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INCOME DISTRIBUTION DETERMINANTS AND PUBLIC SPENDING EFFICIENCY

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Income Distribution Determinants and Public Spending Efficiency[*]

António Afonso,[# $] *Ludger Schuknecht*[#] *and Vito Tanzi*[±]

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Abstract

In this paper we examine the impact of public spending, education, and institutions on income distribution in advanced economies. We also assess the efficiency of public spending in redistributing income by using a DEA (Data Envelopment Analysis) non-parametric approach. We find that public policies significantly affect income distribution, notably via social spending, and indirectly via high quality education/human capital and via sound economic institutions. Moreover, for our set of OECD countries, and within a two-step approach, several so-called non-discretionary factors help explaining public social spending inefficiencies.

Keywords: income redistribution, public spending, efficiency, DEA.

JEL Classification Numbers: C14, H40, H50.

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Contents

Non-technical summary

Income distribution and the role of the market, the public sector and globalisation have gained increasing attention in recent years. In this paper we examine the impact of public spending, education, and institutions on income distribution in advanced economies from a cross-country perspective. This is, to our knowledge, an important and remarkable gap in the literature. The study first discusses conceptually the determinants of income equality: initial conditions and public policies affect income distribution directly (via the effect of taxes and spending) or indirectly (via the effect on earning opportunities, human capital and institutions). It then studies empirically the relation between distribution indicators on the one hand and public spending and other factors on the other.

This study examines empirically the role and efficiency of public spending policies in affecting income distribution from a cross-country perspective. The study first discusses conceptually the determinants of income equality: initial conditions and public policies affect income distribution directly (via the effect of taxes and spending) or indirectly (via the effect on earning opportunities, human capital and institutions). It then studies empirically the relation between distribution indicators on the one hand and public spending and policy outcomes on the other. To assess the efficiency of public spending in promoting and achieving more equalization of income, the study uses a non-parametric DEA approach, following, for instance, the analytical framework by Afonso, Schuknecht, and Tanzi (2005) for public sector performance expenditure in the OECD and by Afonso and St. Aubyn (2005, 2006a, b) for the education and health sectors.

The study finds that redistributive public spending (except pensions) and education performance have a significant effect on income distribution as reflected in stylised facts and in the regression analysis. Results for the role of institutions and personal income taxes point in the right direction but are not robust while more open countries do not have less equal income distribution. In addition, DEA analysis suggests that while some Southern and large continental European countries show a relatively consistent picture of low efficiency and some Nordic countries report relatively high efficiency, the picture is very variable for Anglo-Saxon countries. Moreover, effectiveness and efficiency of public social spending is enhanced in countries with a strong education performance (and to a less robust extent education spending. The direct link from the institutional framework to income distribution appears more tenuous in regressions while the two-step

analysis point to a strong indirect role with favourable institutional indicators significantly correlated with the efficiency of social spending.

We must point to a number of caveats, notably the quality of data, the measurement of income distribution and the factors that influence it (including the appropriate measure of public spending) and the small number of observations.

The analysis of exogenous factors has another caveat which implies some careful interpretation of the results. Treating non-discretionary factors such as PISA scores, institutions and GDP as exogenous explanatory variables in explaining efficiency, is certainly interesting and more policy relevant from a short-term perspective as it can help to gage their quantitative relevance. However, this should not serve as an excuse for poor income distribution indicators and efficiency but rather as an enticement to do better. The policy implication of this study is hence to improve on all these factors that are endogenous in the long run: keep spending as low and well-targeted as possible, improve education performance and strengthen the quality of the institutional framework and public administration.

1. Introduction

Income distribution and the role of the market, the public sector and globalisation have gained increasing attention in recent years. This study examines empirically the role and efficiency of public spending policies in affecting income distribution from a cross-country perspective. This is, to our knowledge, an important and remarkable gap in the literature. The study first discusses conceptually the determinants of income equality: initial conditions and public policies affect income distribution directly (via the effect of taxes and spending) or indirectly (via the effect on earning opportunities, human capital and institutions). It then studies empirically the relation between distribution indicators on the one hand and public spending and other factors on the other.

To assess the efficiency of public spending in promoting and achieving more equalization of income, the study uses a non-parametric approach based on Data Envelopment Analysis (DEA), following, for instance, the analytical framework by Afonso, Schuknecht, and Tanzi (2005) for public sector performance expenditure in the OECD and by Afonso and St. Aubyn (2005, 2006a, b) for the education and health sectors.

The study finds that redistributive public spending (except pensions) and education performance have a significant effect on income distribution as reflected in stylised facts and in the regression analysis. Results for the role of institutions and personal income taxes point in the right direction but are not robust while more open countries do not have less equal income distribution. In addition, DEA analysis suggests that while some Southern and large continental European countries show a relatively consistent picture of low efficiency and some Nordic countries report relatively high efficiency, the picture is very variable for Anglo-Saxon countries. Moreover, effectiveness and efficiency of public social spending is enhanced in countries with a strong education performance (and to a less robust extent education spending. The direct link from the institutional framework to income distribution appears more tenuous in regressions while the two-step analysis point to a strong indirect role with favourable institutional indicators significantly correlated with the efficiency of social spending.

The effectiveness and efficiency of policies to affect income distribution should not be seen as “God given” and the findings of the paper suggest significant scope for reform

(and further work). The functioning of the institutional framework and the effectiveness and competence of government in providing education or in attaining the objectives of redistributional policies can be improved by appropriate policy reforms. In some cases, when policy targets are well-achieved efficiency gains may nevertheless be reached by spending less money (e.g. via better targeting). In some other cases, targets may not be achieved but a better use of existing funds might already be sufficient to improve things.

The remainder of the paper is organised as follows. Section two provides conceptual considerations and reviews the literature on the determinants of income distribution and the role and efficiency of public policies in this regard. Section three provides some correlation and regression analysis in this regard. Section four and five set up and conduct the efficiency analysis public policies in equalizing income, using both DEA and Tobit analysis. Section six concludes.

2. Income distribution and its determinants: some conceptual considerations

What determines the distribution of income in a given country and at a given time? Why is the income distribution more even in some countries than in others? Can the distribution of income be changed through the intervention of the government? These and similar questions have been raised with increasing frequency by economists and political scientists. In the often undemocratic societies of the past, in which oligarchies ran governments, the distribution of income was seen as an almost natural condition of society. However, in modern, democratic societies, in which most adult citizens, rich or poor, have the right to vote for those who will represent them in the government, there is less tolerance for, or acceptance of, high inequality. As a consequence policymakers are pressured to introduce policies intended to make the distribution of income or of consumption more equal. Over the years the focus of attention has shifted form the distribution of (real) wealth to that of income and, more and more, to that of consumption.

Robert W. Fogel, the 1993 winner of the Nobel Prize in Economics, has argued that until the last third of the 19th century, the concern of economists had been with equality of opportunities. Then over the next hundred years the attention shifted to the equality of material conditions such as food, clothing, lodging and so on. This objective could be achieved by taxing the rich with high and progressive income taxes while subsidizing the

incomes or the consumption of the poor. However, progressively, because of the potential disincentive effects that taxes could generate and because of the concentration of income taxes on dependent workers, taxes lost some or much of their potential impact on income distribution. They acquired the characteristic of "fiscal churning" that is reshuffling of income that changes only marginally the whole distribution. At the same time the income transfers that had been focused on the poor were largely replaced by universal entitlement programs, especially in health and education, which benefited all citizens and not just the poor. Fogel (2000) argues that because material goods account for a progressively smaller share of total spending for most people, in the future the fight for more equality or equity will be directed to the distribution of immaterial goods.

This paper deals mainly with the role that the government has played in promoting more income equality, than it would exist without its intervention, at a given time. It thus attempts to link policies at a given time with measures of income distribution at the same time. However, it must be recognized that past government policies have also played some role in determining the current income distribution. These policies have contributed to the determination of so-called initial conditions. This means that it may not be possible to isolate completely the impact of past and present public policy on income distribution. This must be kept in mind when assessing the econometrically determined impact of these policies in the later parts of this paper.

At a given point in time, and in a given country, without the current intervention of the government, through taxation, spending policies, and regulations, the income distribution that would emerge would be largely determined by the following factors:

(a) The inheritance of tangible and financial wealth;
(b) The inheritance of human capital, including within-the-family learning as well as the inheritance of attitudes toward learning, work, risk and so on. Whether inherited, genetic factors can play a role in this process is still a highly controversial area; the inheritance of useful connection, positional rents, and other valuable assets that determine a person's social capital;
(c) Societal arrangements and norms, such as whether individuals tend to marry individuals with similar wealth or educational background; real or de facto caste systems, and so on (see Tanzi, 2000).

In addition to the initial conditions mentioned above, that are largely determined by inheritance and societal traditions and norms, there are more individually-nested, or random factors, which also play important roles. These are (a) the distribution of skills, intelligence, and even look not directly inherited and (b) what could be called luck, or the role that randomness plays in determining incomes in non-traditional and market-oriented economies. The chance that someone will end up with the skills or acumen of Tiger Woods, Bill Gates, or Warren Buffett cannot be determined by the initial conditions or by government policies. In a market economy, individuals with exceptional skills in various areas (entertainment, sport, economic or financial activities, and so on) are more likely to end up with exceptional incomes. In many cases luck (or a randomness factor) will also play a role. Some of these individuals may end up in the annual Forbes or similar lists of the world richest individuals and will have an impact on Gini coefficients or on other measures of inequality.

Initial conditions, exceptional skills, luck, and past public policies will combine with the working of the market to determine the distribution of income that prevails in a society before the current intervention of the government. Afterwards, to determine the distribution of spending power among the population the government steps in with taxes, public expenditures, tax expenditures, and some relevant regulatory policies. Relevant regulations will be (a) those that control prices or rents; (b) that determine hiring quotas for some categories of individuals; (c) that establish property rights for patents or for other forms of intellectual property; (d) that pursue anti-trust policies and so on. We shall not be able to take into account regulations in our empirical work and will also ignore the impact that progressive tax systems can have on the after tax distribution of income. Much of the focus of this paper will be on public spending and policy outcome and their impact on inequality.

It may be worthwhile to stress that the impact of the government on the income distribution may be direct or indirect and that this distinction is in part linked with the current and past impact of the government.

The direct and current impact of the government can come through taxes and through spending and other public policies. The level of taxation and its progressivity is the most

direct factor. This factor, per se, can make the distribution of after-tax incomes different, and presumably more equal than the pre-tax distribution. However, various forms of "tax expenditures" that indirectly subsidize some categories of private spending – education, health, training, expenses connected with mobility, etc. – will undoubtedly, over time, have some impact on income distribution. Through its features, the tax system can also influence the retirement age, the size of families, and individual effort, which are all features with a direct impact on income distribution.

On the expenditure side of public policies we can also identify direct and indirect effects. Public spending that injects income or spending power in the hands of individuals, through cash payment or direct support for spending that is important for poorer individuals (food stamps, subsidized housing, free child care for working mothers, subsidized tariffs for low levels of consumption of public utilities, etc.) has a clear effect on income distribution. However, public spending can have indirect but still significant effects on the distribution of income in other ways that mainly improve productivity and opportunities to find a job disproportionately for the less well off. For example an efficient public transportation system can widen the area in which poorer individuals can search for jobs by reducing travel costs. Spending for job training or retraining can move individuals from the unemployed to the employed category. Spending on education can benefit the poor disproportionately if it improves their relative endowment with human capital. Free access to health facilities can keep people healthy and make possible for them to be in the labour force.

