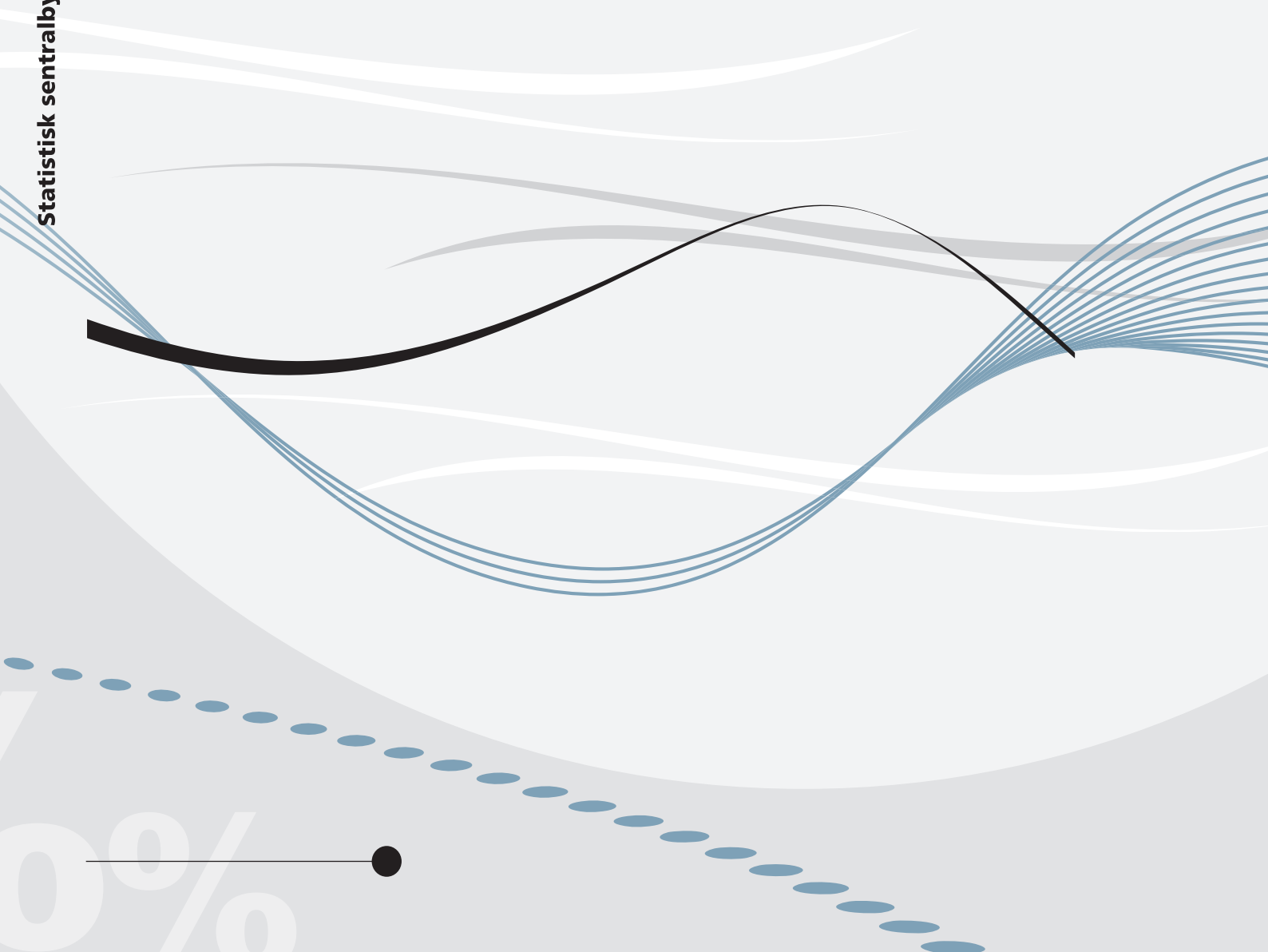Statistics Norway

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A common base answer to "Which country is most redistributive?"

