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A Suggestion for Evaluating the Redistributional Effects of Tax Changes: With an Application to the 2006 Norwegian Tax Reform

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Abstract

An evaluation strategy for answering the question, "Is the tax schedule more redistributive after a reform than prior to a reform?" is presented. The procedure builds upon addressing measures of tax redistribution, utilizing micro data from periods before and after the reform. Tax redistributional effects are measured in terms of a "common base" approach, which means that a benchmark is established which facilitates identifying how the redistributional efforts of policy makers develop over time. When applying this method for evaluation of the 2006 Norwegian tax reform, the

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results suggest that the modification of the dual income tax system of the 2006 reform has improved the redistributional effect of the schedule. This conclusion is qualified by addressing measurement challenges brought up by the reform, such as behavioral responses and timing effects.

Keywords
redistributional effects, income tax, measurement problems, timing effects, common base

We present in this article an evaluation strategy for answering the question, ''Is the tax schedule more redistributive after a reform than prior to a reform?'' Evaluation in terms of redistribution implies that trends in inequality of pretax income are assessed against changes in posttax income distributions, before and after a tax reform. Thus, this conceptual angle differs from analyses that look at effects of tax reform on inequality measured by posttax income distributions only. Further, the evaluation method is non-welfarist, in the sense that characterizations are based on the distribution of income and not based on the utilitarian sum of individual utilities, as the so-called welfarist approach suggests, see Kaplow and Shavell (2002).

While measuring the degree of income redistribution by using both pretax and posttax income distributions (and the difference between them) is not new, we find that this method is beneficial for identifying the contributions of tax changes on the income distribution. First, a tax reform affects income distributions both through direct and indirect behavioral responses. The identification of behavioral effects of tax changes, such as changes in labor supply, gains from addressing information about pretax income distributions before and after the reform.

Second, using information on both pretax and posttax income accentuates that the definition of income is crucial for identification of effects of tax changes. For instance, income measurement problems are decisive when tax reforms affect the incentive to shift income over time and between tax bases. In the application of the present article, which concerns the 2006 Norwegian tax reform, this is exemplified by the changed incentives involved in the decision between paying out dividends and saving in the firm, generating strong timing effects on dividend payout. Instead of measuring the actual income transfers from firms to individuals, which show highly fluctuating patterns due to changing

tax rules, a normalized corporate return is calculated and added to pretax income. Another measurement issue that we address is the treatment of income from owner-occupied housing, utilizing new imputed rent data.

Third, the pretax income distribution also serves to establish a baseline scenario or a benchmark for tax policy evaluation; the reasoning is as follows. Year-specific measures of inequality or redistribution over time provide only very weak identification of the role of tax policies. One may observe that there is more redistribution or that inequality has increased after a reform, but the role of tax policy for outcomes is not identified. Pretax income distributions and the resulting posttax income schedules are influenced by a number of factors, such as the business cycle, demographical changes, and tax changes. In order to go further in identifying the effect of tax policy changes, we apply the so-called ''transplant-and-compare'' procedure of redistribution, suggested by Dardanoni and Lambert (2002). According to this perspective and methodology, the redistributional effect is measured in terms of a ''common base'' or a ''common reference'' where measures of redistribution for each year are adjusted for pretax income inequality differences between years. Thus, this method holds the promise of getting closer in identifying the policy makers' contribution to redistribution over time. Given that, as already noted, we also are able to address the effects of behavioral adjustments on pretax income distributions, the transplant-and-compare procedure sorts out the variation in policy makers' ''redistributional efforts'' over time. We therefore believe that the common base concept for tax policy comparison is highly relevant for the evaluation of tax reforms.

