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Torberg Falch
Justina Fischer

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Does a generous welfare state crowd out student effort? Panel data evidence from international student tests

Torberg Falch*
Department of Economics
Norwegian University of Science and Technology

Justina AV Fischer+
Department of Economics
Stockholm School of Economics

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Abstract

Student achievement has been identified as an important contributor to economic growth. This paper investigates the hypothesis that redistributive government activities have a negative effect on investment in human capital using data from international comparative student achievement tests in Mathematics and Science for over 70 countries during the period 1980 to 2003. In fixed effects models, the impact on student achievement of both government consumption and government social expenditures are negative and seem to be robust across different model specifications. The effect of social expenditures appears to be driven by spending on pensions and active labor market policies.

** Department of Economics, Norwegian University of Science and Technology, Dragvoll, N-7491 Trondheim, Norway, e-mail: Torberg.Falch@svt.ntnu.no

++ Department of Economics, Stockholm School of Economics, Sveavägen 65, SE-11383 Stockholm, Sweden, and Thurgauer Wirtschaftsinstitut an der Universitaet Konstanz, Switzerland, e-mail: Justina.Fischer@hhs.se

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1. Introduction

The equity-efficiency quandary of the welfare state is usually attributed to perverse incentive effects in the labor market. The welfare state includes 'unproductive' government spending which reduces the return to work and is financed by distortionary taxes. Drawing an analogy to investment in human capital, the present paper analyzes whether welfare state aspects affect the performance in compulsory schooling in an international panel data framework.

The welfare state can be seen as a social insurance mechanism, see for example Sinn (1995). But if the insurance terms for the insured improve, her incentives to invest to avoid capture are weakened. This moral hazard problem may have detrimental effects on investment in human capital, saving, and, ultimately, economic growth. However, the empirical cross-country literature indicates that there is no relationship between government expenditures and growth, although the results vary somewhat across studies, see for example Fölster and Henrekson (2001) and Agell, Ohlsson and Thoursie (2006). However, Bjørnskov, Dreher and Fischer (2007) find that higher government consumption spending is related to less well-being, perhaps through misallocation of resources and the inefficiencies mechanisms inherent in taxation. Kneller, Bleaney and Gemmell (1999) distinguish between different types of taxes and spending categories, and find that overall government expenditures induce growth, but with welfare expenditure having significantly lower effect compared to what they call "productive expenditures". Similarly, Zhang and Zhang (2004) find positive effects of old-age benefits on education (secondary enrolment rates) and economic growth, while Ehrlich and Zhong (1998) and Ehrlich and Kim (2007) identify a negative effect on both, particularly for developed countries.[1]

In this paper we investigate whether government involvement in the economy through public goods creation and income redistribution is related to individual investment in human capital, the former approximated by both government consumption and social expenditures and the latter by international student test scores. Most of the existing empirical analyses on economic growth include as proxy of human capital some measure of *quantity* of education in the population. This is obviously a crude measure, and we follow Wössmann (2003a) who argues that the number of *quality*-education-years varies across countries stronger than the mere duration of education, with which it might even be uncorrelated. Indeed, Hanushek and Kimko (2000) find that average student achievement in compulsory schooling is a much more

[1] Ehrlich and Kim (2007) report that, not unsurprisingly in a growth context, the estimates are sensitive to whether the models condition on initial GDP or not.

sizable determinant of economic growth than years of education in the population. The strong effect of student achievement is confirmed by Hanushek and Wössmann (2007) and Jamison, Jamison and Hanushek (2007).

In this analysis we employ data from several comparative international tests that have been conducted over the last three decades. We focus on tests in mathematics and science for the age group 13-15 years and include eight tests in the period 1980-2003 for a maximum of 79 countries, giving rise to an unbalanced panel of 246 observations that allows the application of panel data estimation methods. Existing studies utilizing cross-country variation in student achievement are either almost exclusively based on a cross-section of individual test performances in the same test of a single year, see for example Wössmann (2003b) and Frölich, Bourdon, and Michaelowa, (2007), or the average in performance across many years as in Hanushek and Kimko (2000), Hanushek and Wössmann (2007), and Jamison et al. (2007). We follow the latter methodological approach but exploit the panel structure in the data and estimate country fixed effects models that account for unobserved national heterogeneity. Our empirical findings indicate that a more generous welfare state is detrimental to student performance.

Our empirical analysis is preceded by a simple economic model that relates the size and the scope of the welfare state to education investment in terms of student effort. The insurance aspect of the welfare state manifests in a system that both reduces the risk of future income and that redistributes from high income individuals to low income individuals. In traditional human capital models (Becker, 1964) where educational outcomes are determined by rational decision-making of individuals weighting costs and benefits, increased redistribution of income is predicted to weaken the incentive to invest in education (for an exemplary theoretical model, see Poutvaara, 2007). The prediction of the effect of reduced idiosyncratic risk in future income is more complicated and ambiguous. In a traditional investment model analogous to models in financial economics, Charles and Luoh (2003) show that reduced uncertainty in education returns increases the investment in education. On the other hand, investments in education have several similarities with real options. Hogan and Walker (2007) and Jacobs (2007) show in a framework where risky investments in human capital are irreversible that reduced variability in the return to education investments lowers the investment since the upside payoff is reduced by more than the downside.

The paper proceeds as follows. The next section presents the theoretical considerations. Section 3 describes the international student tests data and our measure of average student

attainment, section 4 presents the empirical model, and section 5 discusses the empirical results. Section 6 offers some concluding comments.

2. Theoretical considerations

We present a simple partial two-period model that illustrates how redistribution of income and income uncertainty affects students' incentives in schools. The model builds on Glomm and Ravikumar (1992), but differs by including income redistribution and uncertainty. Consider a life-time utility maximizing individual living in two periods. In period one, the individual invests in her human capital. The investment is modeled as the residual time devoted to education Z instead of leisure L, where Z + L is normalized to unity. Thus, effort at school has an opportunity cost in terms of foregone leisure, but is an investment in future income. In period two, the individual consumes the return on her education investment. Neglecting discounting and assuming separability over time, the life-time utility in expectational terms is

$$E\{V\} = u(1-Z) + E\{U(C)\}$$

where the utility functions u and U are concave.