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Abstract:
Which country is most redistributive? This question is often discussed in terms of comparisons of measures of redistribution when each country's tax schedule is applied to its pre-tax income distribution. However, we believe that what most authors have in mind when referring to the "most redistributive country" is one in which the tax schedule is unanimously most redistributive across all pre-tax income distributions. A stronger identification of the most redistributive tax schedule therefore implies applying each tax schedule to all pre-tax income distributions and compare redistribution for all possible combinations. Given that this is practically complicated, we suggest applying the transplant-and-compare method of Dardanoni and Lambert (2002), which provides a tax progressivity ordering of schedules according to a common base. This paper shows how the transplant-and-compare approach can be utilized to approach an identification of the most redistributive country. The method and its implications are discussed by employing micro data from Luxembourg Income Studies, also contrasting results to those obtained using standard measures of redistribution.

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Discussion Papers comprise research papers intended for international journals or books. A preprint of a Discussion Paper may be longer and more elaborate than a standard journal article, as it may include intermediate calculations and background material etc.

Sammendrag

I hvilket land er det mest omfordeling og hva er bidraget fra den personlige inntektskatten til dette? Slike spørsmål diskuteres i litteraturen både med utgangspunkt i teoretiske perspektiver og med basis i interesse for internasjonale sammenlikninger per se. For eksempel sier den såkalte Meltzer-Richard-hypotesen at ved relativt høy inntektsulikhet vil medianvelgeren ha lav inntekt og vil påvirke det politiske systemet til mer omfordeling. I litteraturen finner en imidlertid ikke udelt støtte for denne hypotesen, som blant annet har gitt opphav til det såkalte Robin Hood-paradokset: omfordeling skjer der det er minst nødvendig. I dette arbeidet rettes oppmerksomheten mot hvordan en skal måle omfordeling i et internasjonalt perspektiv. Flere forfattere har påpekt at det er begrenset informativt å sammenlikne omfordelingen ved å se på skattenes omfordelende effekt i hvert enkelt land separat. For å tilnærme seg «hvilket land som er mest omfordelende» er det mer relevant å vurdere hvordan skattesystemet i ett land, for eksempel Norge, ville virket dersom det ble implementert i USA og vice versa, hvordan det amerikanske skattesystemet ville virket i Norge.

I dette arbeidet vises det til en metode som kan anvendes i slike internasjonale sammenlikninger, utviklet av Dardanoni og Lambert (2002). Metoden går ut på å finne forskjellen mellom to inntektsfordelinger før skatt, slik at en kan kontrollere for denne forskjellen før en sammenlikner inntektsfordelingene etter skatt. Ambisjonen er å etablere en felles sammenlikningsmal. Forskjellene i fordelingene mellom to år beskrives ved hjelp av to parametre, konstantledd og stigningsforhold. I praksis gjøres dette ved en lineær regresjon (minste kvadraters metode) med variabelen inntekt før skatt fra den ene fordelingen på venstre side og variabelen inntekt før skatt fra den andre fordelingen på høyre side. Parameterestimatene fra en slik regresjon, konstant og stigningstall, reflekterer forskjeller mellom de to fordelingene. Nærmere bestemt vil et stigningstall større eller mindre enn 1 gi uttrykk for hvilken av de to fordelingene av inntekt før skatt som er mest ulik. Forskjellen mellom fordelingene før skatt, angitt ved parameterestimatene, benyttes deretter til å justere inntektene i fordelingen av inntekt etter skatt. På det viset kan det sies at etter-skatt-fordelingene sammenliknes for et hypotetisk likt nivå på ulikheten før skatt.

Det anvendes data fra Luxembourg Income Studies (LIS) til å illustrere metoden og dens implikasjoner for internasjonale sammenlikninger av den personlige inntektsskattens omfordelende effekt. Disse illustrasjonene viser, for eksempel, at USA har et mer omfordelende inntektsskattesystem for personer enn Norge ved en standard sammenlikning av omfordelingen i de to landene, dvs når dette måles separat i hvert land for seg. Når det anvendes en felles sammenlikningsmal, vurderes omfordelingen som lik i de to landene.