In addition to the above, it has to be recognized that a good institutional set up that guarantees rule of law and fair and quick access to justice will also contribute to a better distribution of income by reducing abuses and corruption. Some studies have, for example, linked corruption with higher Gini coefficients. When rule of law is not fair or is not respected, poorer people are more likely to be exploited through lower compensation for their work and higher costs for some services, as for example in the case of usury when they borrow money.

The above description suggests clearly that while some public actions or policies have an immediate and direct impact on the distribution of income or on the income of some groups, others have an indirect impact or an impact only over time. Thus the empirical

work that follows reflects some of these limitations because it is focused largely on current public spending on income distribution.

3. Cross-country and historical assessment

In this section, we first take a look at the data that underpins our analysis of income distribution, before providing some first descriptive statistics, correlations and regression analysis of the determinants of income distribution. We focus in particular on the impact of redistributional expenditure policies, education as a provider of human capital/opportunities and some tax policy and institutional issues.

3.1. Income distribution data: a brief stock-taking

Income distribution data reflects the different objectives of measurement.[1] We have identified five overall indicators. 1) The Gini coefficient is probably the most famous indicator where a low number suggests more equality and a high number inequality. 2) The income share per quintile is another popular indicator with the income share of the poorest or the poorest two quintiles being typically examined. Other indicators include 3) the poverty rate as the share of people with less than 50% (or any other share) of median income. These three indicators also allow cross-country comparisons with relative ease. 4) The absolute poverty rate which looks at the share of people living below some pre-defined threshold of income and 5) the absolute per-capita income of the poorest (or poorest two) quintile(s) are further alternatives. They are only reasonably comparable if they are adjusted (for the consumption basket or purchasing power parity). In addition, there are indicators that refer to segments of the population like 6) child poverty, 7) absolute child poverty or 8) old age poverty, to name only a few.

A few further caveats are worth mentioning. Indicators can refer to gross income, factor income or disposable income. They can look at families, households, individuals or taxpayers. They can include or exclude the self-employed. The sources can be surveys, censuses, tax or social security records. This illustrates that great care needs to be applied, especially when comparing indicators across countries and over time. Finland,

[1] Different measurements may not only have different objectives but also implicitly reflect the value-judgement of analysts. The Gini coefficient for example measures the relative distribution within one society. A measure of per capita GDP for the poorest quintile across countries puts more weight on the absolute situation of the poor and the presumed trade-offs between income distribution and growth.

for example, reported for the year 2000 a Gini coefficient for disposable income of 26.4, of factor income of 47.2 and of gross income of 31.2.

In a first step we would like to take stock of some of the available income distribution indicators and their distribution over time and countries. The largest dataset of Gini coefficients is to our knowledge published by WYDER which covers many countries and in some instances starts in the 19th century. Chart 1a illustrates the data distribution for the period 1950 until most recently. It shows a trend towards greater equality until the 1980s followed by a more ambiguous pattern thereafter. But the chart also shows the enormous diversity of data for the reasons mentioned above. A reasonably homogenous and comparable dataset for Gini coefficients and disposable income is compiled by the Luxembourg income dataset in which, however, observations before 1980 are rather rare. Nevertheless, for the past 25 years the ambiguous pattern of the WYDER dataset is broadly confirmed (Chart 1b). From a global perspective, the World Development Report provides data for Gini coefficients and the income share per quintile for many countries and, via different vintages, different years.

[Chart 1]

The most important data source for income distribution indicators for advanced countries seems to be the OECD. Foerster and d'Ercole (2005) have put together an excellent set of cross-country data for the period 1985 to 2000, including for sub-groups of society. Taking a glimpse also at this dataset, it is interesting to note that the only group which experienced an unambiguous further fall in poverty rates since the 1980s is the elderly while child-poverty has tended to increase (Chart 1c-d).

Changes over the past two decades can also be illustrated by plotting the Gini coefficient for 1980, 1990 and 2000, as in Chart 2. Observations below the 45 degree line reflect an equalisation in income distribution over this decade while those above suggest a tendency towards less equality. For instance, for the period 1990-2000, while all countries are relatively close to the 45 degree line, equality appears to have increased most notably in Denmark, the Netherlands, France and Switzerland while it decreases in the US, Belgium, Sweden and Finland.

[Chart 2]

3.2. Determinants of income distribution: some correlations

Consistent with our earlier discussion of the likely determinants of income distribution, we conducted two types of quantitative analysis. This aims to get a better feel for the data and their interrelation. In this sub-section we conduct correlation analysis before, in the next one, we look at some simple regression analysis. We look at levels of indicators in recent years and at their changes over recent decades, as presented in Table 1 (for an overview of basic descriptive statistics see the Annex).

Starting with the role of public finances, there is a relatively strong correlation between public expenditure and income distribution in recent years (Table 1a). This correlation, however, is somewhat weaker for total expenditure (correlation coefficients of about 0.5) than for redistributional components, i.e. social spending, transfers and subsidies and family benefits (about 0.5-0.7). The correlation between pensions and old-age poverty is relatively weak (see Foerster and Mira d'Ercole, 2005, for a discussion). There is also a much weaker correlation between public spending and absolute income indicators. This is illustrated in the fourth column which shows the correlation between public spending and PPP-based per-capita GDP of the poorest quintile across countries.

There is a relatively strong correlation between the change in income distribution as measured by the change in the income share of the poorest 40% of households and the change in public spending between 1960 and 2000 (Table 1b). However, this relationship is already significantly weaker for the change in the Gini coefficient. Moreover, initial (unequal) income distribution is not a good predictor for subsequent spending increases.

[Table 1]

The magnitude of interrelations between income distribution and public spending can be illustrated very roughly by the bi-variate regressions displayed in Chart 2. To attain a 1% higher income share of the poorest 40% of households, it is necessary to rise social spending by roughly 3.3% of GDP (Chart 3a).[2] The correlation between the change in

[2] A 1% income share for the poorest two quintiles reflects an increase in relative per capita GDP in this group by about US$ 600 (given an average per capita GDP ppp across sample countries in 2000 of slightly

social spending and income distribution over the past 40 years is also rather positive (Chart 3b).

[Chart 3]

The picture changes significantly when looking at the past 20-25 years only. There is virtually no correlation between the change in total or social spending and income distribution since the 1980s (Table 1b). Chart 3, as quoted from Heipertz and Warmedinger (2007) confirms this picture with part a) confirming the positive correlation of levels and part b) showing an even negative correlation between changes in social spending and the Gini coefficient since the mid 1980s.

[Chart 4]

This picture is consistent with the findings of two of the authors in an earlier study (Schuknecht and Tanzi, 2006) where countries that undertook ambitious expenditure reform and notably lowered social spending did not experience much adverse effects on the income share of the poorest quintile of households. At the same time, absolute incomes of the poor increased most strongly in the group of countries that undertook early and ambitious reforms, starting already in the 1980s (Table 2). This may be due to the elimination of poorly targeted benefits (that helped poor little) and the improvement of incentives and employment opportunities (that benefited the poor disproportionately).

[Table 2]

Synthesizing this first set of results, one can safely say that public and notably social spending matters for income distribution both in terms of levels and, perhaps a bit less strongly, for changes over the past 30-40 years. The picture, however, seems to have changed in recent decades when the correlation of changes in public social spending and income distribution may have broken down. We will come back to this issue in the next sub-section.

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below US$ 25000). A 3.3% of GDP spending increase implies roughly US$ 800 per capita. Perfect targeting would imply an increase in spending by US$250 per capita (fully spent on the poorest 40% and financed by the richest 60%).

Turning to human capital as contributor to income distribution, there is also a surprisingly strong relationship between some measures of educational achievement (OECD PISA) and various income distribution indicators across countries (Table 1c). It is noteworthy that correlation coefficients between mathematical and problem solving skills and various income distribution indicators except old age poverty show high values above 0.4. Although the correlation coefficient with public education spending is similarly high, this may be spurious and reflect more the correlation of education and social spending than the human-capital related effects (as will also be shown in the next section). The correlation between public education spending and educational achievements is in fact very limited (see e.g., Hauptmeier et al., 2006).

We only undertook a very tentative and limited glimpse at the effect of taxation by looking at personal income taxes which should have an equalising impact on income distribution through progressivity as also implied by correlation coefficients of above 0.4 for personal income tax revenue and income shares and Gini coefficients (1d).

The effect of initial conditions on today's income distribution can be assessed by correlating recent indicators with those of some decades ago. While the income share of the poorest two quintiles in 1960 and 2000 are not correlated, the 2000 Gini coefficient is still strongly related to that prevailing in about 1970 (1e).

Finally we look at institutional indicators and globalisation/openness (Table 1f). A strong correlation of better institutions and more income equality is confirmed for two of the four indicators, i.e., the degree of independence of the judiciary and the amount of red tape. Regulation quality and the size of the shadow economy appear to be less strongly correlated. The correlation between openness as measured by exports plus imports over GDP and income distribution is relatively high between 0.3 and 0.4 with more open economies having a more equal income distribution (contrary to some conjectures in the debate).

3.3. Determinants of income distribution: a first regression analysis

In this section, we undertake some simple cross-section regression analysis. The hypotheses are that public spending and notably redistributional spending and the tax

system affect income inequality directly. Education/human capital and the institutional framework of a country do so indirectly via equalising the human capital endowment and providing a level playing field. In the literature is has also sometimes been claimed that globalisation may undermine equality. Our findings from regression analysis support the hypotheses on the role of public redistributive spending and education/human capital, results are mixed for institutional indicators and insignificant for personal income taxes and openness.

In a first set of equations, we look at income distribution across countries in recent years (about 2000) as measured by the income share of the poorest 40% of households and by the Gini coefficient (equations 1-4 in Table 3a). It is not very surprising that transfers and subsidies and social spending are highly significant in affecting income distribution. Coefficients around 0.3 suggest that 1% of GDP higher redistributive spending raises the income share of the poorest two quintiles by 0.3%. Despite the significant positive correlation, there is no significant correlation between personal income taxes and income distribution in any specification (including when replacing spending variables).

[Table 3a]

Institutional variables have the right sign but they do not show a robust and significant direct relation with income distribution with variables reflecting red tape/bureaucracy, the size of the shadow economy and independent judiciaries being significant in some specifications. As mentioned, the positive relation between openness and income distribution is also supported in regression analysis but it is not significant (not indicated). The inclusion of GDP per capita and unemployment as additional control variables (proxying the possible growth-distribution trade off and the fact that the poor are typically disproportionately affected by unemployment) does not yield significant results in this set of equations (not indicated).

In line with the earlier correlation analysis, education achievement on average and notably for mathematics and problem solving is significantly related to income distribution. About 25 points more in PISA imply a 1% higher income share of the poorest 40% of households (for reference, the largest difference in our sample countries is 75 points between Finland and Portugal, and the largest difference in the income share

is 7.6% between Finland and the US). Ten PISA points improve the Gini coefficient by one point according to these regressions. The inclusion of education achievement also significantly enhances the overall fit (adjusted R-square) of the models. Education spending, by contrast, does not significantly affect income distribution.