In this model, the welfare state is an institution that transfers a fraction τ of the income from individuals with high income to individuals with low income, and thus reduces the consumption inequality in the society in period two. The uncertainty of the representative agent's future income is captured by two independent random components. One type of uncertainty is related to the return of education investment (ε_1) and the other is independent of the return (ε_2), such as macroeconomic shocks, where $E(\varepsilon_i) = 0$ and $Var(\varepsilon_i) = \sigma_i^2$, i = 1, 2. We write the consumption in period two as

$$C = (1-\tau)\left(y(Z)(1+\varepsilon_1) + \varepsilon_2\right) + \tau\bar{y}$$

where the right hand side is the representative individual's income after redistribution. The deterministic part of the income is the productivity that depends on effort in school, y(Z), with diminishing returns ($y'(Z) > 0,\ y''(Z) < 0$). Because of income redistribution only a fraction $1-\tau$ of the consumption is related to own productivity while the fraction τ is related to the average productivity in society, $\bar{y}$. This formulation implies that individuals with productivity below (above) the mean will have an increasing (decreasing) consumption in transfer income

$\tau(y - (y(Z)(1+ \varepsilon_1) + \varepsilon_2))$. Thus, τ is an indicator of the generosity of the welfare state. For simplicity, the implicit taxation and transfer rules are not written down in the model.

The individual maximizes equation with respect to effort Z subject to constraint . The first order condition is

$$u'(1-Z) = (1-\tau)y'(Z)E\{U'(C)(1+\varepsilon_1)\}.$$

In optimum, the marginal cost of effort is equal to the expected marginal return to effort. To keep the analysis simple, we continue with the quadratic utility function $U_2(C) = \alpha C - \beta C^2/2$. Then the first order condition (3) can be written as

$$u'(1-Z) = (1-\tau)y'(Z)\left[\alpha - \beta\left((1-\tau)\left(1+\sigma_1^2\right)y(Z) + \tau\bar{y}\right)\right]$$

Calculation of the partial derivates of is straightforward. Regarding the redistribution parameter τ, its partial effect on effort Z is given by

$$\frac{dZ}{d\tau} = -\frac{1}{D}\left[\frac{u'(1-Z)}{1-\tau} + \beta(1-\tau)y'(Z)\left(\bar{y} - \left(1+\sigma_1^2\right)y(Z)\right)\right]$$

where $D = \beta(1-\tau)^2\left(1+\sigma_1^2\right)\left(y'(Z)\right)^2 - u''(1-Z) - y''(Z)u'(1-Z)/y'(Z) > 0$. The first term in the bracket reflects that the incentive to invest in education is reduced when the return to education declines. The sign of the second term in the bracket depends on the relative income position. For individuals with income below the mean $\bar{y}$, increased redistribution increases income and decreases the marginal utility of consumption, which partially lowers investment in education. For rich people, however, income decreases and thus the marginal utility of consumption increases, partially working in the direction of higher investment. In principle, this indirect effect of income redistribution may be so strong that its total effect on education investment is positive. For a representative individual with income close to mean income,[2] the effect of redistribution is negative.

Regarding uncertainty, it follows from that

[2] Since mean income seems to be higher than median income in all income distributions, it is more reasonable to assume that the representative individual has income below the mean than above the mean.

$$\frac{dZ}{d\sigma_1^2} = -\frac{\beta(1-\tau)^2 y'(Z)y(Z)}{D} < 0 \quad \text{and} \quad \frac{dZ}{d\sigma_2^2} = 0$$

Increased uncertainty in the return to education σ_1^2 decreases investment in education. The individuals prefer less risky investments, all else equal. On the other hand, changes in the general uncertainty of income σ_2^2 have no effect on the education investment.

The result that volatility in the return to education reduces education investment is, however, not universally true. While our model considers the investment in effort at school as an asset, education investment may also have similarities with real options. In a model where education investment is the time devoted to non-compulsory education, and once the individual has left education for the labor market she cannot return to education, Hogan and Walker (2007) show that the investment is positively related to the uncertainty in the labor market. If a bad state of the labor market occurs, the individual can continue at school, but if a good state occurs, she can always switch to the labor market. Increased variability of the state of the labor market increases the upside payoff more than the downside payoff and, thus, increases the expected return to education investment. Jacobs (2007) reaches the same conclusion in a somewhat different model. He assumes that one can always leave the labor market for education. Then increased variability of the return to education increases the probability that education investment is profitable at one point in time.

In this paper, however, we analyze determinants of education outcome at the compulsory level. At the compulsory level, termination of education is not regarded as a choice for most individuals and time devoted to education measured by months or years is not a decision variable. Thus, the mechanisms described by Hogan and Walker (2007) and Jacobs (2007) are not directly applicable. However, the probability to enroll at higher, non-compulsory education and the range of higher education institutions an individual student can choose among is typically related to past performance at the compulsory level. Thus, low effort in compulsory schooling reduces the probability to attain the real option inherent in higher education.

The implicit function of education investment that follows from is

$$Z = f\left(\tau, \sigma_1^2, \bar{y}\right) = Z\left(g, \bar{y}\right)$$

where $g = g\left(\tau, \sigma_1^2\right)$ captures the common effects of the welfare state. The investment Z decreases in $\bar{y}$ because the utility function is concave, while the effect of the welfare state g is in general ambiguous. However, redistribution of income τ is the dominating aspect of the welfare state and has a negative effect on Z. Our testable hypothesis is that a more generous welfare state affects individuals' educational investments negatively.

3. International measures of student achievement

We rely on comparative international tests of student achievement conducted by different international organizations. The International Association for the Evaluation of Educational Achievement (IEA) has been responsible for the largest number of such tests, but also the OECD has developed a Programme for International Student Assessment (PISA).

We construct a synthetic panel data set of the national averages of international tests on student performance covering a period of almost 25 years (1980 – 2003). As these tests cover the core subjects Reading, Mathematics and Natural Science separately, an important question is which of them should be included in a time-series cross-section of test scores. We restrict our attention to student assessments in Mathematics and Science for two reasons. First, these two subjects have more similarities with each other than with Reading and are thus more suitable for constructing a synthetic panel, besides that Reading is tested less regularly internationally. Second and more important, it is performance in Mathematics and Natural Science that are more likely to determine a country's innovativeness in an economic growth context, as empirically tested in Hanushek and Wössmann (2007). Comparability of test results is also given in the age dimension, as all tests included are conducted on middle-aged students (13-15 years). Choosing this age group has also the advantage that compulsory schooling still applies, mitigating selection issues. The tests we utilize are described in Table 1.