1. Introduction

The relationship between income inequality and redistribution in a cross-country perspective continues to be on the research agenda, probing the question: which country is most redistributive? For example, according to Whiteford (2012) recent discussion of evidence from the OECD (OECD 2008; 2011) has caused "an outbreak of unpleasantness about which OECD country has the most progressive tax system".[1] It turns out that some of the complications in the exchanges come from not clearly distinguishing between tax progressivity and tax redistribution, an issue to which we shall soon turn.

Besides that identifying the most tax redistributive country is interesting in itself, there has been considerable attention devoted to redistribution across countries as the information signifies a key component in discussions of the (initial) inequality and redistribution relationship, see Milanovic (2000; 2010) and Scervini (2012). The "median voter" hypothesis (Romer, 1975; Roberts, 1977; Meltzer and Richard, 1981) suggests a positive relationship between initial inequality and redistribution, as the median voter demands more redistribution the greater is the distance between the median income and the mean income. However, as it is often claimed that unequal societies redistribute less, Lindert (2004) refers to "the Robin Hood paradox": redistribution from rich to poor is least present when and where it seems most needed.

The present paper questions the way redistribution is defined in empirical work across countries on tax redistribution, such as in discussions of the median voter and redistribution hypotheses, or when simply identifying the most redistributive country. It seems that one is aware of the limitations of the standard procedure of identifying tax redistribution in each country. For example, Bishop, Formby and Thistle (1990), Dardanoni and Lambert (2002) and Seidl, Pogorelskiy and Traub (2012) refer to comparisons of tax redistribution based on estimations of tax redistribution in each country (separately) as less informative about the working of tax schedules in an international context.[2] In order to approach the identification of the most redistributive tax system, one would like to see the results of the schedule of country y applied to the pretax income distribution of country z, and vice versa (Bishop, Formby and Thistle, 1990).

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[1] Whiteford refers to exchanges of views among bloggers, involving a whole range of eminent commentators, such as Jonathan Chait, Clive Croook, Brad DeLong, Veronique de Rugy, and Paul Krugman; see Whiteford (2012) for details.

[2] This point was already referred to by Musgrave and Thin (1948, p. 510): ". . . the less equal the distribution of income before tax, the more potent will be a (given) progressive tax structure in equalizing income".

A full comparison involving several countries is complicated,[3] but the transplant-and-compare method of Dardanoni and Lambert (2002), to secure a common base measurement of tax progressivity, represents a move in this direction. The aim of this paper is to call attention to the application of the transplant-and-compare method for identification of tax redistribution and tax progressivity across countries.

In the common base international comparisons according to the transplant-and-compare method, pre-tax income inequalities (G_X) in each country have been neutralized and transplanted into the measures of spread in post-tax income and taxes (G_N and C_T).[4] In terms of the Reynolds and Smolensky (1977) index of redistributive effect,[5] $RE = G_X - G_N$, the common base comparison means that redistribution in each country now is measured for a common G_X and for a G_N that has been controlled for differences in pre-tax inequality (between the country in question and a chosen reference). Correspondingly, according to the common base version of the Kakwani (1977) tax progressivity index, $P^K = C_T - G_X$, G_X is common base pre-tax income inequality and C_T results from transplantation of pre-tax income inequality differences.

The inequality differences between countries are accounted for by making statistical adjustments using parameters for location and spread. In practice this means regressing the pre-tax income vector of a given country against the income vectors of all other countries, to obtain the two parameters to be used in the adjustment of the post-tax income distribution. Comparisons after such "transplantation" are guaranteed invariant to the choice of baseline if candidate distributions are isoelastic transformations of one another (i.e. if the pre-tax income distributions only differ in logarithms by location and scale, thus not exhibiting major shape dissimilarities).

The transplant-and-compare method and its implications are discussed by using data from the LIS database (http://www.lisproject.org), a high-quality source of internationally comparable microdata on household incomes. For illustration, we selected 14 countries and the time period 1999-2001, on

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[3] Lambert and Thoresen (2009) discuss intertemporal redistribution in Norway (1992–2004) by applying different schedules to several pre-tax income distributions belonging to different years, but report several complications. Obviously, practical implementation of such an identification strategy becomes even more demanding in a cross-country setting.

