autocorrelation and heteroscedasticity of the residuals. He also presents some instrumental variables estimates. They showed quantitatively similar results with, however, reduced significance of the expenditure and tax shares. – In calculating the growth rates CH.A. SCHALTEGGER employs the logarithm with base 10 (instead of the natural logarithm as usual). This has, however, no impact on the parameters of interest β_1 and β_2 or their statistical significance.

39. The data have been provided by CHRISTOPH A. SCHALTEGGER.

40. To check the robustness of his results, CH.A. SCHALTEGGER (2004, p. 5) also shows the results of a reduced model where some of explanatory variables have been eliminated. This has only a minor impact on the results of the expenditure and tax rates. – His results are, however, also dubious for another reason: With the

Table 2: Growth rate of real GDP per capita,
1980 – 2001, 546 Observations

Model	(1)	(2)	(3)	(5)
lagged GDP	-0.142*** (4.89)	-0.129*** (5.08)	-0.137*** (5.69)	-0.122*** (4.97)
government share	-0.064** (3.11)			
tax share		-0.010 (0.78)		
government expenditure per capita			0.036(*) (1.95)	
Tax revenue per capita				0.011(*) (1.86)
private investment	0.003 (0.46)	-0.010 (0.98)	-0.017* (2.02)	-0.010 (1.57)
participation rate	0.046 (1.59)	0.029 (0.98)	0.014 (0.50)	0.024 (0.82)
urbanisation	0.012 (0.76)	0.023 (1.42)	0.027(*) (1.66)	0.023 (1.42)
population	-0.109** (2.70)	-0.109** (2.70)	-0.112** (2.71)	-0.118** (2.87)
Share of population below 19 years	0.102 (1.43)	0.118(*) (1.71)	0.107 (1.52)	0.093 (1.33)
Share of population above 65 years	0.129(*) (1.93)	0.187* (2.46)	0.218** (2.97)	0.93** (2.72)
Dummy variable for German speaking cantons	-0.031 (0.96)	-0.019 (0.59)	-0.009 (0.28)	-0.019 (0.62)
Share of population with high school diploma	-0.021 (0.83)	-0.021 (0.83)	-0.032 (1.22)	-0.027 (1.03)
unemployment rate	-0.002** (3.31)	-0.002** (3.25)	-0.002** (3.07)	-0.002** (3.04)
$\overline{R}^2$	0.592	0.576	0.579	0.577
standard error of regression	0.007	0.007	0.007	0.007
Jarque-Bera statistic	710.773***	921.881***	1052.154***	1077.998***

The numbers in parentheses are the absolute values of the estimated t-statistic. The standard errors have been corrected using the Newey-West procedure. '***', '**', '*' or '(*)' indicate that the corresponding null hypothesis can be rejected at 0.1, 1, 5, or 10 percent significance level, receptively.

exception of one of the estimated two cross-sections which he presents, private investment seems to have no significant on economic growth; some of the estimated coefficients are even negative. Insofar, the model he employs does not seem to be a meaningful one to explain economic growth. But this is not further discussed in this paper.

To take account of the simultaneity we can do the same as above and use a long lag for government expenditure and taxes. Using five lags leaves us still the 16 years from 1985 to 2001 or 416 observations. Re-estimating equations (1) and (2) of *Table 2* we get t-statistics of -1.76 for the expenditure share and of -1.02 for the tax share. Lagging these shares five years, we get t-statistics of 0.37 for the expenditure share and of 0.26 for the tax share. Thus, we find the same qualitative result as for the international panel: the coefficients of expenditure- or tax-shares in growth equations become insignificant once we lag them long enough to take account of the simultaneity between government activity and economic growth.

The different results for the expenditure and tax shares which could also be observed in the paper by D. ROMERO DE ÁVILA und R. STRAUCH (2003) provide additional evidence that reverse causality is dominating. In Switzerland, the short-run mechanism explained above which implies the negative correlation between the current growth rate and the current expenditure share is different with respect to the tax share, as income and property taxes are paid with a delay of one to two years. Thus, we might get again a negative correlation as between the expenditure share and the growth rate, but it might be less pronounced. Thus, it is not surprising that we do not get a significant result.