Insert Table 1 about here

Even though all tests are in the fields 'Mathematics' and 'Science', they do not necessarily test the same cognitive skill: The IEA tests are related to common elements of school curricula across countries while IAEP is geared towards the curriculum in USA building on the national testing procedures developed by the National Assessment of Education Progress NAEP. The OECD PISA test has a more real-world approach and claims to assess the skills that are considered to be essential for full participation in the society. These differences do not, however, seem to be very important with respect to measured student performance. For

example, the correlation coefficient between the test results for the 18 countries participating both in TIMSS 2003 and PISA 2003 is 0.94.[3]

Recently, it has become common to report national averages based on Items Response Theory weighting the different questions by their difficulty ("Warm estimates", Warm, 1989), and standardizing the scores such that the average across all students across countries participating is 500 with standard deviation of 100. With this approach, the average score of a particular country will depend on the achievement of the students in the other participating countries. Thus, the official test score for a particular country is not necessarily comparable over time, particularly when the composition of the country sample changes. More importantly, for the tests prior to 1991, "Warm estimates" were not calculated, so that we have to rely on the share of correct answers for these tests.[4]

To make the scores on the different international tests comparable on a common metric, we have re-scaled the average scores for each international test by the following procedure. First we calculate the average of the Mathematics and Science tests when both subjects are tested. Second, we standardize the average score for each test to have mean zero and standard deviation equal to unity for a "core" group of 15 countries. The "core" is defined as the countries that have participated in at least six out of the eight international tests reported in Table 1, namely Australia, Canada, Hong Kong, Hungary, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Russia, Sweden, Thailand, UK, and USA.[5] Third, we re-scale the scores for each of the other countries using the same parameters as for the "core" countries. Finally, since there are two tests for many countries in 2003 (TIMSS and PISA), we calculate the average of those tests in 2003.

Making the results from different tests comparable has been a challenge also for previous empirical studies. For example, Hanushek and Kimko (2000) calculate a measure of labor-

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[3] The correlation coefficient between the average Science and Mathematics score in TIMSS-repeat 1999 and PISA 2000 is 0.87 and for IAEP 1991 and TIMSS 1995 the correlation coefficient is 0.80. The correlation coefficients are calculated using the adjusted test score described below. Interestingly, as can be seen from Figure 2 below, USA has its poorest performance in the IAEP test that was based on the US curriculum.

[4] We have compared the Warm estimates and percent correct answers for the IEA tests in 1994-95 and 1998-99 for which both measures are available. The correlation coefficients for Mathematics are 0.997 and 0.982, respectively, and for Science 0.994 and 0.977, respectively. Thus, the differences across countries do not seem to be influenced in any important way by the choice of scale.

[5] More precisely, we standardize the score for those of the "core" countries that participated in the particular test. Out of the 15 "core" countries used to standardize the test scores, the data sources reports results for 11 countries in 1980-81, 12 in 1983-84, 8 in 1990-91, 15 in 1994-1995, 14 in 1998-99, 15 in OECD 2000, 13 in TIMSS 2003 and 13 in OECD 2003. Only USA has test scores for all tests.

force quality based on the percent of correct answers in international student achievement tests for the period 1965-1991. They adjust the mean for each test, but not the variance (except the linear scaling that follows from the adjustment of the mean). Adjusting the means is crucial in their analysis because they subsequently calculate an aggregated quality measure for each country. More recently, Hanushek and Wössmann (2007) utilize tests from TIMSS, PISA and the IEA up to 2003 and, in addition to adjusting the means, they correct the dispersion of each single test in a similar way as ours, but their "core" countries include 13 OECD countries with "stable education systems".

Figure 1a shows that the density of our measure of student achievement across the 15 "core" countries observations is close to the normal distribution. The density for all observations presented in Figure 1b has a long left tail, illustrating that some countries, mostly developing countries that participate less frequently in international tests, have low student achievement.

Insert Figure 1 about here

In fixed effects models, identification is only based on within-country variation. Figure 2 shows the development over time for the "core" countries. The figure indicates that there are some systematic changes. For example, the relative achievement in the more neo-liberal Western economies USA, Canada and UK increased during the 1990s, while the achievement declined in Israel and in the transition countries Russia and Hungary. Some countries perform consistently better than others. For example, Italy performs below average and Netherlands performs above average in each test. However, Figure 3 shows that there is quite some variation in the change in student achievement, although the variation is lower than that for the distribution in levels of achievement.[6]

Insert Figures 2 and 3 about here

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[6] In Figure 3, only observations with at most eight years interval are utilized.

4. Model specification

We estimate the following model

$$Z_{it} = \beta_1 g_{it} + \beta_2 \log(GDP/POP)_{it} + \beta_3 \log(POP)_{it} + \beta_4 PISA_{it} + \beta_5 IEA_{it} + \phi_i + \varepsilon_{it}$$

g_{it} is a measure of the welfare state of country i in year t (discussed in detail below), while GDP per capita (GDP/POP) is the proxy for $\bar{y}$ in . In addition we include population size (POP) and country specific effects ϕ_i . We also include indicators for testing organization, (PISA) and (IEA), to control for systematic differences in test design. By employing country fixed effects we take account of unobservable time-invariant country characteristics. Among them, given the period of our analysis and the countries included, are factors such as societal income inequality, return to education, and population characteristics like average risk aversion and educational level.[7]

It is a question how to specify the time structure of the model. In our theoretical model, it is assumed that it is the welfare state arrangements *in the future* that affect students' investment decisions made *today*. We argue that the current societal situation may be the best proxy of students' expectations on her net income. On the other hand, it may equally be argued that the production of educational achievement is cumulative. For this reason, expectations of students and parents at earlier grades in the past may be important for observed achievement today, at the age of 13-15 years. To some extent this is taken into account by the fixed effects approach because the identification is based on within-country changes, but we will also investigate this issue by using five-years moving averages in the independent variables in some model specifications.

[7] Notice that the model does not include time specific effects. One purpose of the scaling of the test scores described above is to make the scores comparable over time. By including time specific effects, the model would in essence draw inference on which other countries that participated on the different tests, but not on the within country changes compared to a "core" set of countries. We have also estimated models with time specific effects, but they where not jointly significant.