There is a huge literature on empirical measurements of distributional effects of tax-benefit reforms, covering a whole range of various methodological approaches. For instance, one line of research uses structural modeling approaches, employing models that are surveyed in Blundell, MaCurdy, and Meghir (2007). Whereas others assess contributions by addressing measures of income inequality and redistribution over time, see, for example, Jenkins (1995) and Bishop et al. (1997). Recently, we have witnessed increased efforts to establish ''benchmark'' or ''counterfactuals'' within the latter type of research (within a fully structural approach these concepts follow more or less directly), see Kasten, Sammartino, and Toder (1994); Clark and Leicester (2004); Thoresen (2004); Lambert and Thoresen (2009);

Bargain and Callan (2010). Our contribution relates to this part of the literature.

In this article, we show the application of the common base framework for measurement of redistributional effects by discussing effects of the Norwegian tax reform of 2006. The Norwegian reform implied a major revision of the dual income tax system of the 1992 tax reform. A dual income tax system is characterized by separate tax schedules for capital and wage income, and prior to the 2006 reform capital income and wage income were taxed by a (basic) flat rate of 28 percent, whereas a two-tier surtax supplemented the basic rate with respect to wage income. The tax reform of 2006 implies a substantial realignment of dividend income and wage income taxation, as the top marginal tax rates are reduced combined with the introduction of a tax on dividends above a normal rate of return. As income earners at the high end of the scale both are punished by the new tax on dividends and benefit from the reduction in marginal tax rates on wage income, the total distributional effect is genuinely uncertain.

In the following, we describe the informational content of our suggestion for identification of tax policy changes: a common base evaluation strategy which controls for different measurement problems (such as timing effects resulting from the shifting of income between personal and corporate tax bases) and labor supply effects. Empirical measures are derived by employing cross-sectional data from several administrative registers over the period 2000–2008. The main data source is the Income Statistics for Households from Statistics Norway (2010b), which contains register-based information on the whole population. To control for the timing effects, we establish a link between after-tax profits of the firms and individual shareowners. This is done by linking information about profits from the Accounting Statistics for Nonfinancial Limited Companies (Statistics Norway 2010a) to individuals, using the Register of Shareholders (Statistics Norway 2009b) as the identifier.

The income distribution changes due to individual adjustments because of lower wage income marginal tax rates are obtained by employing the tax-benefit model system LOTTE (Aasness, Dagsvik, and Thoresen 2007), describing post-tax income distributions under alternative pre-tax income distributions. To predict the labor supply effects of the tax reductions, we use the main estimates from Aarbu and Thoresen (2001) and Thoresen, Vattø, and Aarbu (2011), who exploit the variation in net-of-tax rates of the 1992 and 2006 tax reforms, respectively, to obtain estimates of income elasticities for Norway.

The article is organized as follows. In the second section, we describe the Norwegian tax reform of 2006. Next, in the third section, we explain in

further detail the empirical strategy that we follow. After a short description of data in the fourth section, we present the results. The fifth section concludes the article.

The Norwegian Tax Reform of 2006

Norway has a dual income tax system, enacted by the 1992 tax reform[1] which consists of a combination of a low proportional tax rate on capital income and progressive tax rates on labor income. The system proliferated throughout the Nordic countries in the early 1990s. The Norwegian version had a flat 28 percent tax rate levied on corporate income; capital and labor income coupled with a progressive surtax applicable to labor income. Double taxation of dividends was abolished, as taxpayers receiving dividends were given full credit for taxes paid at the corporate level, and the capital gain tax system exempted gains attributable to retained earnings taxed at the corporate level. These separate schedules for capital and labor income created obvious incentives for taxpayers to recharacterize labor income as capital income. To limit such tax avoidance, the 1992 reform introduced the "split model" for the self-employed and closely held firms (defined as businesses in which more than two-thirds of the shares were owned by the active owner). Rules were established for dividing business income into capital and labor income, and the resulting imputed wage income was subject to a two-tier surtax. The top marginal tax rates for wage earners and owners of small businesses (the self-employed and owners of closely held firms) were 48.8 percent and 51.7 percent in 1992.[2] Between 1992 and 2004, both the threshold for the second tier of the surtax and marginal rates increased, resulting in the statutory tax rates for 2004 shown in figure 1, with 55.3 percent at the maximum. The schedule for imputed wage income under the split model (not shown in figure 1) has a very complicated structure, implying highly nonconvex budget sets, with marginal tax rates moving from 52.2 through 49.3, 28, to 55.3 percent, and then back down to 28 percent again as income increases.