We also tested for the role of initial income distributions in 1960s/70s as reflecting initial conditions (wealth patterns, social norms and other factors that may change only very slowly over time). While this did not show up significantly in the equation on income shares for the poorest two quintiles (not indicated) it appears to be relevant for today's Gini coefficients (in line with the findings on correlations above).

There are two additional findings worth reporting which perhaps point to the need for more analysis. In equation 3 we use public education spending (an input indicator) instead of achievements (=output). This does not turn out to be a significant determinant of income distribution. In the same equation, however, regulatory quality becomes significant. The finding of insignificant institutional indicators in the other equations may hence be due to a correlation between education achievement and institutional quality (which may result in better policies including more efficient public education spending).

A second finding worth commenting on is represented in equation 5 where we regressed the Gini coefficient on social spending and an interaction term between social spending and educational attainment. While the former reverses sign and is now highly positive (suggesting a negative effect on income distribution) the latter is strongly significant and negative, implying that only high social spending coupled with good education positively affects income distribution. We will come back to this point in the DEA analysis.

A further equation 8 examines per capita GDP (PPP-adjusted) of the poorest quintile of households across sample countries. Unsurprisingly, a higher overall per-capita GDP of a country also implies a higher income of the poor and the elasticity here is a relatively low 0.4 (which could perhaps be interpreted as a trickle-down factor). The equation also suggests that each % of GDP of social spending raises per capita GDP of the 20% poorest households by US$232.[3] A higher unemployment rate is a significant factor in

[3] This implies that if the growth effect of lower social spending is 2 ½ times as high as the income effect, then the poor would be absolutely better off from reform. If reforms are designed in a manner that the

lowering the absolute income of the poorest quintile (a 1% higher unemployment rate lowers the income by 275$). Each additional PISA point raises income of the poor by about US$ 30.

A first tentative effort to explain changes in income distribution is reflected in equations (1)-(4) of Table 3b. These equations have to be seen with even more caution than the earlier ones as indicators may be less comparable over time and as the number of observations are very limited. Nevertheless, the results are broadly consistent with the earlier correlation analysis. Over long horizons, rising redistributive spending mattered and, for example, the change in the social spending ratio between 1960 and 2000 had a significant impact on the change in the income share of the poorest 40% of households (equation 1) while the finding is less robust for the Gini coefficient (equation 2). Personal income tax receipts have an equalising but non-robust effect on income distribution while the initial Gini level is correlated inversely with subsequent changes.[4]

[Table 3b]

When looking at changes over the past 20 years, public spending variables do not provide a robust picture. This is in line with the earlier findings from correlation analysis and the literature. Unlike for the longer horizon, initial income distribution is also not relevant for explaining subsequent changes. The results for education achievements (despite the above-mentioned caveat) are fully consistent with the earlier cross-section results.

All in all, income distribution appears to be significantly affected by public redistributive spending and education achievements. This relationship, however, does not appear to be very robust for changes, especially over the past 20 years. Moreover, there are hints that the beneficial effects of such spending may interact with better education quality. Results for the role of institutions and personal income taxes are not robust while more open countries do not have less equal income distribution. Further analysis beyond these very preliminary findings is certainly needed.

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income effect is smaller (e.g. through better targeting) then the threshold for the poor to benefit from higher growth will also be lower.

4. Efficiency of public spending

4.1. Literature

Previous research on the performance and efficiency of the public sector that applied non-parametric methods find significant divergence of efficiency across countries. Studies include notably Fakin and Crombrugghe (1997) for the public sector, Gupta and Verhoeven (2001) for education and health in Africa, Clements (2002) for education in Europe, St. Aubyn (2003) for education spending in the OECD, Afonso, Schuknecht, and Tanzi (2005, 2006) for public sector performance expenditure in the OECD and in emerging markets, Afonso and St. Aubyn (2005, 2006a, 2006b) for efficiency in providing health and education in OECD countries.[5] De Borger and Kerstens (1996), and Afonso and Fernandes (2006) find evidence of spending inefficiencies for the local government sector. Most studies apply the DEA method while Afonso and St. Aubyn (2006a) undertook a two-step DEA/Tobit analysis, in the context of a cross-country analysis of secondary education efficiency. Nevertheless, little or no work has been done using such non-parametric methods to assess the efficiency of public policies in affecting income distribution.

Another relevant issue for the analysis of public spending inefficiencies is the fact that public expenditure financing must rely on distortional taxation. This implies that both direct and indirect costs are relevant when estimating the economic impacts of inefficiency in public services provision. Indeed, the relative importance of indirect costs of public sector provision inefficiency, linked to financing through distortional taxation, increases with the magnitude of the inefficiency. Afonso and Gaspar (2007), in simple numerical exercises, with a calibrated model, found that indirect costs, associated with excess taxation burden, amplify the cost of inefficiency by between 20 and 30 per cent.

4.2. Non-parametric and parametric analysis

Non-parametric approach

Together with the set of already identified outputs, a set of inputs will be used to assess efficiency regarding income distribution measures. Among such inputs we can mention, as potential candidates, social spending, transfers and subsidies, spending on pensions,

4 While we do not have time series data for education attainment, including the 2000 value is not very meaningful as this assumes no change in education quality. Doing so just for illustrative purposes in equation (12) suggests borderline significance.

[5] See also Joumard et al. (2004) for additional information on OECD countries.

health, and education, tax and institutional indicators. Sometimes, principal component analysis may prove useful to reduce the number of variables used in the input side. In order to perform the efficiency study we use the DEA approach.

The DEA methodology, originating from Farrell's (1957) seminal work and popularised by Charnes, Cooper and Rhodes (1978), assumes the existence of a convex production frontier. The production frontier in the DEA approach is constructed using linear programming methods. The term "envelopment" stems from the fact that the production frontier envelops the set of observations.[6]

Regarding public sector efficiency, the general relationship that we expect to test can be given by the following function for each country *i*:

$$Y_i = f(X_i), \; i=1,\ldots,n \qquad (1)$$

where we have Y_i – a composite indicator reflecting our output measure; X_i – spending or other relevant inputs in country *i*. If $Y_i < f(x_i)$, it is said that country *i* exhibits inefficiency. For the observed input level, the actual output is smaller than the best attainable one and inefficiency can then be measured by computing the distance to the theoretical efficiency frontier.

The analytical description of the linear programming problem to be solved, in the variable-returns to scale hypothesis, is sketched below for an input-oriented specification. Suppose there are *k* inputs and *m* outputs for *n* DMUs. For the i-th DMU, y_i is the column vector of the inputs and x_i is the column vector of the outputs. We can also define *X* as the $(k \times n)$ input matrix and *Y* as the $(m \times n)$ output matrix. The DEA model is then specified with the following mathematical programming problem, for a given i-th DMU:[7]

[6] Coelli et al. (1998) and Thanassoulis (2001) offer introductions to DEA.
[7] We simply present here the equivalent envelopment form, derived by Charnes et al. (1978), using the duality property of the multiplier form of the original programming model.

$$
\begin{aligned}
&Min_{\ \delta,\lambda}\ \delta \\
&\text{s. to} \quad -y_i + Y\lambda \geq 0 \\
&\qquad\quad \delta x_i - X\lambda \geq 0 \\
&\qquad\quad n1'\lambda = 1 \\
&\qquad\quad \lambda \geq 0
\end{aligned}
\qquad . \qquad (2)
$$

In problem (2), δ is a scalar (that satisfies $\delta \leq 1$), more specifically it is the efficiency score that measures technical efficiency. It measures the distance between a country and the efficiency frontier, defined as a linear combination of the best practice observations. With $\delta<1$, the country is inside the frontier (i.e. it is inefficient), while $\delta=1$ implies that the country is on the frontier (i.e. it is efficient).

The vector λ is a $(n \times 1)$ vector of constants that measures the weights used to compute the location of an inefficient DMU if it were to become efficient. The inefficient DMU would be projected on the production frontier as a linear combination of those weights, related to the peers of the inefficient DMU. The peers are other DMUs that are more efficient and are therefore used as references for the inefficient DMU. $n1$ is a n-dimensional vector of ones. The restriction $n1'\lambda = 1$ imposes convexity of the frontier, accounting for variable returns to scale. Dropping this restriction would amount to admit that returns to scale were constant. Problem (2) has to be solved for each of the *n* DMUs in order to obtain the *n* efficiency scores.

Using non-discretionary factors

The analysis via composite performance indicators and DEA analysis assumes that expenditure efficiency is purely the result of discretionary (policy and spending) inputs. They do not take into account the presence of "environmental" factors, also known as non-discretionary or "exogenous" inputs. However, such factors may play a relevant role in determining heterogeneity across countries and influence performance and efficiency. Exogenous or non-discretionary factors can have an economic and non-economic origin.

As non-discretionary and discretionary factors jointly contribute to country performance and efficiency, there are in the literature several proposals on how to deal with this issue, implying usually the use of two-stage and even three-stage models (see Ruggioero, 2004). Using the DEA output efficiency scores, we will evaluate the importance of non-

discretionary factors below in the context of our new member and emerging market sample. We will undertake Tobit regressions by regressing the output efficiency scores, δ_i, on a set of possible non-discretionary inputs, *Z*, as as follows

$$\delta_i = f(Z_i) + \varepsilon_i \,. \tag{3}$$

5. Efficiency analysis results

5.1. Relative efficiency via a DEA approach

As a starting point of our efficiency analysis we computed the DEA efficiency scores from a one input and one output specification. As an input measure we use total public social expenditure as a percentage of GDP, as an average for the period 1995-2000.[8] Our output measure is based on the Gini coefficient data, also as an average for the period 1995-2000. Since in the DEA programme we need to insert increasing outputs as the desired objective, and given that higher Gini coefficients imply a bigger inequality in terms of income distribution, our output variable, $Gini^T$, is constructed by transforming the Gini coefficient observations as follows:

$$Gini^T = 100 - Gini \,. \tag{4}$$

Table 4 reports the results for the input and output oriented efficiency scores for the above described one input-one output model for a set of 26 OECD countries. The most efficient countries in terms of influencing income distribution via social expenditure appear to be the Nordic countries, Japan, the Netherlands, and Slovakia while Anglo-Saxon and Southern European countries, Germany and France appear to be less efficient.

[Table 4]

More concretely, the production possibility frontier is constructed with three countries: Denmark, Japan and the Slovak Republic, which envelop all the other countries (see also

[8] Social expenditure includes public and (mandatory and voluntary) private social expenditure at programme level and the main social policy areas are: old age, survivors, incapacity-related benefits, health, family, active labor market programmes, unemployment, housing, and other social policy areas. See the Data Annex and OECD (2007) for more details on how the OECD defines social expenditures.

Chart 5).[9] Additionally, in Table 4 we report the ranking of the countries, given their respective efficiency scores (Rank 1) and taking into account, for the countries on the frontier, the number of times each of those countries is a peer of a county outside the frontier Rank 2).