An alternative way to eliminate this effect which stems from the fact that in the government's and the taxes shares GDP per capita and, therefore, the dependent variable, is in the denominator, is to use government expenditure per capita (or tax revenue, per capita, respectively) instead of the government's share as explanatory variables. This is done in equations (3) and (4) of *Table 2*. Then we get for government expenditure as well as for tax revenue positive effects which are significant at the 10 percent level; an extension of government activity seems to strengthen economic growth.[41)] Again, however, it can be argued that what we observe is reverse causality: cantons with high economic potential do not only have higher tax revenue per capita but are also able to provide their citizens with more and qualitatively better services.

This does, of course, not explain the change of the signs in the equations of *Table 1*. To see which mechanism is producing this result it makes sense to start with the simple traditional model which explains government expenditure as a function of income, i.e.

$$G = \alpha + \beta Y , \tag{3}$$

where G is government expenditure and Y GDP. Generally, it can be assumed that there is a positive relation between government expenditure and GDP, i.e.

$$\frac{\partial G}{\partial Y} = \beta > 0 \tag{4}$$

For the relation between the government's share and GDP per capita we get instead

41. If the outliers are eliminated from the data significance considerably increases: The positive impact of taxes is significant at the 5 percent and the one of government expenditure even at the 1 percent level. See the results in *Table A1* in the *Appendix*.

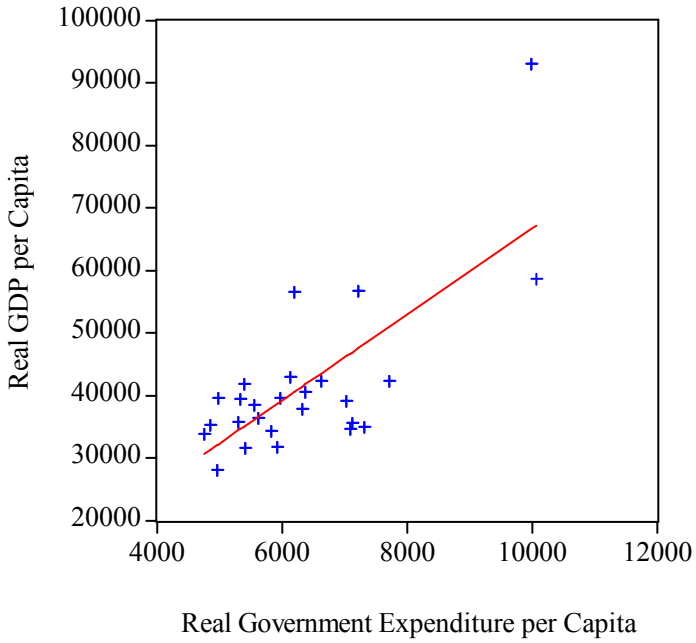

Figure 1: Relation between GDP and Government Expenditure per Capita Mean Values, 1981 – 2001

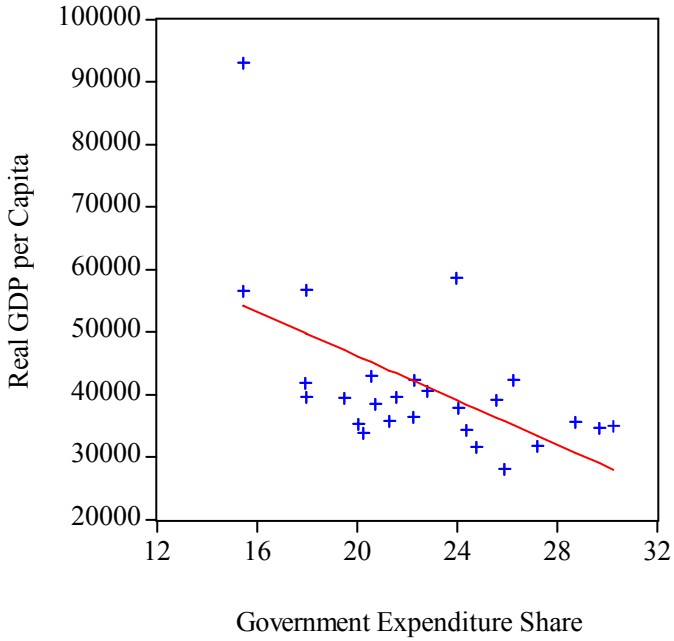

Figure 2: Relation between GDP and Government Expenditure Share Mean Values, 1981 – 2001

$$\frac{\partial \frac{G}{Y}}{\partial Y} = -\frac{\alpha}{Y^2} < 0 \quad \text{for} \quad \alpha > 0\,, \tag{5}$$

i.e. we get a negative relation.