Our focal determinant in this analysis, the welfare state g_{it}, is made operational in two ways: Firstly, we employ general government consumption spending (in percentage of GDP), obtained from the WDI 2007 database of the World Bank, a widely used measure of government involvement in the economy and has been employed in various cross-country growth studies (Fölster and Henrekson, 2001, Agell et al., 2006) and happiness studies (Bjørnskov, Dreher and Fischer, 2007 and 2008). Government consumption excludes financial transfer arrangements of the welfare state, but includes the production of services and public goods that is the responsibility of the government and mostly financed by taxes. Given that most public goods are financed through progressive tax systems, they entail a strong consumption redistribution aspect. Secondly, we use public sector social expenditures (in percentage of GDP) that are obtained from OECD *Social Expenditure database* (SOCX) and includes aggregated public expenditures of all government tiers.[8] This measure captures transfers from government institutions, namely "benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer." (OECD, 2007, p. 7). Broadly spoken, the OECD defines expenditures as 'social' if they satisfy two criteria: first, they have to intend a social purpose, and, second, these programs must be based on either inter-personal redistribution or compulsory participation (OECD, 2007, p. 8). As policy objectives vary slightly across OECD member states, so do the classifications of government expenditures as 'social'. Components of social spending as defined by the OECD include "cash benefits (e.g. pensions, income support during maternity leave, and social assistance payments), social services (e.g. childcare, care for the elderly and disabled) and tax breaks with a social purpose (e.g. tax expenditures towards families with children, or favorable tax treatment of contributions to private health plans)" (ibidem, p.7) (see Table 2). As this measure excludes administrative costs, social expenditures are measured as net expenditures.

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[8] The OECD defines expenditures as 'public' (as opposed to being 'private') when institutions of the General Government control the relevant financial flows. The 'General Government' in this context includes different levels of government and social security funds. This definition of 'public' includes, often by tradition, transfers by compulsory social insurances and social assistance schemes (see also OECD 2007, p.8-10).

Insert Table 2 about here

Figure 4 presents within country variation in social expenditures as a share of GDP for the "core" countries with data available. There is a tendency of increased social expenditures during the empirical period. The average share of social expenditures for the countries in the figure increased from 0.17 in 1980 to 0.19 in 2003.[9] Netherlands is the only country with reduced social expenditures, while Japan has the largest growth. Notice that social expenditures as a share of GDP serve as automatic stabilizers and, thus, typically decrease in a boom and increase in a recession. Thus, it is important to include GDP in the empirical model in order to avoid identification on variation in national income.

Insert Figure 4 about here

We also employ components of public social expenditure separately that differentiate government transfers by different social policy areas such as on, e.g., health, old-age, unemployment, active labor market policies, housing, and family. Table 2 provides an overview of spending programs that are attributed to each policy area. For our analysis, we employ those spending categories to which the major population is, in principle, entitled to (that excludes 'survivor' or 'incapacity' benefits as well as 'other social expenses'). The correlation coefficient between government consumption spending (from the WDI) and total social spending (from the OECD) is equal to 0.67 in our sample.

Table 3 presents some descriptive statistics on government consumption, social expenditures, and the single components of social expenditures. The variance in social expenditures is slightly higher than for government consumption, both overall and within countries. The within country variation, for which we identify the effects on student achievement, constitutes

[9] For all 29 OECD countries included in the empirical analyses, social expenditures increase from 17 percent of GDP in 1980 to 21 percent in 2003.

7-8 percent of the overall variance. Pension spending is the largest component of social expenditures, followed by public health spending. Whether we will find significant effects or not may depend on the amount of within-country variation for the specific component of interest. In particular housing subsidies and active labor market policy exert little within-country variation. On the other hand, there have been some reforms in the social security systems over the last 20 years.

Insert Table 3 about here

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5. Empirical Results

5.1. Government consumption

Table 4 presents results for government consumption spending including up to 72 countries and 232 observations. The first column simply presents the correlation between student achievement and government size, measured by government consumption spending as share of GDP. There is no unconditional relationship. Column (2) adds some control variables, namely national income, dummies for the testing organizations and population size.[10] The effects of population size and organization are insignificant, but there is a strong positive effect of GDP per capita. The positive income effect mirrors Hanushek and Kimko (2000) who find a positive effect of student achievement on economic growth, but contrasts the prediction of our theoretical model. The conditional effect of government consumption appears large and highly significant. Conditional on income, a small public sector is favorable, and conditional on public sector size, rich countries perform better than poor countries.

Insert Table 4 about here

The last part of Table 4 presents models with country fixed effects that mitigate the potential omitted variable problem. In particular, the fixed effects capture that student achievement is highest in developed countries. Indeed, including fixed effects makes the effect of GDP smaller in magnitude and insignificant at the 5 percent level (column (3)). However, the performance lowering effect of government consumption remains unchanged. Furthermore, columns (4) and (5) show that the effect seems to be of similar size for OECD-countries and non-OECD countries, albeit insignificant when we split the sample.[11] Overall, the evidence is

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[10] Following the traditional public finance literature, we will refer to this measure of welfare state as government size. Please note that, in principle, inclusion of population size allows to interpret government spending also as generosity towards the general population that is entitled to consume these public goods.

[11] The sample is split according to OECD membership in the year 2000.

in accordance with our hypothesis that a more generous welfare system generates disincentives for educational investment. The result indicates that when government consumption spending as a share of GDP increases by one log-point, student achievement is reduced by almost one “core country” standard deviation.

5.2. Social expenditures

Table 5 presents results for government social expenditures using 29 OECD countries, resulting in a sample of 124 observations. Column (1) shows that the unconditional correlation between social expenditures and student achievement is negative and significant at 5 percent level. The difference of the unconditional effect compared to Table 4 is likely due to the fact that only rich (OECD) countries form the sample for the analysis of social expenditures. Inclusion of co-variates (column 2) even increases the effect of social expenditures both in terms of magnitude and statistical significance. Also within OECD countries, there is an important impact of GDP. Column (3) in Table 5 adds country fixed effects. The effect of social expenditures is still significant at 5 percent level and of comparable magnitude compared to the effect of government consumption spending in Table 4.

Insert Table 5 about here

In the last part of Table 5 we analyze student performance regarding the different components of social expenditures relating to specific social policy areas. In column (4) we replace total social expenditures with all its various components. All components have a negative sign as expected, except health care spending (zero effect) and family allowances: The effect of expenditures for family allowances is positive and significant. Relaxing parents’ budget constraints in the poorest families appears to have a positive effect on the average achievement level of students.

The different expenditure components are positively correlated, which may contribute to the heterogeneous and mainly insignificant effects in column (4). Thus, we have run regressions including each of the components separately. In all cases, the effects are negative, except for family allowances. Columns (5)-(7) in Table 5 report the three cases where the effects are significant at least at the 10 percent level. The effects of spending on active labor market policies and pension payments are both performance lowering, and since the former constitutes only a small part of social expenditures, the negative effect of social expenditures seem to a large part be driven by pension spending.[12] In contrast, family allowances have a positive and significant effect also when included as the only expenditure component in the model. In contrast, unemployment spending and health spending never appear as decisive determinants of student performance.