[4] An alternative measurement procedure is to keep tax levels fixed at the country-specific level and only control for the tax progressivity component. This corresponds to the approach seen in the intertemporal analysis of Lambert and Thoresen (2009), when discussing the fixed income and the transplant-and-compare methods.

[5] Other measures of redistribution are the Blackorby-Donaldson (1984) and Kiefer (1985) indices, see also Lambert (2001). Consult Lambert, Nesbakken and Thoresen (2010) for a discussion of how results depend on the choice of index of redistribution.

grounds of availability of comparable information: Australia, Canada, Denmark, Finland, Germany, Israel, Netherlands, Norway, Poland, Sweden, Switzerland, Taiwan, United Kingdom and United States.

The paper is organized as follows. In Section 2 we give a brief overview over the literature on redistribution across countries, whereas Section 3 presents the measures of tax progressivity and redistribution used. The transplant-and-compare method for redistributional comparison is explained in Section 4, using data for the above 14 countries in the application of the approach. Section 5 concludes the paper.

2. Cross-country comparisons

As already noted, evidence from the OECD (OECD 2008; 2011) has recently spurred considerable disagreement among some key commentators about tax progressivity and tax redistribution in a cross-national perspective; see the summary in Whiteford (2012). It seems that some of the dispute is caused by not clearly distinguishing between tax progressivity and tax redistribution; for example, the U.S. tax system appears to score well on progressivity (compared to other countries), but is lower ranked according to tax redistribution (when also accounting for tax levels). Nevertheless, this shows that there is considerable interest in placing different countries in the "redistribution ranking".

Previous studies of cross-country redistribution not only discuss redistribution across countries *per se*, but often relate redistribution to the degree of initial pre-tax income inequality. Intuitively one would expect that countries with the highest pre-tax income inequality are most redistributive, simply because the potential for redistribution is highest. This may follow from standard social welfare reasoning (based upon an additive social welfare function) with individual utility functions exhibiting diminishing marginal utility of income, but may also be explained by the median-voter model (Romer, 1975; Roberts, 1977; Meltzer and Richard, 1981). However, a positive relationship between income inequality and redistribution across countries is not always found, and it is often claimed that redistribution from rich to poor is least present when and where it seems most needed, see for example Lindert (2004). Both across the globe and over time Lindert sees a general tendency that anti-poverty policy is positively related to average income and negatively related to income inequality.

A complicating factor whenever the median voter hypothesis is involved is uncertainty regarding the exact definition of the median voter (Scervini, 2012). Milanovic (2000) therefore suggests focusing attention on the redistribution hypothesis, i.e., that greater redistribution is likely to happen in more

market-unequal environments. His results show strong support for the redistribution hypothesis, whereas support for the median-voter model as the pivotal explanation is considerably weaker. However, the identification in Milanovic (2000) is based on a fixed effect estimation, which influences the interpretation of results. As also emphasized by Milanovic (2010), the identification of a positive "within country" relationship means that one will observe more redistribution *in each country* for increasing income inequality, as the "between countries" variation is not used to identify effects.

As already seen, the ambition here is to investigate tax redistribution in a "between countries" context, to show how one may identify the most redistributive country. Several other contributions within the field discuss the redistribution hypothesis in a "between countries" fashion. For instance, Wagstaff et al. (1999) is a comprehensive analysis of redistributional effects and tax progressivity effects of the personal income tax for twelve OECD countries. They find that there is no link between pre-tax income inequality and the degree of redistribution brought about by the personal income tax. Ireland, Spain, the UK and the US are the countries with the most unequal pre-tax income distributions, and they are found to be more redistributive than many other countries, but less redistributive than Sweden and Finland, which have very low levels of pre-tax income inequality. In an analysis along the same line as Wagstaff et al., Verbist and Figari (2014) find evidence supporting the view that more unequal societies demand less redistribution. Moreover, in a cross-country perspective they see a negative correlation between progressivity of taxes and tax levels.