The 1990s saw increasing pressure on the dual income tax system. For instance, it was apparent that some owners of small firms were able to gain from moving out of the split model, as documented by Thoresen and Alstadsæter (2010). The reform of 2006 emerged as an attempt to create a system that would prevent taxpayers from transforming labor income into capital income to benefit from the lower flat rate applied to the latter; see Sørensen (2005) for the wider background to the reform and steps taken

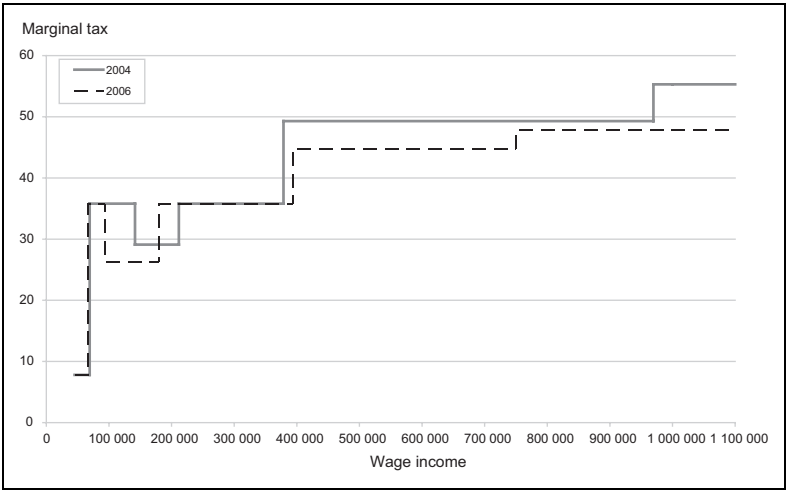

Figure 1. Statutory marginal tax rates on wage income, 2004 and 2006. All thresholds adjusted to 2006 level (1US$ = NOK6.418)

to adjust the dual income tax system and Bø, Lambert, and Thoresen (forthcoming) for horizontal inequity effects of the reform.

Under the 2006 tax reform, the split model was superseded by rules of a more general nature, with dividends taxed at both the corporate and individual levels, in contrast to the 1992 reform, which had only corporate-level taxation. The current tax is levied on individual dividend incomes and capital gains above a rate-of-return allowance, that is, on profits above a risk-free rate of return. Thus, only the equity premium is subject to taxation, by 48.2 percent.[3] The rate-of-return allowance is determined by the imputation rate and the stepped-up basis for the share, the latter being calculated by the acquisition price and all previous unused rate-of-return allowances.[4] Sørensen (2005) demonstrates that the tax on the equity premium is neutral with respect to the use of capital and the firm's investment decisions.

Top marginal tax rates on wage income were cut to narrow the differences between the marginal tax rates on capital income and labor income. Figure 1 reflects the principal features of the Norwegian labor income tax system: a two-tier surtax that supplements a basic income tax rate of 28 percent plus a 7.8 percent social insurance contribution. In 2004, the first tier of the surtax was applied at approximately Norwegian kroner (NOK) NOK380,000 (USD59,200),[5] leading to a marginal tax rate of 49.3, whereas the second tier applied to income in excess

approximately NOK970,000 (USD151,100), resulting in a top marginal tax rate of 55.3.[6] In the 2006 reform,[7] the maximum marginal tax rate fell from 55.3 percent to 47.8 percent but became effective at a lower level of NOK800,000 (USD124,600). To sum up, the reform effected a dramatic realignment of the maximum marginal tax rates on dividend income in excess of the risk-free rate of return and wage income, from 28 percent and 55.3 percent, respectively, in 2004, to 48.2 percent and 47.8 percent in 2006. Such cuts might be expected to have substantial labor supply effects, and we will return to this issue in the next section.