[Chart 5]

Still from Table 4 we conclude for the existence of both input and output inefficiencies when relating the use of public social spending to assess the inequality in income distribution. The average input efficiency score is 0.76 implying that for the overall country sample it would be theoretically possible to attain the same level of income distribution, as measured by the Gini coefficient, with roughly 24 percent less public social spending. The average output efficiency score is 0.93, which means that with the same level of public social spending one could in principle increase income equality indicators by 7 percent. (This reflects the very low marginal product of higher spending in terms of equality as reflected in the rather flat production possibility frontier.)

Naturally, such averages encompass rather heterogeneous realities. For instance, several individual input efficiency scores are closer to the production possibility frontier (the US, the Czech Republic, Ireland, Canada, Luxembourg or Australia) while there are also situations were the room for improvement seems to be larger (France, Belgium, Italy, Germany, and Poland). On the other hand, output efficiency scores exhibit overall lower volatility with the relative positioning of the countries showing some differences vis-à-vis the results for the input oriented case (the correlation between the two rankings is around 0.6).

We also specified two alternative models that consider one input (social spending as before) and two output indicators, both income inequality measures: the Gini coefficient and the poverty rate or the income share of the poorest 40% of the population. Again as in the case of the Gini coefficient we had to transform the poverty rate data in the same fashion. Tables 5 and 6 report the results of these two one input and two outputs models.

[9] Note that we did not consider Korea in the sample since it biases the findings (however, results with Korea area available upon request). Indeed, social spending-to-GDP ratio for Korea was extremely (roughly four times) below the sample average.

[Table 5]

[Table 6]

The estimation of these models shows two things. First, input efficiency scores are somewhat higher. Second, the results are not very robust across methods. In the models with two outputs, Southern European countries, the UK, France and Germany continue to show low efficiency of social expenditure. But a few countries, including a number of Anglo-Saxons (Canada, Ireland, the US and Australia) are now rather efficient while some of the Nordics report much lower ranks. This indicates that one needs to take these results with a great pinch of salt.

Among the 22 country sample as reported in Table 5, six countries are on the production possibility frontier: Canada, Finland, Hungary, Ireland, Luxembourg and the US. Ireland is efficient by default in the output oriented specification since it is never a peer of any other country outside the frontier. Moreover, the US is a bit of a special case since it has in this country sample both the lowest public social spending as a % of GDP and the worst values for the two output indicators, Gini and poverty rate.

For the estimation presented in Table 6, there are seven countries on the production possibility frontier: Canada, Denmark, Finland, Ireland, Luxembourg, Norway and the US. Interestingly, we can also observe that both Finland and the US are labelled as efficient by default, respectively for input and output orientation. Finland is not the highest spending country in terms of the social spending-to-GDP ratio but it has one of the best Gini indicators and the best performance in terms of the income share of the poorest 40%.

As an additional illustration, Chart 6 shows in two dimension the production possibility curve for the output-oriented case, for the model involving a single input (social spending) and two outputs (Gin and income share of the poorest 40%). From the picture it is possible to notice that Ireland has done the best in the income share of 40%-to-social spending ratio while the US has done better in the Gini-to-social spending ratio. Together these two countries form the efficiency frontier in the context of constant returns to scale,

as also shown in Table 6, putting an upper bound on the production possibilities for this particular 1 input and 2 outputs specification.

[Chart 6]

Overall, the results of this analysis should be seen as illustrative. While they reflect the significant data and measurement problems they are perhaps a first useful step in this largely unexplored domain. We summarise in Table 7 the main findings of our non-parametric efficiency analysis, confirming the very different degrees of efficiency across industrialised countries as we already detected in the earlier stylised facts.

[Table 7]

5.2. Explaining inefficiencies via non-discretionary factors

As an additional step, we extend our analysis to exogenous (non-discretionary) factors that might explain expenditure efficiency. The output efficiency score outcomes of the first two models as reflected in tables 4 and 5 serve as dependent variables.

As to exogenous factors, it is probably reasonable to conjecture that expenditure efficiency depends on the "technology" applied and skills available in the public sector, on institutional factors that influence, for example, the ability of private agents to protect their resources from public claims, on the monitoring capacities of public and private agents, and on international constraints. We proxy these considerations with the following independent variables: Education levels and education spending stand for human capital endowment that should increase the productivity of the public sector and facilitate its monitoring. Competence of the civil services more concretely proxies public sector "technology". Property tax income is seen as an (admittedly rather poor) index of the adverse distributional implications of taxation. Institutional variables (independent judiciary, red tape, shadow economy, regulation quality) should signal the security of property rights and sound checks and balances that boost efficiency in public spending. Amongst other control variables, the population share above 65 aims to capture "competition" over public resources while openness aims to gauge international influences. Per capita GDP is an indicator of capital stock in the economy (that should lead to better technology) but we also face a causality problem: rich countries may be

rich because they are more efficient in their redistribution (by discouraging rent seeking and other wasteful activities).

As a first step we look at correlations across dependent and independent variables. We report the correlation matrix for efficiency scores and several potentially relevant non-discretionary factors in the Annex. In a nutshell there seems to be significant correlation between expenditure efficiency on the one hand and PISA scores and several institutional variables on the other. Correlations are less high with education spending (consistent with the earlier regression analysis) and openness. When looking at correlations across independent variables (exogenous factors) it appears that the same institutional variables that are correlated with efficiency also show a strong relation with PISA scores and public sector competence while again public spending and openness show relatively lower coefficients. This observation points to multicollinearity problems for our regression analysis for certain variables with the economic intuition that countries with strong institutions are also likely to have efficient public sector policies in both the education and social domain.

Keeping this caveat in mind, regression analysis is broadly supportive of the above claims. More specifically, Tables 8 and 9 report the results from the Tobit analysis using the previously computed output efficiency scores from the DEA models respectively in Tables 4 (1 input and 1 output) and 5 (1 input and 2 outputs). It is noteworthy that PISA scores, the competence of civil servants, the quality of the judiciary and a small shadow economy are significant variables for explaining social expenditure efficiency. In addition high public education spending (only model 1), low property tax revenue and high per capita GDP contribute to explaining efficiency scores. Other variables are insignificant except for the elderly population ratio in model 2. Note, however, that the sample size ranges from only 18 to 22 countries, hence again suggesting to treat the results as illustrative.

[Table 8]

[Table 9]

In Tables 10 and 11 we report output efficiency score corrections for specifications 1 and 5 in Table 9 for the variables detected as statistically significant in the Tobit analysis (i.e., per capita GDP, PISA indicator, share in GDP of tax property revenues, public spending in secondary education and the extent of shadow economy). The corrections were computed by considering that the non-discretionary factors varied to the sample average in each country. The output scores corrected for non-discretionary or environmental effects (truncated to one when necessary) are presented in columns four and five of Tables 10 and 11 respectively as a result of the sum of the previous three and four columns. One should also notice that, for instance in Table 11, the number of countries considered decreased from twenty-three in the DEA calculations to eighteen in the two-step analysis, since data for public spending in secondary education and the shadow economy were not available for all countries.

[Table10]

[Table11]

The findings suggest a revision of efficiency scores and a reshuffle of the ranking of countries. Some inefficient countries appear to be so mainly due to exogenous factors, notably Greece, Portugal or New Zealand (to name only a few) where low per capita GDP results in a big adjustment parameter. Additionally, we illustrate in Chart 7 the changes in the efficiencies scores after taking into account the corrections prompted by the non-discretionary factors identified for models in Tables 10 and 11. Again, this is only a first step and much more analysis appears needed.

[Chart 7]

6. Conclusion

This study examines empirically the role and efficiency of public spending policies in affecting income distribution from a cross-country perspective. The study first discusses conceptually the determinants of income equality: initial conditions and public policies affect income distribution directly (via the effect of taxes and spending) or indirectly (via the effect on earning opportunities, human capital and institutions). It then studies empirically the relation between distribution indicators on the one hand and public

spending and policy outcomes on the other. To assess the efficiency of public spending in promoting and achieving more equalization of income, the study uses a non-parametric DEA approach, following, for instance, the analytical framework by Afonso, Schuknecht, and Tanzi (2005) for public sector performance expenditure in the OECD and by Afonso and St. Aubyn (2005, 2006a, b) for the education and health sectors.

The study finds that redistributive public spending (except pensions) and education performance have a significant effect on income distribution as reflected in stylised facts and in the regression analysis. Results for the role of institutions and personal income taxes point in the right direction but are not robust while more open countries do not have less equal income distribution. In addition, DEA analysis suggests that while some Southern and large continental European countries show a relatively consistent picture of low efficiency and some Nordic countries report relatively high efficiency, the picture is very variable for Anglo-Saxon countries. Moreover, effectiveness and efficiency of public social spending is enhanced in countries with a strong education performance (and to a less robust extent education spending. The direct link from the institutional framework to income distribution appears more tenuous in regressions while the two-step analysis point to a strong indirect role with favourable institutional indicators significantly correlated with the efficiency of social spending.

We must point to a number of caveats, notably the quality of data, the measurement of income distribution and the factors that influence it (including the appropriate measure of public spending) and the small number of observations.

The analysis of exogenous factors has another caveat which implies some careful interpretation of the results. Treating non-discretionary factors such as PISA scores, institutions and GDP as exogenous explanatory variables in explaining efficiency, is certainly interesting and more policy relevant from a short-term perspective as it can help to gage their quantitative relevance. However, this should not serve as an excuse for poor income distribution indicators and efficiency but rather as an enticement to do better. The policy implication of this study is hence to improve on all these factors that are endogenous in the long run: keep spending as low and well-targeted as possible, improve education performance and strengthen the quality of the institutional framework and public administration.

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Data annex

Table A1 – Descriptive statistics and sources

	Mean	Maximum	Minimum	Std. Dev.	Source
Income distribution					
Income share, poorest 2 quintiles, 2000	20.5	23.7	16.1	2.8	DI: WDI,
Income share, poorest 2 quintiles, 1980	18.4	21.2	15.7	1.5	Luxembourg Income Study,
Income share, poorest 2 quintiles, 1960	15.4	19.7	10.0	3.0	T&S [a]
Gini coefficient, 2000	29.3	36.8	24.7	4.6	GI:Luxembourg
Gini coefficient, 1970	29.8	35.1	22.4	4.7	Income Study,
Gini coefficient, 1980	26.7	33.8	19.7	4.2	WYDER,OECD
Poverty rate, 2000	9.7	17.0	5.4	3.9	All other OECD
Per capita income poorest quintile, 2000, PPP	10240.6	12989.9	7369.7	1696.7	
Child poverty	10.7	21.9	2.8	6.8	
Poverty rate in old age	13.5	25.6	5.9	6.4	
Fiscal data (all public, % of GDP)					
Total expenditure, 2000	45.8	57.1	32.5	8.0	AMECO
Social expenditure, 2000	24.2	29.5	14.2	4.3	OECD
Transfers and subsidies, 2000	16.1	21.3	8.6	3.8	AMECO
Total expenditure, 1960	17.7	30.6	3.0	7.1	AMECO, T&S
Social expenditure, 1960	12.9	20.5	6.9	4.0	OECD [b]
Transfers and subsidies, 1960	6.0	9.7	1.3	2.9	AMECO, T&S
Family benefits, 2000	2.1	3.7	0.4	1.0	OECD
Pension spending, 2000	9.1	11.8	5.2	2.5	OECD
Public education spending	5.3	7.7	3.8	1.0	OECD
Personal income tax receipts	12.1	26.9	5.4	5.2	OECD
Education achievement/PISA					
Average	505.9	545.9	461.7	23.3	OECD
Maths	507.1	544.0	445.0	29.6	OECD
Problem solving	507.1	548.0	448.0	28.5	OECD
Institutions					
Judiciary	6.0	6.7	4.5	0.7	World Ec.Forum
Regulation	3.6	5.3	2.4	0.9	World Ec.Forum
Bureaucracy	1.9	2.6	1.4	0.4	World Ec.Forum
Other controls					
Openness ((X+M)/GDP)	79.9	256	22.4	51.1	WEO
Per capita GDP, 2000, PPP	24294.8	31741.0	14979.0	3834.6	OECD
Unemployment, 2000	6.7	11.7	2.5	3.0	OECD

Notes:
a – Luxembourg Income Study (LIS). Income distribution data, http://www.lisproject.org/keyfigures.htm.
b – Social Expenditure Database (SOCX), www.oecd.org/els/social/expenditure.
The OECD defines social expenditures as "The provision by public and private institutions of 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." Still according to the OECD, "social benefits 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 favourable tax treatment of contributions to private health plans)" (see OECD, 2007).