Bishop, Formby and Thistle (1990), Norregaard (1990), Dardanoni and Lambert (2002) and Seidl, Pogorelskiy and Traub (2012) are examples of studies that mark the difficulties of making redistribution comparisons in cases with both different tax schedules and different income distributions. As noted by Bishop et al.: "One fiscal system is uniformly more progressive if it is more progressive for all prefisc income distributions" (p. 9). Bishop et al. then establish new measures of tax progressivity after controlling for differences in tax and transfer height between two situations, which are exploited in dominance assessments.

Seidl et al. also apply a dominance procedure, influenced by the empirical approach seen in Seidl (1994). The starting point is the generalized Lorenz dominance criterion which applies only to a fixed pre-tax income distribution, which is unrealistic. In order to approach dominance, they suggest displaying Lorenz curves and concentration curves for income and population quantiles, giving rise to so-called Suits-curves. Then pairwise comparisons between countries are addressed by shifting

between tax schedule and income distribution pairs using the same values of population or income quantiles, looking for dominance of tax schedules.

Norregaard (1990) controls for pre-tax income inequality differences by superimposing each country's tax system on a chosen common pre-tax income distribution, with Germany selected as the standard. Dardanoni and Lambert (2002) move further in this direction, when applying the transplant-and-compare method to account for the pre-tax differences between countries, and comparing local progression between Canada, Israel and the U.K. Lorenz- and Suits-curves are used to search for unambiguous characterization in the common base setting.

The present paper adds to the paper by Dardanoni and Lambert by describing how the method can be applied to a comparison of *global* measures of progressivity and redistribution in a cross-country context, to explain how the method can be used to help in finding the most redistributive country. Thus, the underlying message is that instead of discussing "which countries are most redistributive" in terms of comparison of actual distributions of income and tax (see for example the discussion among bloggers, referred to in the beginning of this section), the analyst should turn to methods with ambition of sharper identification of effects of tax schedules.

3. The measurement of tax progressivity and redistributive effect

The Gini coefficient is by far the most prevalent and well-understood inequality index. The tax progressivity measure of Kakwani (1977), call it P^K, is based on the Gini coefficient: $P^K = C_T - G_X$, where G_X is the pre-tax Gini and C_T is the concentration coefficient of taxes with respect to the pre-tax income ordering. The Reynolds-Smolensky (1977) index of redistributive effect is also Gini-based: $RE = G_X - G_N$, where G_N is the Gini coefficient of net incomes. Let the total tax ratio (overall average tax rate) be $g = T/X$. The factor $\left[g/(1-g) \right]$ is often called tax level. In the absence of income rerankings caused by application of the tax, a simple relationship exists: $RE = \left[g/(1-g) \right] P^K$, as shown by Kakwani (1977). Kakwani (1984) introduced a reranking term, $R^K = G_N - C_N$, obtaining the decomposition $RE = \left[g/(1-g) \right] P^K - R^K = V^K - R^K$, say, in which

$RE = \left[g/(1-g) \right] P^K - R^K = V^K - R^K$, quantifies the inequality-reducing impact of the tax on average

(its "vertical effect"). In Urban and Lambert (2008) it is shown how to adapt this decomposition when, as is common, there is a sparsity or complete lack of exact pre-tax equals in one's data.[6]

4. Common base results

4.1 The transplant-and compare procedure

In Lambert and Thoresen (2009) some of the complications of applying different tax schedules to the same pre-tax income distribution in an intertemporal setting for one country (Norway) are discussed, concerning the sensitivity of results with respect to the choice of base. In a cross-country perspective we believe that the practical challenges become overwhelming. Applying the closely related transplant-and-compare method of Dardanoni and Lambert (2002) to find ordering of countries in terms of redistribution or progressivity represents a more feasible approach.[7]