In order to mitigate the distributional problems associated with the compression of marginal tax rates on wage income, the government increased the wage income standard deduction, which is constructed by multiplying wage income by a factor (equal to 24 percent in 2004) subject to a maximum (NOK50,780 or USD7,900, in 2004, in terms of wage-adjusted 2006 kroner). In 2006, the multiplicative factor increased to 34 percent, and the maximum deduction increased to NOK61,100 (USD9,500).[8] There were some other changes in the income tax as well. For instance, the tax on income generated by owner-occupied homes was phased out. This was paralleled by increased wealth taxation of homes, basically derived by increasing house values by 25 percent (the valuation is based on a separate valuation system and not on market values). Changes in the wealth taxation are reflected by measures of posttax income. Further, with respect to other tax bases, the general value-added tax (VAT) rate increased from 24 percent to 25 percent, and the lower VAT rate on food and nonalcoholic drinks from 12 to 13. Even though effects through indirect taxation very straightforwardly can be included in the empirical approach, as seen in Nygård and Thoresen (2009), we restrict our attention to effects of changes in the personal income tax. The main reason is that the changes in the indirect taxation have very small effects.[9] Nygård and Thoresen find that the indirect tax schedule of Norway is less regressive after 2001, which they attribute to the reduction (cut in half) in the VAT on food and (nonalcoholic) drinks that year. This suggests that the effect of an increase in the lower rate on food is negative for redistribution (but the magnitude of the effect is likely small).

As these components of the reform are expected to gain different parts of the income distribution, the total redistributional effect is hard to determine without a closer empirical examination. In the rest of the article, we present a method to measure overall redistributional effects of tax reforms.

A "Common Base" Evaluation Strategy for the Measurement of Tax Policy Effects

The Transplant-and-Compare Procedure

A welfarist approach to tax reform would be founded on aggregations of after-tax well-being (utility) across the population, see the presentation and argumentation in Kaplow and Shavell (2002).[10] There are well-known applied approaches for evaluation of policy changes in terms of utility instead of income, see suggestion for measures in terms of money metric utility in King (1983). However, given the ambition of a comprehensive evaluation, there are practical constraints involved. For instance, the development of realistic (utilitarian) decision models for all the different groups of the population is rather demanding and information intensive.[11] Although it can be argued that using an income-based welfare metric does not solve this informational problem, as income is an insufficient indicator of well-being (Sen 1997), it is nevertheless a key concept for decision makers' social evaluation.

The present approach suggests evaluating policy changes by studying measures of redistribution over time, which we will show is useful in order to establish a common reference for which different tax schedules can be evaluated. Even though measures of overall welfare effects will not be presented here, it is worth noting that the present framework also can be expressed in terms of a social welfare metric, a so-called abbreviated social welfare function (Lambert 1993; Creedy 1996). Lambert (1993) shows that the welfare premium associated with a tax change can be measured assessing the performance of the (new) tax relative to the (new) equal yield proportional tax, in comparison with the performance of the old tax relative to the old equal yield proportional tax.[12]

Another limitation of the present analysis is its partial nature. The tax incidence approach, as for instance put forward by Pechman and Okner (1974), reminds us that the burden of the tax may fall upon someone else than the people actually paying the tax. Despite that one can think of employees for instance being able to pass on increased taxes to employers, the personal income tax is normally assumed to be born by the people on whom the tax is initially levied. Accordingly, the present analysis basically follows this assumption. However, as already noted, special attention is given to the distinction between corporate and individual income, as there is evidence of substantial income shifting between corporate and personal tax bases over time. We will return to this issue shortly.