Table A2 – Correlation matrix for output efficiency scores and non-discretionary factors

	EFO1	EFO2	EFO3	GDP	PISA	PIT	Edu	Comp	Judic	Shadow	Pop 65	Red tape	Regulation	Rights	Open
EFO1	1														
EFO2	0.69	1													
EFO3	0.69	0.91	1												
GDP	0.47	0.70	0.70	1											
PISA	0.64	0.63	0.51	0.37	1										
PIT	0.41	0.52	0.39	0.43	0.60	1									
Edu	0.29	0.28	0.15	-0.07	0.24	0.41	1								
Comp	0.65	0.81	0.63	0.55	0.75	0.62	0.26	1							
Judic	0.70	0.79	0.71	0.57	0.81	0.55	0.15	0.81	1						
Shadow	-0.48	-0.72	-0.61	-0.64	-0.80	-0.53	-0.05	-0.71	-0.79	1					
Pop65	-0.04	-0.61	-0.58	-0.35	-0.39	-0.11	0.16	-0.42	-0.49	0.60	1				
Redtape	-0.55	-0.50	-0.45	-0.45	-0.50	-0.19	-0.29	-0.42	-0.63	0.41	0.12	1			
Regulat.	0.38	0.43	0.56	0.35	0.53	0.22	0.12	0.32	0.53	-0.57	-0.42	-0.56	1		
Rights	0.56	0.66	0.53	0.79	0.61	0.28	-0.09	0.67	0.69	-0.80	-0.29	-0.40	0.25	1	
Open	0.45	0.31	0.32	0.23	0.25	0.44	0.08	0.30	0.24	0.05	-0.09	-0.46	0.11	0.07	1

Notes:
EFO1, EFO2 and EFO3, output efficiency scores from the DEA models 1, 2 and 3, reported respectively in Tables 4, 5 and 6.
GDP – per capita GDP, ppp, 2000.
PISA – OECD PISA indicators on secondary performance, 2003.
PIT – Personal income tax revenues as a % of GDP, 2000.
Edu – public spending in education as % of GDP, average for 2000-2001.
Comp – index of competence of public officials, 2001/02.
Judic – index for the quality of judiciary, 2000/01.
Shadow – index of the informal sector in the economy, 2001/02.
Pop65 – share of population aged 65 years and above, 2000.
Redtape – index for bureaucracy, 2000/01.
Regulat – index of the burden of regulation, 2000/01.
Rights – index of property rights protection, 2001/02.
Open – degree of openness of the economy: (Imports+Exports)/GDP, 2003.

Tables and charts

Table 1 – Income distribution, public expenditure, education achievements, taxes, initial conditions, institutional variables and openness (correlations)

	Disposable income share of poorest 40% of households, 2000	Gini coefficient, 2000	Poverty ratio (less than 50% of median income), 2000	Per capita GDP, poorest quintile of population, ppp, 2000	Child poverty, 2000	Absolute poverty among children, 2000	Old-age pvoerty, 2000
	DI4000	GI00	POTO00	PABS00	POCH00	POCH200	POLD00
a) Public spending, % of GDP							
Transfers and subsidies, 2000	0.60	-0.57	-0.59	0.29			
Social spending 2000	0.61	-0.56	-0.65	0.46			
Total spending, 2000	0.52	-0.49	-0.48	0.18			
Family benefits, 2000					-0.73	-0.73	
Old age pensions, 2000							-0.07
	DI40, change 1960-2000	Gini, change 1970-2000			DI40, change 1980-2000	Gini, change 1980-2000	
b) Change in public spending, % of GDP							
Social spending, change 1960-2000	0.73			Social spending, change 1980-2000	0.14	-0.04	
Social spending, change 1970-2000		-0.31					
Total spending, change 1960-2000	0.72			Total spending, change 1980-2000	-0.20	-0.09	
Total spending, change 1970-2000		-0.68					
Transfers and subsidies, 1960-2000	0.70			Transfers & subs. 1980-2000	0.31	0.20	
Transfers and subsidies, 1970-2000		-0.39					
	DI4000	GI00	POTO00	PABS00	POCH00	POCH200	POLD00
c) Education achievements and spending							
Mathematics	0.46	-0.49	-0.57	0.35	-0.50	-0.49	-0.23
Projects	0.45	-0.43	-0.60		-0.55	-0.55	-0.27
Science	0.20	-0.14	-0.46		-0.37	-0.37	-0.22
Reading	0.31	-0.27	-0.32		-0.35	-0.34	-0.02
Public education spending	0.51	-0.53			-0.67		
	DI4000	GI00			DI4000	GI00	
d) Taxation				**f) Institutions and openness**1/			
Personal income tax receipts, % of GDP	0.41	-0.46		Independ. Judiciary	0.45	-0.48	
				Regulation quality	0.10	-0.09	
e) Initial conditions							
Income share poorest 40% households, 1960	-0.16			Size shadow econ.	-0.25	0.30	
Gini coefficient 1970		0.57		Red tape	-0.49	0.42	
				Openness	0.36	-0.39	

1/ A higher index number implies a more independent judiciary and higher quality regulation but more red tape and a larger shadow economy.

Table 2 – Income distribution and expenditure reform

a. Gini coefficient				
	Mid-1980s	Mid-1990s	2000	mid-1980s-2000
Average, all countries	28.0	29.0	29.4	1.3
Euro area	28.7	29.5	29.6	0.9
b. Income share of poorest quintile of households				
	Mid-1980s	Mid-1990s	2000	mid-1980s-2000
Average, all countries	8.6%	8.4%	8.2%	-0.4%
Euro area	9.0%	8.7%	8.5%	-0.4%
Ambitious reformers, early	9.4%	8.9%	8.9%	-0.5%
Ambitious reformers, late	9.9%	10.0%	9.4%	-0.5%
Timid reformers, early	8.3%	8.0%	7.8%	-0.5%
Timid reformers, late	8.3%	8.1%	7.9%	-0.4%
Non reformers	7.9%	7.6%	7.6%	-0.3%
c. Per-capita GDP poorest quintile, 1995 prices, PPP US$				
	Mid-1980s	Mid-1990s	2000	mid-1980s-2000
				% change
Average, all countries	7374	8677	9893	34.2
Euro area	6917	8128	9458	36.7
Ambitious reformers, early	7273	8456	10400	43.0
Ambitious reformers, late	9213	10532	11813	28.2
Timid reformers, early	6936	8141	9036	30.3
Timid reformers, late	7735	9047	9860	27.5
Non reformers	4299	4984	5819	35.4

Source: Schuknecht and Tanzi (2006) based on Förster and d'Ercole (2005).

Table 3a – Income distribution determinants, cross section regression analysis

Dependent variables	Income share, poorest 40% of households, 2000		Gini coefficient, 2000			Per capita income ppp poorest quintile, 2000
	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables						
Transfers & subsidies, 2000	0.35***	0.28**	-7.13***			
	(3.19)	(2.58)	(-3.93)			
Social spending 2000				-2.51***	1.64***	-0.61***
				(-4.10)	(3.38)	-(6.80)
Personal income taxes	0.07		-1.51			
	(0.09)		(-1.17)			
Per capita income ppp, 2000						0.00
						(0.12)
Amount of red tape/ bureaucracy		-1.90				
		(-1.72)				
Gini 1970				0.47***		
				(4.85)		
Unemployment						-275***
						(-3.05)
Education achievement, total			-0.86***			28.75***
			(-2.92)			(3.07)
Education achievement, maths	0.02**					
	(2.56)					
Education, problem solving				-0.90***		
				(-6.13)		
Education, public expenditure		0.53				
		(1.38)				
Social spending * education					-0.004***	
					(-4.22)	
No. of observ.	17	18	22	11	22	18
R^2 adj.	0.58	0.52	0.56	0.92	0.66	0.86

Notes: t statistics in parentheses. *, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 3b – Change in income distribution, cross section regression analysis

Dependent variables	Change in income share poorest 40% of households 1960-2000	Change Gini 1970-2000	Change in income share, poorest 40% of households, 1980-2000	
Independent variables	(1)	(2)	(3)	(4)
Social spending change 1960-2000	0.39* (1.91)			
Transfers and subsidies, change 1970-2000		-0.57 (-0.24)		
Social spending change 1980-2000			0.08 (0.81)	
Transfers & Subsidies change 1980-2000				0.23** (2.76)
Personal income taxes	0.05 (0.37)		0.18* (2.01)	
Education achievements, total		-1.19** (-3.34)		
Education achievements, maths				0.05** (2.95)
Initial income distribution	-1.11*** (-5.32)	-0.42** (-2.75)	-0.18 (-0.77)	
No.of observations	15	10	19	16
R^2 adj.	0.79	0.59	0.11	0.38

Notes: t statistics in parentheses. *, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 4 – Model1, DEA results of income distribution efficiency, 1995-2000
(1 input, public social expenditure; 1 output, Gini coefficient)