5.3 Generosity of the welfare system

The size of the government sector expressed in percentage of GDP is commonly viewed as a proxy for the generosity of the government in terms of public goods creation and financial transfers to households. However, in principle, generosity of social transfers can be directly assessed only if values per recipient in place of per capita numbers are employed. As information on number of recipients is not easily available, we analyze the effects of generosity by estimating models with some components of social expenditures together with a measure of number of recipients, by using either the share of elderly in the population or the share of unemployed in the active population. Indeed, omission of beneficiary measures might bias our results as the spending estimates might capture population composition effects. Simple correlations of the spending measures with the number of its beneficiaries are large.[13] For this reason, we also conduct F-tests of joint significance as the high correlation might inflate the standard errors of the corresponding estimated coefficients.

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[12] We are unable to exclude the possibility that more public expenditures on pension may equally proxy for a large body of civil servants. In this case, the prospects of becoming a civil servant with high job security and generous retirement options may equally lower effort in mandatory schooling.

[13] The correlation coefficients between unemployment spending and unemployment rate is 0.51 and between pension spending and the share of the population above the age of 60 is 0.86. The correlation between active labor market policy and the unemployment rate is only 0.17.

In Table 6, we present results for models with measures of the number of recipients included. Taken all together, since the baseline model findings prevail, the results indicate that government size is a good proxy for the generosity of the welfare state, which appears to lower student performance. Pension spending and active labor market policy spending still exert a performance lowering impact when the share of elderly and the unemployment rate, respectively, are included in the model (columns 1 and 2), while the effects of unemployment and health care spending remain insignificant (columns 3 and 4). The similarity of the coefficients on the spending variables with the original models reported in Table 5 suggests that the bias from using per GDP measures in place of per recipient values is rather small. Regarding pension spending in column (1), the significance level is reduced to 10 percent when the share of elderly is included. However, the share of the population above 60 years of age is insignificant at 10 percent level, and the test of joint significance clearly suggests that at least one of the variables is related to student achievement. The effect of active labor market policies spending is significant at 5 percent level when the unemployment rate is included (column 2).

Insert Table 6 about here

5.4. Robustness analyses

The student achievement tests we include from the 1980s are not average results for jointly counted math and science tests as are those tests employed in the 'post-communist period', (1990s and beyond), but separate tests on the two subjects. It is also usual to argue that the test design and test procedures have improved over time. The dependent variable may therefore include more measurement error in the 1980s than later on. Table 7 presents results for regressions on the subsample 1990-2003. Columns (1) and (2) in the table show that both the effect of government consumption and that of social expenditures are in fact larger in this subsample compared to the full sample including the pre-1990 tests.

Insert Table 7 about here

It might also be argued that government consumption spending and the generosity of the welfare state are proxies for educational expenditures. Existing evidence either from analyses both within and between countries, indicates that educational expenditures have at most a minor effect on student performance, see for example Hanushek and Luque (2003).[14] If, however, despite this evidence, educational expenditures have a positive effect on student achievement, there will be a positive bias on the effect of government size in models excluding educational expenditures since the variables are likely to be positively correlated. In columns (3) - (4) in Table 7 we employ school spending data from the WDI 2007 database, which is available for 1991 and, on an annual basis, from 2000 on. We linearly intrapolate the gaps. In columns 5 and 6 we add lagged annual public spending on primary school education to the baseline model, obtained from the OECD and available from 1986 to 2002. We allow for a separate effect of the respective student body size.[15] In general, the effect of educational expenditures is clearly insignificant, and close to zero on the OECD sample. Taken all together, the effects of government consumption or welfare spending hardly change when school spending is accounted for.

Lastly, we investigate whether the choice of functional form of the model is important. One may argue that it is not short-term fluctuations in the independent variables that are important, but the development in the medium or long term. We have carried out identical regressions as reported in Tables 5 and 6 using 5-year moving averages of the independent variable instead of current values. The findings for government consumption spending appear to be sensitive to the choice of time window. The effect of the 5-year moving average is clearly insignificant. The effect of social expenditures analyzed for the OECD countries, however, is similar to the

[14] For contrasting evidence exploiting variation across Swiss states, see Fischer (2008). She finds that educational spending exerts a decisive impact through teachers' wages.

[15] A measure of student body for the full sample is not available.

model using current values.[16] We have also investigated whether the results are sensitive to using the log of the spending shares, but that does not seem to be the case.[17]

[16] The point estimate of the 5-year moving average of social expenditures is exactly equal to the effect of the current value, but only significant at 10 percent level. The effects of 5-year moving averages of active labor market policy and pension spending are also qualitatively similar to that of the models in Table 5. In contrast, family allowances appear not to affect student performance in the medium-run, while support of needy families in the form of housing subsidies exerts a beneficial effect. The results are available on request.

[17] Including the share of government consumption at level and squared form in the model, both variables have a significant effect at ten percent level. Student achievement is lowest for government consumption of about 30 percent of GDP. This is clearly at the upper part of the distribution of government consumption, indicating that the log-form chosen in the baseline model is a reasonably approximating. For social expenditures, not assuming the log-form yields identical results for pension spending, active labor market spending and family allowances, but not for total social spending. The results are available on request.

6. Conclusion

The recent publications of international comparative student achievement tests such as PISA and TIMSS have spurred the debate on school quality in many countries. Indeed, empirical analyses suggest that it is educational quality rather than quantity in terms of years of education that matters to economic growth. While most of the discussion has been centered around educational resource use and institutions, analyses of macro incentives implicit in economic policy is limited. At the same time, there is an ongoing debate whether the welfare state has excessively grown over the last decennials leading to hampered macro-economic growth through bureaucratic waste and high income taxation. Indeed, recent happiness research suggests that government consumption spending reduces welfare in society, both at the individual as well as at the aggregate level (Bjørnskov et al., 2007 and 2008).

This paper provides a link between these two strands of literature, providing a theoretical and empirical investigation into the effects of the size of the welfare state on investment in human capital during mandatory education. A simple economic model demonstrates that individuals' optimal investment in human capital declines in the generosity of the welfare system. Empirically we test the impact of government social spending on student achievement in mathematics and science at the lower secondary education level using a panel of up to 72 countries during the period 1980-2003. In fixed effects models that account for unobserved country heterogeneity, we identify a student performance deteriorating impact of a more generous welfare state, measured by either general government consumption spending or, for OECD countries, more narrowly by social welfare spending. The generosity of the social security system seems to be of particular importance.