To illustrate this relation we calculated mean values for the government's share, real government expenditure per capita and real economic growth of the 26 cantons for the period from 1981 to 2001. With these data we can estimate relation (4) and get

$$G_i = \underset{(6.01)}{3.152} + \underset{(5.85)}{0.077}\, Y_i ,$$

where government expenditure (G) and GDP (Y) are measured in 1000 CHF per capita. This relation is shown in *Figure 1*.[42)] The correlation between the two variables is 0.729.[43)]

For the relation between the government's share and GDP per capita get, however, the following estimate:

$$G_i/Y_i = \underset{(6.01)}{0.206} - \underset{(5.85)}{0.0116}\, Y_i ,$$

i.e. we get the negative relation between the government's share and GDP per capita which can be seen in *Figure 2*. The correlation coefficient between the two variables is -0.557.[44)]

We get the same effect if we use instead of relation (2) the multiplicative model

$$G = \alpha \cdot Y^{\beta} \tag{4'}$$

with $\alpha > 0$ and $0 < \beta < 1$. By taking logarithms we get

$$g = \alpha' + \beta \cdot y \tag{4''}$$

with $\alpha' = \log(\alpha)$. Between government expenditure and GDP per capita we get here a correlation of 0.693 and between the government's share and GDP per capita of -0.628.

To have, in addition, a relation between economic growth on the one hand and government expenditure and revenue on the other hand demands that those cantons with high GDP per capita also have high economic growth. In fact, GDP per capita and its real growth rate are correlated with 0.510 over the period from 1981 to 2001. Such a positive correlation can, however, hardly be taken for granted, at least as long as one believes in neo-classical growth theory. According to the catch up hypothesis of this theory which states a convergence of economic developments in the different cantons one would rather expect the opposite relation. Actually, all corresponding coefficients in the estimates of CH.A. SCHALTEGGER (2004, p. 5) are significantly negative. This result supports such a convergence. The question is, of course, how long it takes until such a convergence takes place. The estimated coefficients imply a mean adjustment period of between 7 and 12 years. Thus, a positive relation between the level of GDP per capita and its growth rate might persist for some extended period. This leads to

42. To calculate the t-statistics we used again heteroscedasticity consistent variances.

43. If we eliminate the 'outlier' Basel-Town which according to its structure has by far the highest GDP per capita, the correlation is still 0.584.

44. If the values of Basel-Town is eliminated here as well, we get a correlation of -0.490.

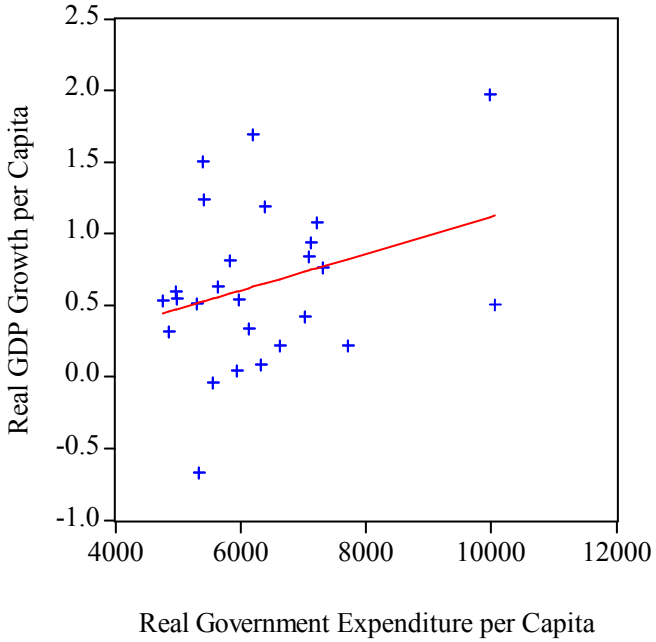

Figure 3: Relation between GDP Growth and Government Expenditure per Capita Mean Values, 1981 – 2001