Country	Input oriented			Output oriented			Peers Input / output	CRS TE
	VRS TE	Rank 1	Rank 2	VRS TE	Rank 1	Rank 2		
Australia	0.808	9	9	0.923	16	16	JAP / SVK, JAP	0.799
Austria	0.644	19	19	0.938	11	11	JAP, SVK / DNK, SVK	0.580
Belgium	0.607	25	25	0.932	13	13	JAP, SVK / DNK, SVK	0.549
Canada	0.833	7	7	0.941	10	10	JAP, SVK / SVK, JAP	0.803
Czech Republic	0.903	5	5	0.974	7	7	JAP, SVK / DNK, SVK	0.790
Denmark	1.000	1	3	1.000	1	2	-	0.537
Finland	0.797	10	10	0.981	4	4	DNK, SVK / DNK, SVK	0.571
France	0.549	26	26	0.912	18	18	JAP, SVK / DNK, SVK	0.513
Germany	0.618	23	23	0.936	12	12	JAP, SVK / DNK, SVK	0.553
Greece	0.640	20	20	0.854	24	24	JAP / DNK, SVK	0.604
Hungary	0.708	15	15	0.905	19	19	JAP / DNK, SVK	0.703
Ireland	0.888	6	6	0.929	14	14	JAP / JAP, SVK	0.856
Italy	0.608	24	24	0.861	22	22	JAP / DNK, SVK	0.581
Japan	1.000	1	1	1.000	1	3	-	1.000
Luxembourg	0.827	8	8	0.980	5	5	JAP, SVK / DNK, SVK	0.703
Netherlands	0.774	11	11	0.972	8	8	JAP, SVK / DNK, SVK	0.662
New Zealand	0.746	14	14	0.876	21	21	JAP / DNK, SVK	0.714
Norway	0.747	13	13	0.975	6	6	JAP, SVK / DNK, SVK	0.630
Poland	0.633	22	22	0.903	20	20	JAP / DNK, SVK	0.632
Portugal	0.751	12	12	0.845	26	26	JAP / DNK, SVK	0.694
Slovak Republic	1.000	1	2	1.000	1	1	-	0.836
Spain	0.700	16	16	0.856	23	23	JAP / DNK, SVK	0.657
Sweden	0.655	18	18	0.966	9	9	DNK, JAP / DNK, SVK	0.506
Switzerland	0.637	21	21	0.928	15	15	JAP, SVK / DNK, SVK	0.590
United Kingdom	0.656	17	17	0.854	25	25	JAP / DNK, SVK	0.618
United States	0.982	4	4	0.913	17	17	JAP / JAP, SVK	0.902
Average	0.758			0.929				0.676

Notes: 1) Social expenditure, as a percentage of GDP, annual average for the period 1995-2000; Gini coefficient, annual average for the period 1995-2000. 2) VRS TE is variable returns to scale technical efficiency. 3) Rank 2, countries in the production possibility frontier are ranked taking into account the number of times they are peers of countries outside the frontier. 4) Countries in **bold** are located on the VRS efficiency frontier. 5) CRS TE is constant returns to scale technical efficiency.
DNK – Denmark; JAP – Japan; SVK – Slovak Republic.

Table 5 – Model2, DEA results of income distribution efficiency, 1995-2000
(1 input, public social expenditure; 2 outputs, Gini coefficient, poverty rate)

Country	Input oriented			Output oriented			CRS TE
	VRS TE	Rank 1	Rank 2	VRS TE	Rank 1	Rank 2	
Australia	0.966	7	7	0.988	10	10	0.886
Austria	0.795	15	15	0.978	14	14	0.643
Belgium	0.748	18	18	0.973	15	15	0.609
Canada	1.000	1	1	1.000	1	4	0.890
Finland	1.000	1	4	1.000	1	1	0.633
France	0.714	22	22	0.980	12	12	0.569
Germany	0.747	19	19	0.970	17	17	0.613
Greece	0.718	21	21	0.910	22	22	0.672
Hungary	1.000	1	2	1.000	1	3	0.810
Ireland	1.000	1	5	1.000	1	6	0.949
Italy	0.721	20	20	0.927	20	20	0.651
Luxembourg	1.000	1	3	1.000	1	1	0.779
Netherlands	0.935	10	10	0.991	9	9	0.734
New Zealand	0.960	8	8	0.985	11	11	0.824
Norway	0.937	9	9	0.994	7	7	0.699
Poland	0.855	11	11	0.972	16	16	0.710
Portugal	0.851	12	12	0.943	18	18	0.792
Spain	0.785	16	16	0.922	21	21	0.735
Sweden	0.838	13	13	0.994	8	8	0.561
Switzerland	0.811	14	14	0.979	13	13	0.654
United Kingdom	0.784	17	17	0.933	19	19	0.705
United States	1.000	1	3	1.000	1	4	1.000
Average	0.871			0.971			0.733

Notes: 1) Social expenditure, as a percentage of GDP, annual average for the period 1995-2000; Gini coefficient, annual average for the period 1995-2000; Poverty rate, data for 2000. 2) VRS TE is variable returns to scale technical efficiency. 3) Rank 2, countries in the production possibility frontier are ranked taking into account the number of times they are peers of countries outside the frontier. 4) Countries in **bold** are located on the VRS efficiency frontier. 5) CRS TE is constant returns to scale technical efficiency.

Table 6 – Model3, DEA results of income distribution efficiency
(1 input, public social expenditure; 2 outputs, Gini coefficient, income share of poorest 40%)

Country	Input oriented			Output oriented			CRS TE
	VRS TE	Rank 1	Rank 2	VRS TE	Rank 1	Rank 2	
Australia	0.963	8	8	0.983	10	10	0.895
Austria	0.830	10	10	0.953	11	11	0.691
Belgium	0.768	16	16	0.941	13	13	0.645
Canada	1.000	1	2	1.000	1	3	0.924
Denmark	1.000	1	6	1.000	1	2	0.626
Finland	1.000	1	7	1.000	1	5	0.701
France	0.660	21	21	0.916	16	16	0.587
Germany	0.806	13	13	0.949	12	12	0.667
Greece	0.700	19	19	0.871	21	21	0.697
Ireland	1.000	1	1	1.000	1	6	1.000
Italy	0.673	20	20	0.875	19	19	0.666
Luxembourg	1.000	1	4	1.000	1	1	0.812
Netherlands	0.935	9	9	0.988	8	8	0.758
New Zealand	0.829	11	11	0.926	15	15	0.808
Norway	1.000	1	5	1.000	1	4	0.783
Portugal	0.781	14	14	0.895	18	18	0.779
Spain	0.775	15	15	0.901	17	17	0.767
Sweden	0.824	12	12	0.984	9	9	0.608
Switzerland	0.766	17	17	0.939	14	14	0.674
United Kingdom	0.706	18	18	0.874	20	20	0.700
United States	1.000	1	3	1.000	1	7	1.000
Average	0.858			0.952			0.752

Notes: 1) Social expenditure, as a percentage of GDP, annual average for the period 1995-2000; Gini coefficient, annual average for the period 1995-2000; Income share of poorest 40% of the population, data for 2000. 2) VRS TE is variable returns to scale technical efficiency. 3) Rank 2, countries in the production possibility frontier are ranked taking into account the number of times they are peers of countries outside the frontier. 4) Countries in **bold** are located on the VRS efficiency frontier. 5) CRS TE is constant returns to scale technical efficiency.

Table 7 – Descriptive statistics of DEA efficiency scores and model specification

			Model1	Model2	Model3
Efficiency scores	Average	Input	0.758	0.871	0.858
		Output	0.929	0.975	0.952
	Maximum		1	1	1
	Minimum	Input	0.549	0.714	0.660
		Output	0.845	0.910	0.871
	Std. dev.	Input	0.134	0.110	0.125
		Output	0.049	0.029	0.048
Nº of DMUs			26	22	21
Nº of efficient DMUs			3	6	7
DMUs on the frontier			DNK, JAP, SVK	CAN, FIN, HUN, IRL, LUX, USA	CAN, DNK, FIN, IRL, LUX, NOR, USA
Inputs			- public social expenditure as a % of GDP	- public social expenditure as a % of GDP	- public social expenditure as a % of GDP
Outputs			- Gini coefficient	- Gini coefficient - Poverty rate	- Gini coefficient - Income share of poorest 40%
DMUs efficient by default				IRL (out)	FIN (in), USA (out)

Note: summary of VRS TE results.

Table 8 – Censored normal Tobit results
(dependent variable: output efficiency scores from Model 1 in Table 4)

	1	2	3	4	5	6
Constant	0.318*	0.625***	0.616***	0.712***	0.402**	0.883***
	(1.92)	(9.66)	(8.56)	(5.76)	(2.51)	(9.78)
Per-capita GDP	5.53E-06***	6.23E-06***	3.39E-06	4.65E-06	6.82E-06***	4.71E-06***
	(3.32)	(4.45)	(1.12)	(1.43)	(4.74)	(2.66)
PISA	0.0009***				0.0004	
	(2.47)				(1.52)	
Public education		0.026***	0.021**	0.025***	0.024***	
spending		(3.27)	(2.40)	(2.83)	(2.84)	
Competence of			0.034*			
civil servants			(1.69)			
Quality of						
judiciary						
Shadow				-0.021		
economy				(-0.99)		
% of pop. aged						-0.005
65 and over						(-1.08)
$\hat{\sigma}_{\varepsilon}$	0.042	0.038	0.037	0.040	0.037	0.047
Nº of observ.	22	20	19	19	20	22

$\hat{\sigma}_{\varepsilon}$ – Estimated standard deviation of ε.

The *z* statistics are in brackets. *, **, *** - Significant at the 10, 5 and 1 per cent level respectively.

Table 9 – Censored normal Tobit results
(dependent variable: output efficiency scores from Model 2 in Table 5)

	1	2	3	4	5	6	7
Constant	0.590***	0.750***	0.768***	0.775***	0.875***	0.581***	0.986***
	(5.88)	(19.96)	(16.06)	(21.54)	(13.53)	(6.05)	(20.76)
Per-capita GDP	4.95E-06***	3.56E-06***	6.37E-06***	3.49E-06***	4.02E-06**	5.11E-06***	5.13E-06***
	(4.64)	(2.67)	(4.60)	(2.74)	(2.60)	(4.86)	(4.57)
PISA	0.0005***					0.0005***	
	(2.61)					(2.25)	
Public education			0.011*	0.005	0.010*	0.008	
spending			(1.67)	(0.94)	(1.74)	(1.33)	
Competence of				0.030***			
civil servants				(3.11)			
Quality of		0.024***					
judiciary		(3.03)					
Shadow					-0.024***		
economy					(-2.11)		
% of pop. aged							-0.009***
65 and over							(-3.68)
$\hat{\sigma}_{\varepsilon}$	0.019	0.018	0.020	0.016	0.019	0.018	0.016
Nº of observ.	20	19	19	18	18	19	20

$\hat{\sigma}_{\varepsilon}$ – Estimated standard deviation of ε.

The *z* statistics are in brackets. *, **, *** - Significant at the 10, 5 and 1 per cent level respectively.