Overall, this paper contributes to the branch of empirical (and theoretical) literature which suggests that cuts in the welfare state and government consumption spending might have beneficial effects to society – in both OECD and non-OECD countries. However, reality often is more complex and a differentiated view is advisable. The policy implications from our results are limited by the fact that empirical findings in form of 'point estimates' always must be interpreted as 'local' changes. Thus, our results cannot be interpreted as if it were optimal

in terms of student performance to cut government spending down to zero. Indeed, in the OECD country sample, we find a positive impact of family allowance payments. This result suggests that different components of social welfare might exert educational investment in different ways, potentially rather calling for a re-targeting of the means rather than simply cutting them in order to promote growth via human capital investment. We also have to acknowledge that our findings are for high- and middle-high income countries only - leaving the question unanswered to what extent least developed countries are affected by such government involvement in the economy.[18]

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[18] Indeed, also Bjørnskov et al. (2007) argue that their well-being lowering influence of the size of government sector may be driven by a sample selection problem, possible disguising an inverted U-shaped relation.

References

Agell, J., H. Ohlsson and P. S. Thoursie (2006): ”Growth effects of government expenditure and taxation in rich countries: A comment”. *European Economic Review* 50, 211-218.

Becker, G.S. (1964, 1993, 3rd ed.). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Chicago, University of Chicago Press.

Bjørnskov, C., Dreher, A. and Fischer, JAV (2007): "The bigger the better? Evidence of the effect of government size on life satisfaction around the world". *Public Choice* 127(3), 267-292.

Bjørnskov, C., Dreher, A. and Fischer, JAV, (2008). "Cross-country determinants of life satisfaction: exploring different determinants across groups in society". *Social Choice and Welfare* 30(1), 119-173.

Charles, K. K. and M.-C. Luoh (2003): “Gender differences in completed schooling”. *Review of Economics and Statistics* 85, 559-577.

Ehrlich, I. and J. G. Zhong (1998): “Social security and the real economy: An inquiry into some neglected issues”. *American Economic Review* 88, 151-157.

Ehrlich, I., and J. Kim (2007): "Social security and demographic trends: Theory and evidence from the international experience", *Review of Economic Dynamics* 10, 55-77.

Fischer, Justina A.V., (2007). "The Impact of Direct Democracy on Public Education: Evidence for Swiss Students in Reading, Mathematics and Natural Science," Working Paper Series in Economics and Finance 688, Stockholm School of Economics.

Fölster, S. and M. Henrekson (2001): “Growth effects of government expenditure and taxation in rich countries”. *European Economic Review* 45, 1501-1520.

Frölich M., Bourdon, J. and Michaelowa, K. (2007): "Teacher Shortages, Teacher Contracts and their Impact on Education in Africa," IZA Discussion Papers 2844, Institute for the Study of Labor (IZA).

Glomm, G., and B. Ravikumar (1992): "Public versus private investment in human capital: Endogenous growth and income inequality". *Journal of Political Economy* 100, 818-834.

Hanushek, E. A. and D. D. Kimko (2000): "Schooling, labor-force quality, and the growth of nations". *American Economic Review* 90, 1184-1208.

Hanushek, E. A. and J. A. Luque (2003): "Efficiency and equity in schools around the world". *Economics of Education Review* 22, 481-502.

Hanushek, E. A. and L. Wössmann (2007): The role of school improvement in economic development". NBER Working Paper 12832.

Hogan, V. and I. Walker (2007): "Education choice under uncertainty: Implications for public policy". *Labour Economics* 14, 894-912.

Jacobs, B. (2007): "Real options and human capital investment". *Labour Economics* 14, 913-925.

Jamison, E. A., D. T. Jamison and E. A. Hanushek (2007): "The effects of education quality on income growth and mortality decline". *Economics of Education* 26, 771-788.

Kneller, R., M. Bleaney and N. Gemmell (1999): "Fiscal policy and growth: Evidence from OECD countries": *Journal of Political Economy*, 74, 171-190.

Lee, J.-W., and R. J. Barro (1997): "Schooling Quality in a Cross-Section of Countries" *Economica* 68, 465-488. Data on http://www.nber.org/pub/barro.lee/

OECD (2007): "$ocial €xpenditure 1980-2003: Interpretative Guide of SOCX", Paris: OECD 2007.

Postlethwaite, T. N., and D. E. Wiley (1992): "The IEA study of science II: Science achievement in twenty-three countries". Pegamon Press, New York

Poutvaara, P. (2007): "Social security incentives, human capital investment and mobility of labor". *Journal of Public Economics* 91, 1299-1325.

PWT 6.2 (2006). Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. http://pwt.econ.upenn.edu/

Sinn, H.-W. (1995): "A Theory of the Welfare State, *Scandinavian Journal of Economics* 97, 495- 526.

Travers, K. J., and I. Westbury, eds. (1989): "The IEA Study of Mathematics I: Analysis of Mathematics Curricula". Pergamon Press, New York.

Warm, T.A. (1989). "Weighted Maximum Likelihood Estimation of Ability in Item Response Theory". *Psychometrika*, 54, 427-450.

Wössmann, L. (2003a): "Specifying human capital". *Journal of Economic Surveys* 17, 239-270.

Wössmann, L. (2003b): "Schooling Resources, Educational Institutions and Student Performance: the International Evidence". *Oxford Bulletin of Economics & Statistics* 65, 117-170.

Zhang, J. and J. Zhang (2004): "How does social security affect economic growth? Evidence from cross-country data". *Journal of Population Economics* 17, 473-500.

Table 1. Data sources description

Year	Test organization	Acronym	Test subjects	Test age or grade	Countries	Data source
1980-81	IEA	SIMS	Mathematics	13 years	3 in 1980 14 in 1981	Lee and Barro (1997) Travers and Westbury (1989)
1983-85	IEA	SISS	Science	14 years	11 in 1983 11 in 1984 1 in 1985	Postlethwaite and Wiley (1992)
1990-91	IAEP	IAEP	Mathematics and science	13 years	2 in 1990 17 in 1991	Lee and Barro (1997)
1994-95	IEA	TIMSS	Mathematics and science	Grade 8	4 in 1994 36 in 1995	timss.bc.edu/
1998-99	IEA	TIMSS-repeat	Mathematics and science	Grade 8	6 in 1998 31 in 1999	timss.bc.edu/
2000-02	OECD	PISA 2000	Mathematics and science	15 years	32 in 2000 9 in 2002	www.pisa.oecd.org
2002-03	IEA	TIMSS 2003	Mathematics and science	Grade 8	7 in 2002 38 in 2003	timss.bc.edu/
2003	OECD	PISA 2003	Mathematics and science	15 years	40 in 2003	www.pisa.oecd.org

Note. For some countries separate scores are reported for different parts of the country. We have calculated mean country averages by using population as weight. IEA (except the 1983/84 test) and IAEP tests are conducted in the fall in the southern hemisphere and in the spring in the northern hemisphere. PISA 2000 originally only included five non-OECD countries, but nine additionally non-OECD countries conducted the same test in 2002.