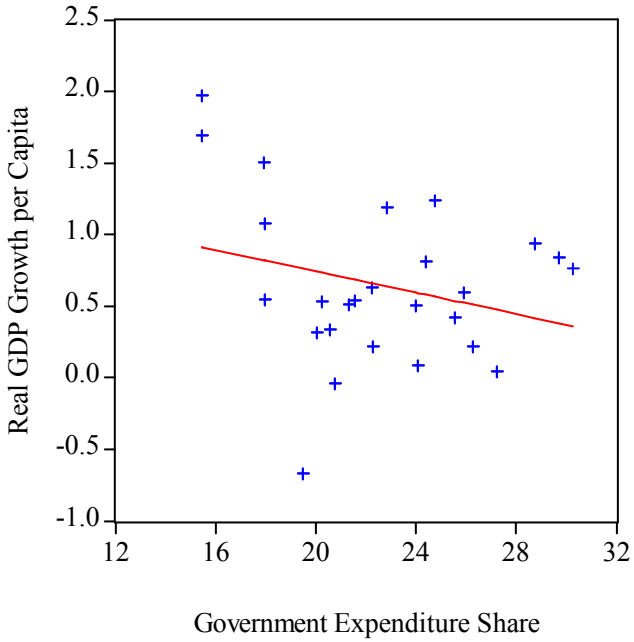

Figure 4: Relation between GDP Growth and Government Expenditure Share Mean Values, 1981 – 2001

the positive relation between real government expenditure per capita and economic growth depicted in *Figure 3*. This relation is less strong than the one between real government expenditure and GDP per capita, but it is still positive with a correlation of 0.306. *Figure*

diture and GDP per capita, but it is still positive with a correlation of 0.306. *Figure 4*shows, on the other hand, the relation between the expenditure share and economic growth. This relation is – as expected – negative with a correlation of –0.266.[45)]

Given the positive correlation between GDP per capita and its growth rate the main effect of the estimated relation between economic development and public expenditure might result from the Swiss federal structure. Cantons with high GDP per capita and high economic growth are able to provide their citizens with quite a lot of services and have, nevertheless, rather low tax rates. If the poorer cantons want to provide the same services, they have to have considerably higher tax rates which leads to a higher government's share. Of course, not all cantons provide the same amount of services, but a certain minimum has to be provided all over the country. This holds, e.g., for education, traffic, or general administration. Thus, expenditure per capita will be smaller in the poorer cantons. There is in addition a dampening effect of wage costs: Poorer cantons generally pay lower wages to the public employees than richer cantons. This is, however, not sufficient for allowing these cantons similar low tax rates as the rich ones. Thus, it is likely that the estimated negative relation between the government's share and economic growth is generated by reversed causality; it does not allow any conclusion about the impact of the size of the government's share on economic development.

Thus, it is also impossible to make an unambiguous statement about whether the rise of the government's share in the nineties – together with other factors – is responsible for the low economic growth Switzerland experienced during the last fifteen years. Moreover, a critical analysis of CH.A. SCHALTEGGER (2004) shows that estimations for states (cantons) in a federal country are even less suited than international cross-sections or panel studies to check whether there is a negative causal relation between the government's share and economic growth. The main reason for this is that the principle of 'homogeneity of living conditions', however incomplete it might be realised in a federal country, will hold much stronger than between independent nations. This intensifies the simultaneity problem. Moreover, even if we could prove without any doubt that at the cantonal level a smaller government's share causes economic growth, it is totally open whether this has an effect on total Switzerland or whether this only causes shifts between the cantons leaving the national growth rate unaffected.

5 Summary and Concluding Remarks

Neither the international cross-sections and even less the studies with the Swiss cantons, i.e. with sub-federal units allow clear statements whether a reduction of government activity would enhance economic growth. Political demands for such a reduction cannot be based on the available empirical literature. This is due to several conceptional and methodological difficulties:

45. If taxes are used instead of government expenditure, we get a correlation of -0.051 between the tax share and the real rate of economic growth. Between taxes per capita and the growth rate we get a correlation of 0.367 which is with a t-statistic of 1.93 despite the small sample statistically significant just below the 5 percent level.

(i) There is a simultaneous relation between government activity and economic development. It is not only that government activity has an impact on economic growth, but the economic development also has an impact on the government's share. For cross-sections, but also for panel studies it is very difficult to disentangle these two causal chains. Many of the presented studies do not even try to do this. There are hardly reliable instruments available. The only way to proceed might be to use the fiscal variable with a rather long lag. As the two examples above show, a seemingly significant impact of government activity on economic growth can become insignificant once we take account of the simultaneity problem in this way.