Table 10 – Corrected output efficiency scores (for specification 1 in Table 9)

	DEA scores (1)	GDP correction (2)	PISA correction (3)	Corrected scores (4)=(1)+(2)+(3)	Corrected Rank
Australia	0.988	0.003	-0.014	0.978	9
Austria	0.978	-0.007	0.002	0.973	13
Belgium	0.973	0.000	-0.009	0.965	15
Canada	1.000	-0.008	-0.017	0.977	10
Finland	1.000	0.004	-0.025	0.981	7
France	0.980	0.007	-0.004	0.983	6
Germany	0.970	0.006	0.000	0.976	12
Greece	0.910	0.048	0.023	0.979	8
Ireland	1.000	-0.013	-0.002	0.985	4
Italy	0.927	0.009	0.016	0.951	18
Luxembourg	1.000	-0.090	0.037	0.947	19
Netherlands	0.991	-0.004	-0.012	0.976	11
New Zealand	0.985	0.030	-0.013	1.000	1
Norway	0.994	-0.016	0.006	0.984	5
Portugal	0.943	0.045	0.018	1.000	1
Spain	0.922	0.029	0.010	0.961	16
Sweden	0.994	-0.002	-0.004	0.988	3
Switzerland	0.979	-0.015	-0.007	0.957	17
United Kingdom	0.933	0.010	-0.015	0.929	20
United States	1.000	-0.037	0.009	0.972	14
Average	0.973	0.000	0.000	0.973	

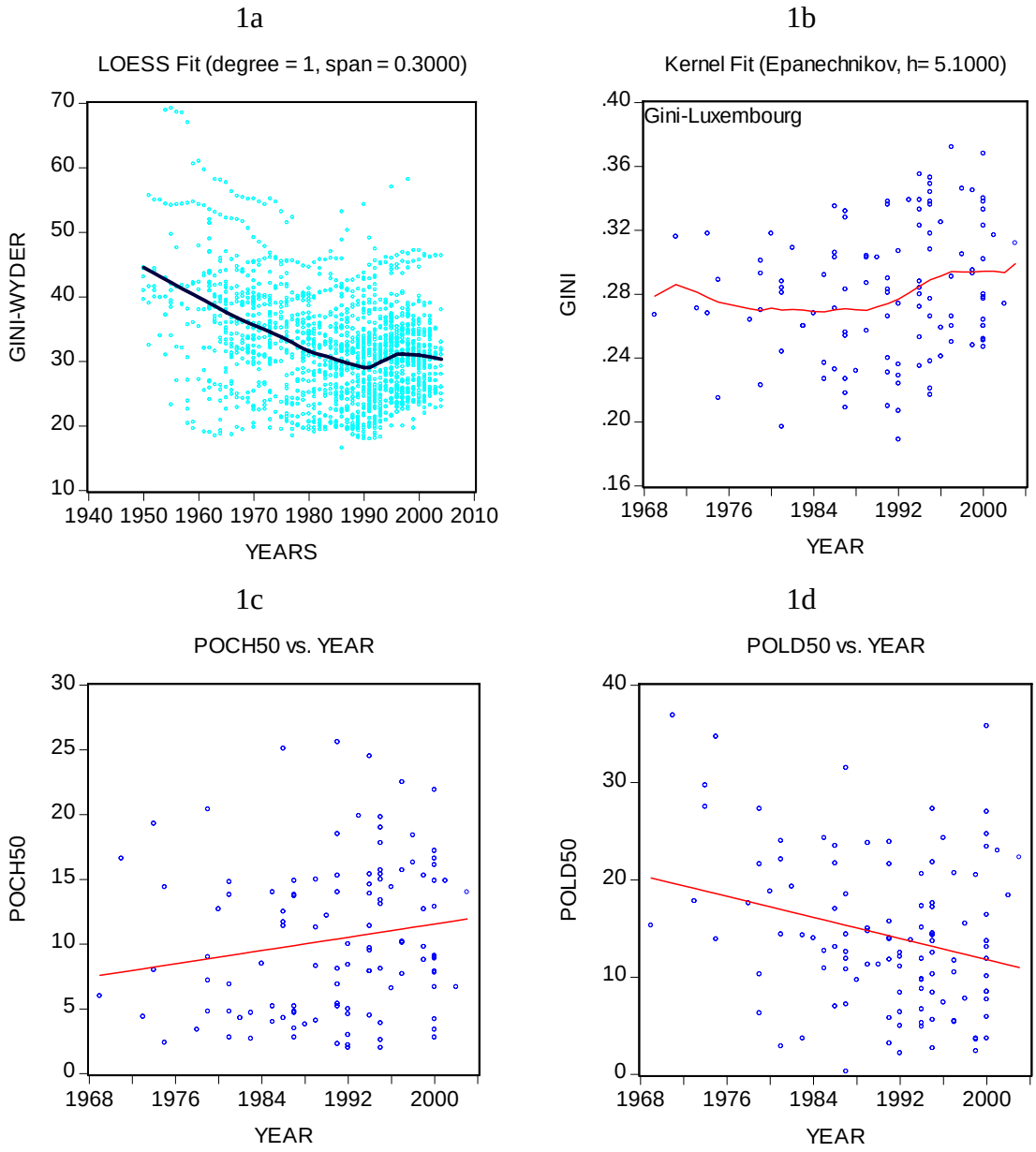
Note: the corrected scores do not always add up to the indicated sum since for the cases were the result was above one it was truncated to the unity.

Table 11 – Corrected output efficiency scores (for specification 5 in Table 9)

	DEA scores (1)	GDP correction (2)	Public educ. spending correction (3)	Shadow economy correction (4)	Corrected scores (5)=(1)+(2)+(3)+(4)	Corrected Rank
Australia	0.988	-0.006	0.006	-0.014	0.973	10
Austria	0.978	-0.010	-0.006	0.000	0.963	13
Belgium	0.973	-0.003	-0.006	0.010	0.973	9
Canada	1.000	-0.012	0.000	-0.012	0.977	7
Finland	1.000	0.001	-0.007	-0.014	0.980	6
France	0.980	0.001	-0.005	-0.005	0.971	11
Germany	0.970	0.000	0.007	-0.002	0.975	8
Greece	0.910	0.031	0.015	0.027	0.982	4
Ireland	1.000	-0.037	0.009	-0.002	0.970	12
Italy	0.927	0.002	0.006	0.012	0.947	16
Netherlands	0.991	-0.007	0.005	-0.007	0.981	5
New Zealand	0.985	0.026	-0.010	-0.012	0.989	3
Portugal	0.943	0.037	-0.005	0.029	1.000	1
Spain	0.922	0.021	-0.009	0.010	0.944	17
Sweden	0.994	0.004	-0.014	0.005	0.989	2
Switzerland	0.979	-0.010	0.003	-0.012	0.960	14
United Kingdom	0.933	0.002	0.008	-0.005	0.939	18
United States	1.000	-0.039	0.004	-0.009	0.955	15
Average	0.971	0.000	0.000	0.000	0.971	

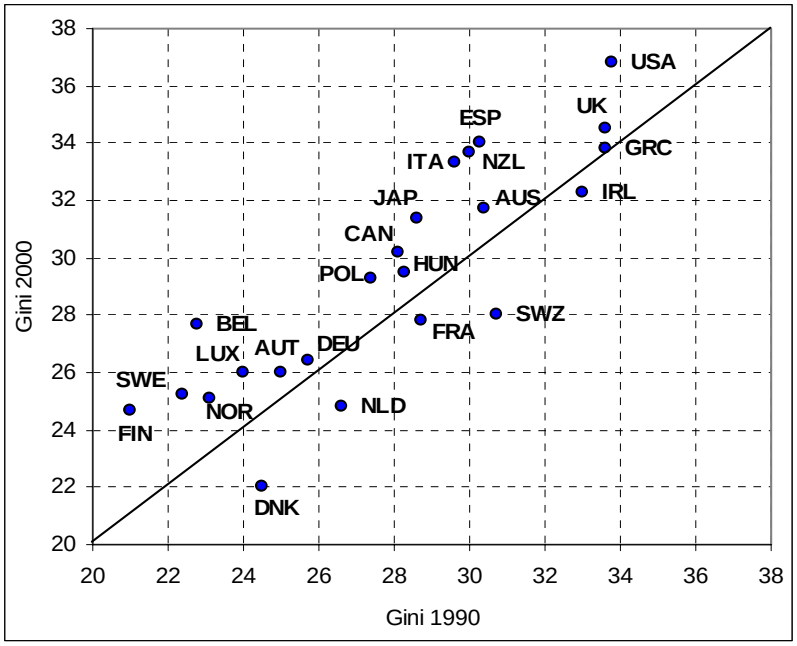
Note: the corrected scores do not always add up to the indicated sum since for the cases were the result was above one it was truncated to the unity.

Chart 1 – Income distribution data: an overview



Notes: POCH50 – Child poverty, 2000; POLD50 – old-age poverty, 2000.
Source of the data: Wyder (panel a) and Luxembourg Income Study (b-d)+A104.

Chart 2 – Gini coefficient,
2a - 1990 vis-à-vis 2000



2b - 1980 vis-à-vis 2000

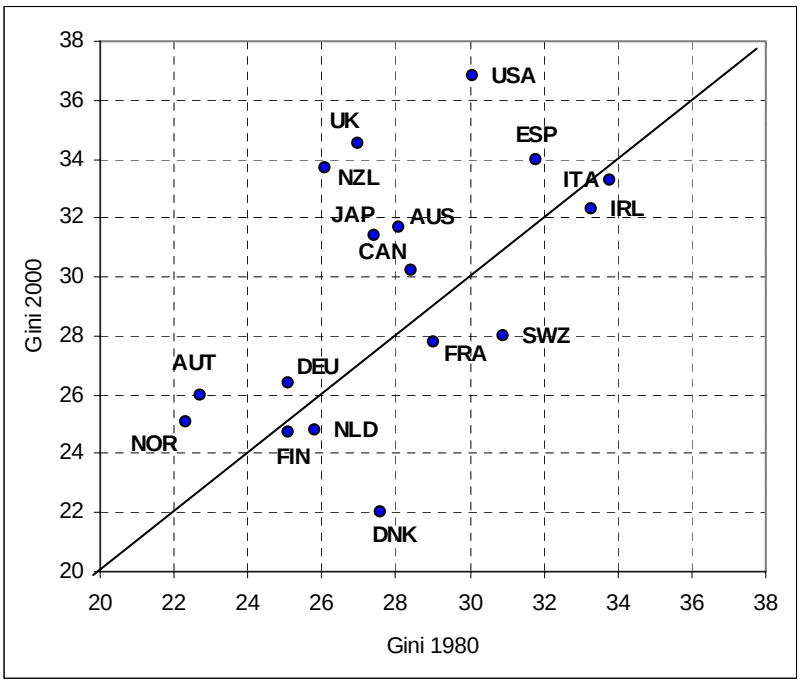


Chart 3a – Social spending and income share of poorest 40% households, 2000

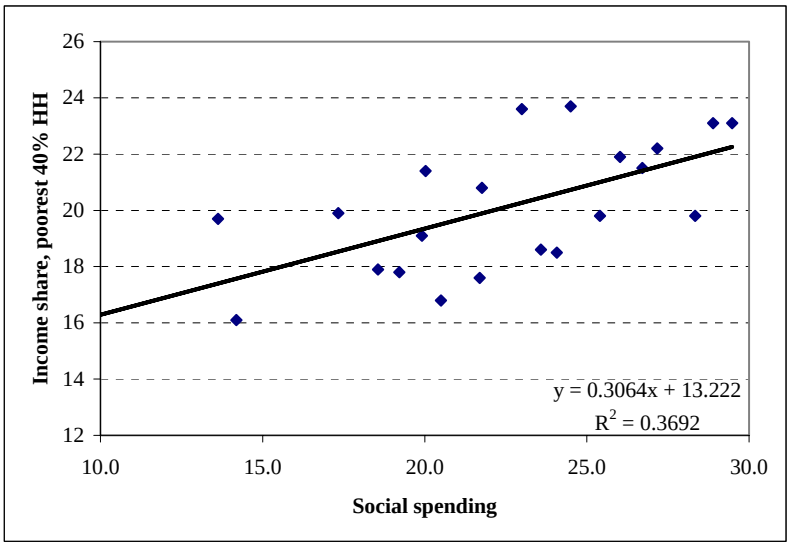


Chart 3b – Social spending & income share, poorest 40% households, change 1960-2000