Table 2. Types of social expenditures in OECD countries

Policy area	Programs
Old-age	Pensions, early retirement pensions, home-help, residential services for the elderly.
Survivors	Pensions and funeral payments.
Incapacity-related	Care services, disability benefits, benefits accruing from occupational injury and accident legislation, employee sickness payments.
Health	Spending on in- and out-patient care, medical goods, prevention.
Family	Child allowances and credits, childcare support, income support during leave, sole parent payments.
Active labour market policies	Employment services, training youth measures subsidised employment, employment measures for the disabled.
Unemployment	Unemployment compensation, severance pay, early retirement for labour market reasons.
Housing	Housing allowances and rent subsidies.
Other social policy areas	Non-categorical cash benefits to low-income households, other social services; i.e. support programmes such as, food subsidies, which are prevalent in some non-OECD countries.

Note. Source is Social Expenditure 1980-2003, OECD 2007, p.8.

Table 3. Descriptive statistics of government consumption and social expenditures

	Obser-vations	Mean	Standard deviation overall	Standard deviation within countries	Minimum value	Maximum value
General government consumption spending, percent of GDP	232	1765	539	146	569	4147
General government consumption spending, percent of GDP	122 (OECD)	1870	422	105	1008	2962
Public sector social expenditures, percent of GDP	118 (OECD)	1977	561	157	280	3250

Active labor market policy spending, share of GDP	117 (OECD)	62	44	19	0	220
Public health spending, share of GDP	121 (OECD)	554	128	67	0	830
Family allowance spending, share of GDP	118 (OECD)	192	108	28	0	410
Unemployment benefit spending, share of GDP	115 (OECD)	118	90	44	0	440
Pension spending, share of GDP	118 (OECD)	642	276	73	60	1280
Housing spending, share of GDP	98 (OECD)	43	39	17	0	180

Table 4. The effect of government consumption on student achievement

	(1)	(2)	(3)	(4)	(5)
Population size (log)	-	58	191	558	-17
		(78)	(22)	(36)	(1)
GDP per capita (log)	-	1.646**	0.707+	252	1.043+
		(102)	(191)	(51)	(171)
PISA	-	-84	-126	71	-471
		(25)	(80)	(44)	(139)
IEA	-	70	-115	-187	176
		(21)	(80)	(136)	(52)
Government consumption spending,	-107	-1.202**	-0.911*	-894	-808
percent of GDP (log)	(26)	(321)	(200)	(108)	(125)
Sample	All	All	All	OECD	Non-OECD
Country fixed effects	No	No	Yes	Yes	Yes
Observations	232	231	231	131	100
Countries	72	71	71	29	42
R^2	3	325	9348	8151	9442
R^2 (within)	-	-	757	1255	1338

Note. Absolute t-values in parentheses, +, * and ** denote significance at 10, 5 and 1 percent level, respectively.

Table 5. The effect of social expenditures on student achievement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Population size (log)	-	49	699	-1657	622	-159	-823
		(80)	(45)	(67)	(38)	(11)	(53)
GDP per capita (log)	-	0.893**	108	78	207	376	193
		(302)	(20)	(100)	(34)	(69)	(35)
PISA	-	226	258	74	198	246	104
		(92)	(163)	(35)	(130)	(160)	(64)
IEA	-	326	-83	-291	-13	-84	-196
		(135)	(62)	(164)	(101)	(66)	(145)
Government social expenditures, percent of GDP	-.488*	-0.757**	-0.870*	-	-	-	-
	(218)	(312)	(201)				
Unemployment spending (log)	-	-	-	-8	-	-	-
				(6)			
Family allowances (log)	-	-	-	0.740*	-	-	0.575*
				(241)			(225)
Pension spending (log)	-	-	-	-1.036+	-	-0.821**	-
				(185)		(284)	
Active labor market policy spending (log)	-	-	-	-274	-0.408*	-	-
				(108)	(256)		
Health care spending (log)	-	-	-	2	-	-	-
				(3)			
Housing spending (log)	-	-	-	-115	-	-	-
				(65)			
County fixed effects	No	No	Yes	Yes	Yes	Yes	Yes
Observations	124	124	124	82	116	124	123
Countries	29	29	29	20	29	29	29
R^2	376	1276	8457	7821	8392	8521	8433
R^2 (within)	-	-	1740	4274	2630	2079	1845

Note. Absolute t-values in parentheses, +, * and ** denote significance at 10, 5 and 1 percent level, respectively.

Table 6. Generosity of the welfare state: OECD countries

	(1)	(2)	(3)	(4)
Population size (log)	-688	401	-3	193
	(45)	(21)	(2)	(12)
GDP per capita (log)	61	511	172	380
	(102)	(67)	(25)	(63)
Pension spending (log)	-0.738+	-	-	-
	(171)			
Active labor market policy	-	-0.443**	-	-
spending (log)		(255)		
Unemployment spending (log)	-	-	46	-
			(28)	
Health care spending (log)	-	-	-	543
				(106)
Share of elderly (log)	-1284	-	-	-2.348**
	(145)			(313)
Unemployment rates	-	-1	-39	-
		(39)	(125)	
Dummy variables for testing institution	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Observations	113	113	116	115
Countries	28	29	28	28
R2	8538	8384	8210	8406
R^2 (within)	2848	2621	1858	2332
F-test (social spending, recipients)	6.93**	3.60*	101	491
(p-value)	17	318	3670	97

Note. Absolute t-values in parentheses, +, * and ** denote significance at 10, 5 and 1 percent level, respectively.