The transplant-and-compare method can be explained as follows. Let *F(x)* be the distribution function for pre-tax income in a given country, and let $u = u(x)$ be some attribute of a person or household having *x* before tax. If *g(x)* is a mapping of pre-tax incomes into $\mathbb{R}^+$, the conjugate mapping $u^g(x) = g(u(g^{-1}(x)))$, i.e. $u^g = g \circ u \circ g^{-1}$, operates on the distribution $F \circ g^{-1}$. If an isoelastic function $g(x)$ can be found such that $F \circ g^{-1}$ is the standard lognormal distribution, call this $\ln(0,1)$,[8] then as Dardanoni and Lambert (2002) have shown, the conjugate of the pre-tax/post-tax income mapping $x \rightarrow y$ can be regarded as the transplant of the tax system into $\ln(0,1)$. This can be done with the data of each country, to enable a set of comparisons, of the actions of transplants upon $\ln(0,1)$, in which actual tax schedules have all been adjusted for pre-tax distributional differences. In fact the lognormal is not required for this "transplant-and-compare" procedure; whenever within-country pre-tax income distributions differ in logarithms only by location and scale, an appropriate "reference" distribution can be selected and comparisons made with tax systems that have been

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[6] Urban and Lambert's decomposition is of the form $RE = V^{UL} - H - R^K$, where *H* is a term measuring the effect of the unequal treatment of *exact* equals, which may be negative if there are few or no exact pre-tax equals in the sample; *H* is an estimate only, and can be an underestimate. An algorithm for computing V^{UL} (or *H*) is given in Urban and Lambert (2008).

[7] Note that the two approaches will not provide completely identical results, as they are conceptually and practically different. As discussed by Thoresen, Jia and Lambert (2015), the transplant-and-compare analysis can be seen as trading off detailed tax policy analysis, as implied by the fixed income approach, for a more general approximation based on overall descriptions of income distributions. Behavioral effects of different schedules (which we do not focus on here) are for example differently accounted for by the two methods.

[8] That is to say, $y \sim \ln(0,1) \Leftrightarrow \ln(y) \sim N(0,1)$, where $N(0,1)$ is the standard normal distribution.

adjusted for international differences in pre-tax location and scale. Empirically, one wants to find that, for each country i, there exist a_i and $b_i > 0$ such that the distribution of $a_i + b_i \ln(x)$ is sufficiently close to the chosen reference distribution, where x is pre-tax income. Thus, the method implies finding estimates of a_i and b_i that minimize the differences between the two distributions in terms of location and scale. This corresponds to finding the intercept and slope in a traditional OLS regression, and the R^2 statistic becomes the relevant measure of goodness-of-fit. The post-tax income values are then adjusted by the fitted deformation function $g_i(x) = e^{a_i} x^{b_i}$ before making comparisons. See Lambert and Thoresen (2009, pp. 237–239) for more on this.[9]

4.2 Common base ordering

We shall illustrate the transplant-and-compare method by providing estimates of tax progressivity and redistribution for a selection of countries from the LIS database (http://www.lisproject.org). We selected 14 countries and the time period 1999-2001, on grounds of availability of comparable information. The countries are Australia (AUS), Canada (CAN), Denmark (DNK), Finland (FIN), Germany (DEU), Israel (ISR), Netherlands (NLD), Norway (NOR), Poland (POL), Sweden (SWE), Switzerland (CHE), Taiwan (TWN), United Kingdom (UK) and the United States (US). The extents of the datasets vary, from observations on more than 80,000 Danish households to about 3,600 households for Switzerland. For all datasets, we converted income and tax variables into equivalent values: these are nominal values weighted by an equivalence scale (the square root of the number of household members). These equivalent values are in turn allocated to each household member, which means that the individual is the unit of analysis.

As already remarked, because of the median voter hypothesis and other conjectures about redistribution and inequality associations, discussions of cross-national comparisons of distributional effects of taxation are typically seen in relationship to initial pre-tax income inequality. Thus, we will relate to this literature by showing results for pre-tax/transfer inequality levels in the selected countries; note that these estimates are indices based on actual data (and therefore have nothing to do with the transplant-and-compare procedure). The pre-tax/transfer definition of income corresponds to what Milanovic (2000) characterizes as *factor P income*: income (including pensions) before tax and social transfers, where the latter includes social insurance transfers and social assistance transfers.[10]

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[9] In particular, before undertaking the regressions, the sample sizes have to be equalized. See footnote 23 in Dardanoni and Lambert (2002).