(ii) The relation between the government's share and economic growth is necessarily non-linear; there is – in principle – an optimal government's share. The size of this share depends on the kind of the welfare state. It is considerably higher in Scandinavia compared with the Anglo-Saxon model. Correspondingly, a government's share which is compatible with economic growth in the former might lead to stagnation in the latter. Thus, the relevant question is whether the government's share of a country is – given its social security system – above or below its optimal one.

(iii) The international cross-section and panel studies do hardly ask the question in this way. They rather assume a simple linear relation. Moreover, they do not take into account that the optimal size of the government's share depends on the institutional environment. Thus, it is no surprise that the results are not unambiguous and sometimes even contradictory, or that with the corresponding manipulation nearly every demanded result can be produced, respectively

(iv) If instead of international cross-sections the development of sub-federal units is investigated the problems caused by different social security systems is avoided. On the other hand, as the Swiss example shows, the problem to disentangle the two causal directions becomes even more severe. If a more or less equal supply of publicly provided services is attempted in all states (cantons), those with higher GDP per capita will exhibit a smaller government's share, even if the latter has no impact at all on economic development. Moreover, it remains totally open whether a growth supporting impact of a low government share, if this could be proved at all, leads to higher growth also at the national level or only to shifts between the sub-federal units leaving the national growth rate unaffected.

The fact that there is no statistically significant negative relation between the size of the government's share and economic development does, of course, not imply that such a relation does not exist nor that there might be no need for action in a country. Statistical insignificance of a relation does not imply that it does not exist. All what can be said is that it is impossible to prove its existence with the necessary confidence. The fact that some studies even find a positive relation demands, on the other hand, some reservation.

Besides this, it should not be forgotten that it is less the amount of government activity that matters but the relation between this amount and its quality on the one and its price on the other side: Citizens accept to pay the necessary taxes if they get the corresponding services

with the appropriate quality.[46)] Thus, it is more the composition of publicly provided services and the structure of the tax system that matters for economic growth than the size of the government's share.[47)]

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46. In evaluating this relation the efficiency which is demanded from the government should, of course, not only be counted with managerial standards. See for this, e.g., A. MEIER (2000).

47. For the latter see, e.g., J. MIACHAELIS and A. BIRK (2004).

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Table A1: Growth rate of real GDP per capita, *1980 – 2001*

Model	(1)	(2)	(3)	(5)
lagged GDP	-0.110*** (6.76)	-0.107*** (5.08)	-0.119*** (6.67)	-0.094*** (5.95)
government share	-0.046** (3.31)			
tax share		-0.005 (0.87)		
government expenditure per capita			0.037** (2.60)	
Tax revenue per capita				0.009* (2.43)
private investment	-0.001 (0.13)	-0.05 (0.93)	-0.011(*) (1.70)	-0.007 (1.30)
participation rate	0.035 (1.50)	0.038(*) (1.71)	0.026 (1.15)	0.023 (1.06)
urbanisation	0.005 (0.39)	0.024* (2.09)	0.027* (2.38)	0.021(*) (1.91)
population	-0.090** (3.14)	-0.106*** (3.70)	-0.110*** (3.86)	-0.107*** (3.81)
Share of population below 19 years	0.021 (0.39)	0.073 (1.40)	0.072 (1.41)	0.034 (0.64)
Share of population above 65 years	0.088(*) (1.70)	0.092 (1.64)	0.121* (2.15)	1.09* (2.08)
Dummy variable for German speaking cantons	-0.026 (0.96)	-0.007 (0.27)	-0.002 (0.06)	-0.020 (0.77)
Share of population with high school diploma	-0.029 (1.51)	-0.045* (2.29)	-0.049* (2.41)	-0.039(*) (1.93)
unemployment rate	-0.002*** (3.86)	-0.001** (2.86)	-0.001** (2.79)	-0.002*** (3.46)
$\overline{R}^2$	0.679	0.688	0.692	0.685
Number of observations	530	527	528	527
standard error of regression	0.005	0.005	0.005	0.005
Jarque-Bera statistic	4.187	3.837	4.503	4.190

The numbers in parentheses are the absolute values of the estimated t-statistic. The standard errors have been corrected using the Newey-West procedure. '***', '**', '*' or '(*)' indicate that the corresponding null hypothesis can be rejected at 0.1, 1, 5, or 10 percent significance level, receptively.