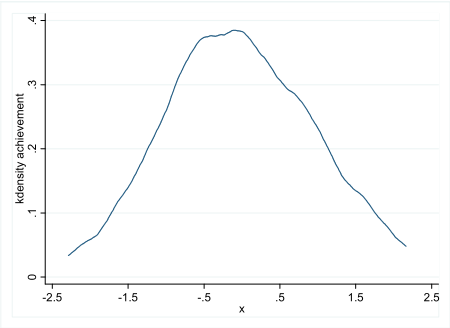
Table 7. Post-communist period 1990-2003; including educational expenditures

	(1)	(2)	(3)	(4)	(5)	(6)
Population size (log)	564	3983	-327	1792	2553	3856
	(48)	(129)	(28)	(59)	(74)	(115)
GDP per capita (log)	590	745	729	884	823	-35
	(122)	(85)	(157)	(105)	(85)	(4)
Government consumption	-1.358**	-	-1.660**	-	-	-
Expenditures, percent of GDP (log)	(275)		(319)			
Government social expenditures,	-	-1.080*	-	-844	-1049	-2.031*
percent of GDP (log)		(208)		(153)	(118)	(210)
Education expenditures,	-	-	691	-13	-	-
percent of GDP (log)			(119)	(18)		
Primary education expenditures lagged	-	-	-	-	0.991+	-141
one year, percent of GDP (log)					(178)	(20)
Number of pupils in primary education	-	-	-	-	-	0.848+
lagged one year (log)						(190)
Sample	All	OECD	All	OECD	OECD	OECD
Dummies for testing institution	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes
Observations	198	104	192	100	89	83
Countries	69	29	68	29	27	26
R2	9550	8684	9568	8795	8718	8715
R^2 (within)	910	2741	1082	2771	3597	3628
F-test (social spending, school spending)			512	159	215	220
(p-value)			74	2110	1255	1211

Note. Absolute t-values in parentheses, + * and ** denote significance at 10, 5 and 1 percent level, respectively.

Figure 1. Kernel density of student achievement

a) “Core” country observations



b) All observations

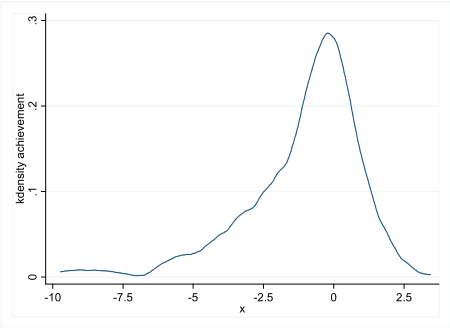
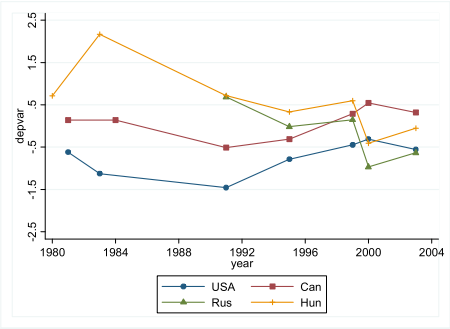
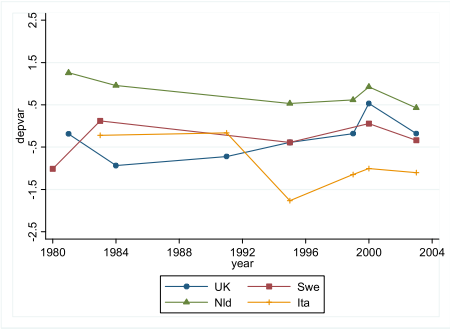
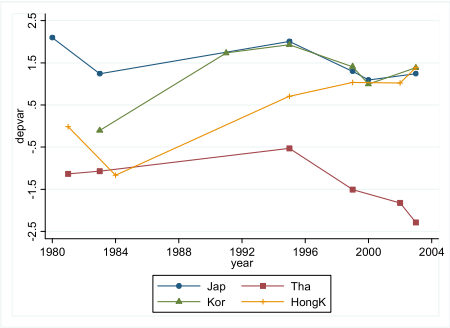


Figure 2. Country specific development in relative student achievement.







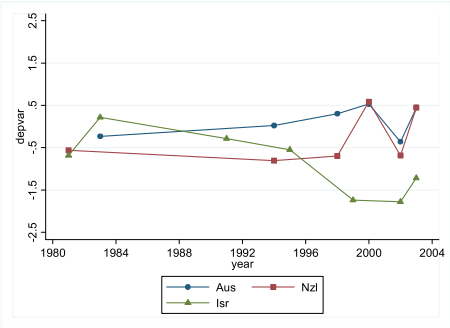


Figure 3. Kernel density of change in student achievement

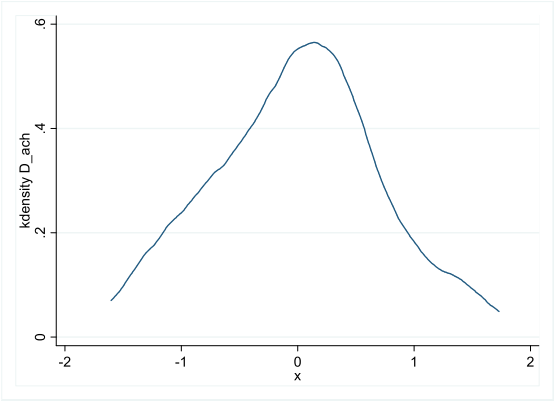
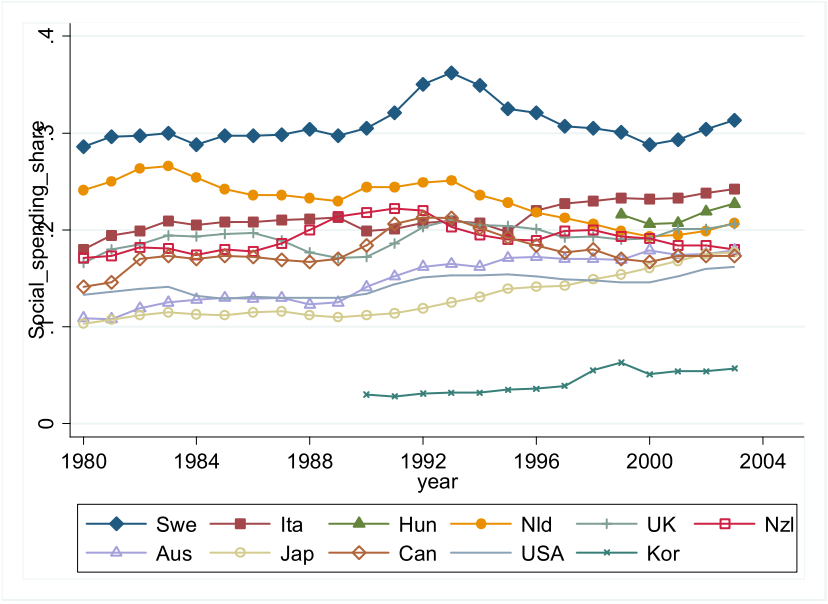


Figure 4. Country specific development in social expenditures as share of GDP



THURGAU INSTITUTE
OF ECONOMICS
at the University of Konstanz

Hauptstr. 90
CH-8280 Kreuzlingen 2

Telefon: +41 (0)71 677 05 10
Telefax: +41 (0)71 677 05 11

info@twi-kreuzlingen.ch
www.twi-kreuzlingen.ch