[10] Note that the income definition which ranks individuals initially here differs from the pre-tax income definition used in the pre-tax income equalization in the transplant-and-compare procedure.

As for the comparison of the results presented here and other cross-country studies of distributional effects, it is important to note that the depictions of the present analysis are restricted to only considering effects of the personal income tax. Leaving out effects of transfers has implications for the ranking of countries, as many European countries achieve more redistribution through public transfers than through the tax system, in contrast to what is seen for the US (Förster and Whiteford, 2009). Further, there are important distributional differences generated by other parts of the tax system (VAT, sales taxes and payroll taxation) not accounted for in the present simplified analysis.

In Figure 1 and Figure 2 we present international orderings of progressivity (Kakwani) and redistribution (Reynolds-Smolensky), for the standard (no common base) approach and for the transplant-and-compare procedure, respectively. Remember that behind the results of the transplant-and-compare method (Figure 2), we have adjusted tax and post-tax income values by a fitted deformation function.[11] The association to pre-tax/transfer inequality is illustrated by adding in straight line plots, derived from OLS regressions.[12]

The graphs in Figure 1 show progressivity and redistributive effect of the personal income tax for each country, relative to its own pre-tax/transfer inequality baseline. As explained in Section 3, orderings according to tax progressivity and redistribution may differ because of tax level differences. Thus, the explanation for the US moving closer to the Nordic countries according to redistribution in Figure 1 is that this measure picks up the higher tax levels in North-Europe. The graphs confirm clear positive links between pre-tax income inequality and progressivity and redistribution.

On the contrary, when measuring redistribution, Norway (along with the other Nordic countries) moves above the US in the ranking. Thus, we clearly see that redistribution orderings may change when using a common base technique, instead of country-specific estimates. Whereas the distributional effects of social security transfers often reorder countries, and may for example move other countries ahead of the US in the ranking (Whiteford, 2012), we here see that the isolated effect of tax redistribution is changed for a common base. In general, we see that the relationship between countries' common base redistributional efforts and their pre-tax income inequality levels is still positive, but statistically weaker than for the standard approach.

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[11] A vital precursor to the comparisons we shall undertake is to validate the base independence of results. Do results depend on the choice of reference distribution, i.e. on whether the pre-tax income distribution of (for instance) the US or Norway is employed as the base? As already discussed, the R^2 statistic is a key indicator of the performance of the method. Cross-country comparison is almost inevitably more challenging than an intertemporal study (as in Lambert and Thoresen, 2009); we refer to Lambert et al. (2010) for further model validations, given the present data.

[12] Of course, it is somewhat "heroic" to carry out regressions with such a limited number of data points, but it provides a helpful way to summarize the empirical links.