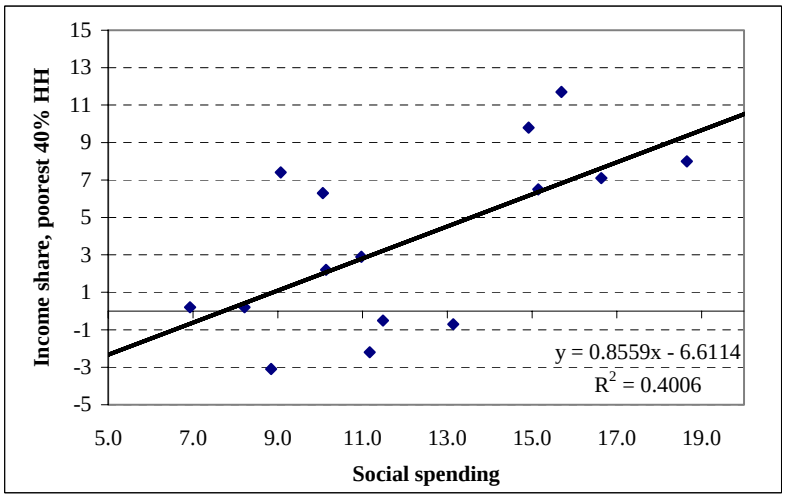
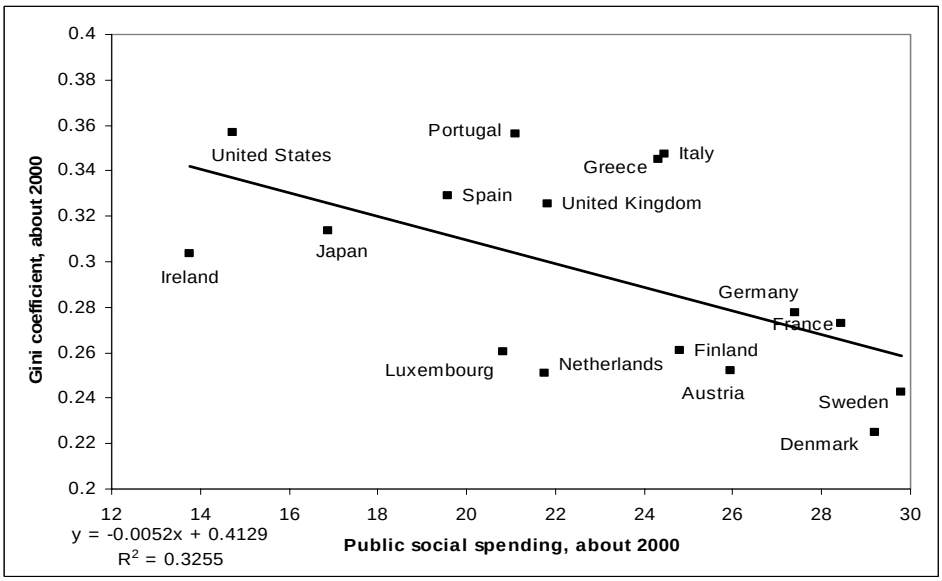
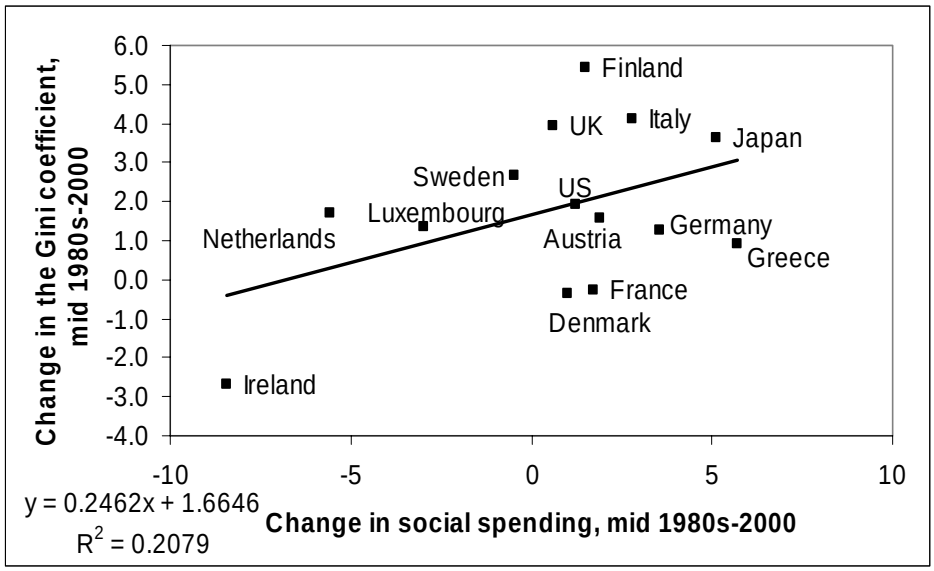


Chart 4 – Income distribution and social spending reform

4a



4b



Source: Heipertz and Ward-Warmedinger, 2007.

Chart 5 – Production possibility frontier: one input, one output

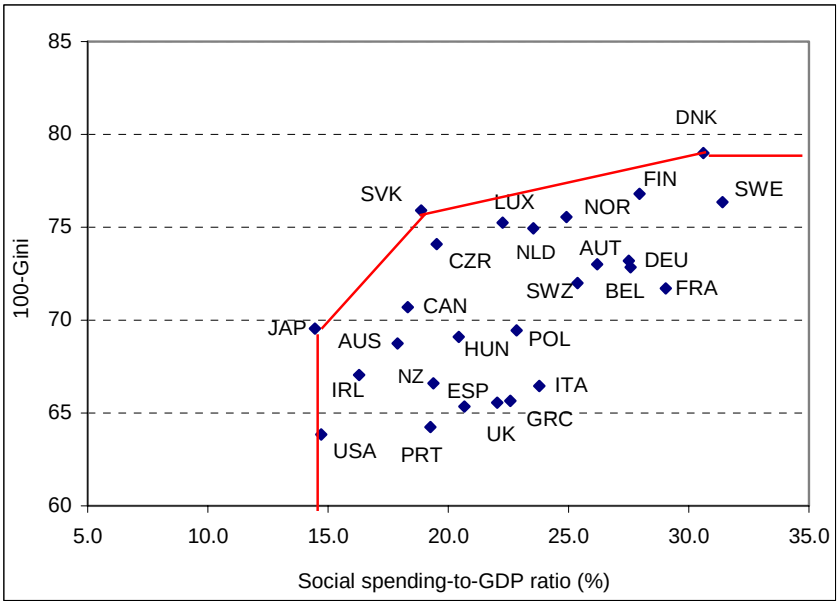


Chart 6 – Production possibility frontier, constant returns to scale, one input (social spending-to-GDP), two outputs (output 1: income share of poorest 40%; output 2: Gini)

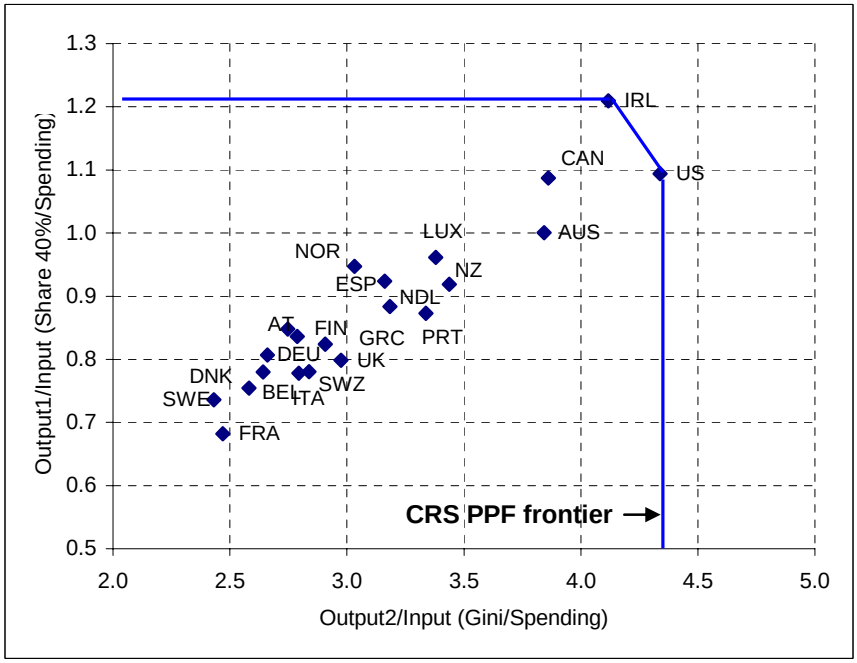
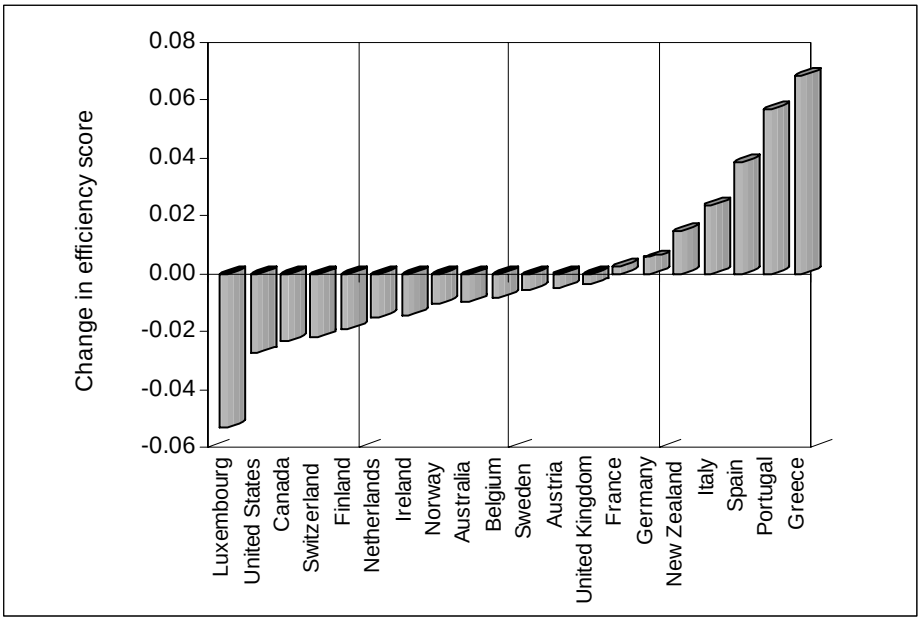


Chart 7 – Change in efficiency scores after correction: +(-), DMU moves closer to (further away from) the production frontier
7a – corrections from Table 10 (GDP, PISA)



7b – corrections from Table 11 (GDP, education spending, shadow economy)