Figure 1. **Standard approach to measuring the relationship between tax progressivity/redistribution and pre-tax/transfer income inequality.**
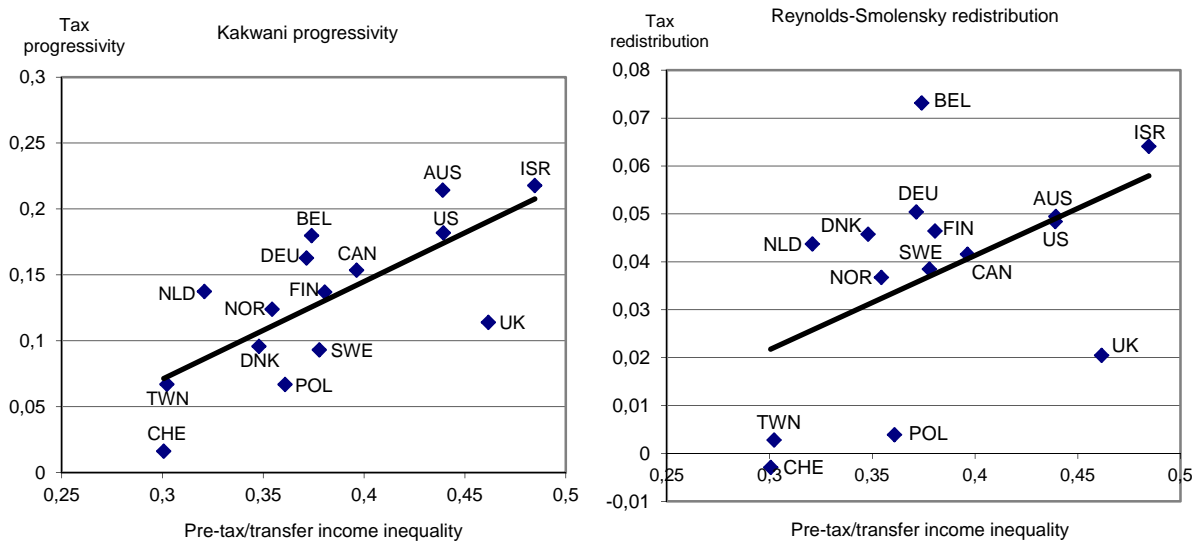
Figure 2. **Common base approach to measuring the relationship between tax progressivity/redistribution and pre-tax/transfer income inequality.**
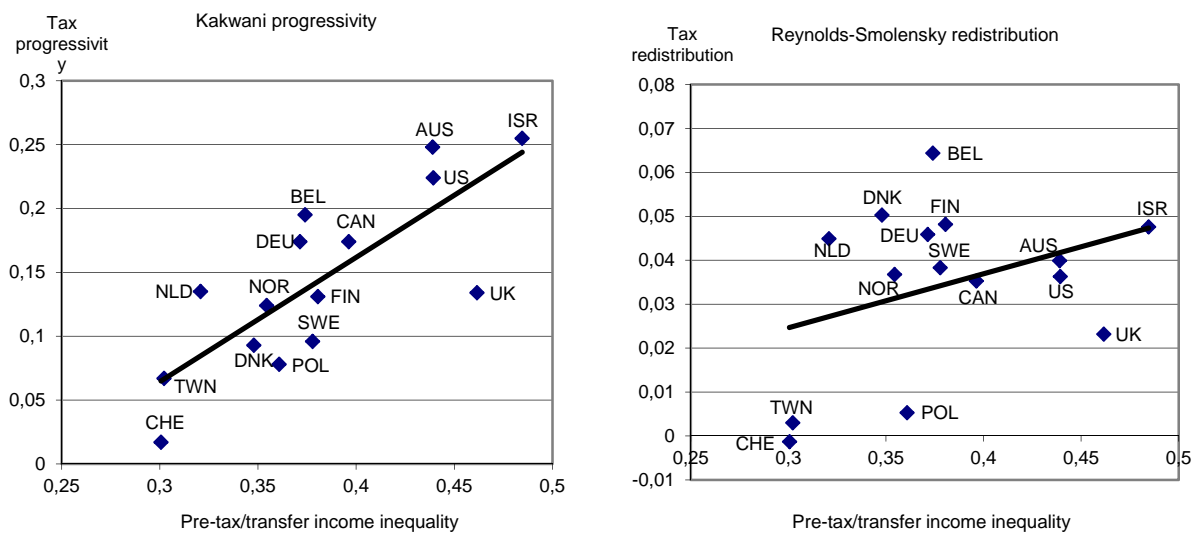
5. Conclusion

We believe that what many authors actually have in mind, when discussing the relationship between income inequality and redistribution across countries, is the concept of *redistributional effort for (hypothetically) the same level of pre-tax income inequality*. Then relevant measure(s) of redistribution would be common-base measures, which come from applying the "transplant-and-compare"

methodology to raw tax and income data. The question, "which country do we consider to have the most redistributive tax system?", may more convincingly be answered using the transplant-and-compare methodology, as exemplified here.

The cross-country tax redistributional effects of the personal income tax, as seen in Figure 1 and reported in many other studies, are functions of the measurement system adopted, which has until now been the traditional one, in which the existing pre-tax inequality values for the various countries condition the results, but confound comparative work. We see the transplant-and-compare method as a move in the right direction, improving the level of comparability. However, we are certain that the method can be extended in various directions, given the breadth of the supposed question "which country is most redistributive?" We leave such extensions to the reader.

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