Distributional effects of the steps that have been taken in order to balance the budget, that is, distributional effects of the expenditure side, are not brought into the analysis. This is in contrast to the evaluation procedure suggested by Elmendorf et al. (2008) for evaluation of the 2001 and 2003 US tax cuts. The main reason for neglecting effects of the expenditure side is that the reform is mainly a shift toward more dividend taxation and less tax on wage income, with only small effects on overall revenue. Total costs are estimated at NOK9.3 billion, which was 0.43 percent of gross domestic product and 1.29 percent of total mainland tax revenue in 2006 (Thoresen, Aasness, and Jia 2010). Moreover, the reform can be seen as funded by borrowing against future income, transferring money from the Norwegian Petroleum Fund, a fund based on Norwegian oil wealth, generating unclear distributional effects (at least in a cross-sectional perspective).

Let us probe deeper into the concept of "redistributional effects," before explaining the establishment of a baseline for identification of tax policy effects. If x and n are individual pretax and posttax incomes, respectively, the pretax income distribution is symbolized by $F(x)$, and posttax or net income is defined by $N(x) = x - T(x)$, where $T(x)$ is the tax schedule. The pair $\langle N, F \rangle$, comprising the net income schedule (N) and the pretax income distribution (F), determines the redistributive effects. An example of further description, which we will use in the following, is to establish a Gini-based measure of redistribution, such as the Reynolds–Smolensky index of redistribution (Reynolds and Smolensky 1977), $\Pi_R = G_X - G_N$, where G_X and G_N are Gini coefficients for the pretax and posttax income, respectively. A standard way to describe the redistributional effects of the tax system over time is to present year-specific measures of redistribution over a period.

Instead of addressing information about posttax income inequality directly, as often seen in over time evaluations of income distributions, the focus on the pair $\langle N, F \rangle$ signifies that the final outcome (N) results from the policy maker's efforts to redistribute market generated income (F) into a welfare maximizing schedule. From a tax policy evaluation perspective, we find this methodological approach beneficial: as it denotes the importance of income definitions, it is helpful for identification of behavioral effects, and it provides an opportunity to establish a common reference from which the policy makers' redistributional efforts over time can be assessed. Let us first address the establishment of a baseline and return to the two other issues below.

Obviously, from a policy-making perspective, it is of key interest to pin down the specific effects of tax policies *per se* on the observed outcomes.

The literature has offered some suggestions to obtain more detailed information on tax policy effects, and two such contributions are the approaches proposed by Kasten, Sammartino, and Toder (1994) and Dardanoni and Lambert (2002). Both methods can be seen as establishing a common base for identification of the tax policy contribution, founded on the utilization of pretax income distributions and differences between them. Kasten, Sammartino, and Toder suggest identifying effects of tax policy changes through what we characterize as a "fixed-income" approach, which means that pretax income distributions are kept fixed, a base year being chosen and exposed to taxation as per the various tax schemes of the period. Using this method for evaluation of the 2006 tax reform, a relevant comparison is between $\langle N_{2006}, F_{2006} \rangle$ and a simulation where the 2004 tax schedule is inflated to 2006 and applied on 2006 incomes, symbolized by $\left\langle N_{2004}^{p^{06}}, F_{2006} \right\rangle$, where the superscript p^{06} indicates that the posttax income schedule of 2004 is projected to 2006.

According to Lambert and Thoresen (2009), the "fixed-income" approach may be vulnerable to base dependence problems; that is, results will differ depending whether one adjusts the 2004 tax schedule to 2006 and uses the 2006 income distribution as base for the comparison or deflates the 2006 tax schedule to 2004 and employs the 2004 schedule as the base. Lambert and Thoresen (2009) find that the procedure suggested by Dardanoni and Lambert (2002) performs better in that respect. Dardanoni and Lambert propose to compare posttax distributions that have been adjusted to a common base regime, in which differences in pretax income inequality have been controlled for through a transplant-and-compare procedure. The pretax income distributions are turned into a common base, indicated by the subscript C of F_C, and the relevant comparison for the period 2000–2008 is now founded on the following pairs: $\left\langle N_{2000}^{g^{C00}}, F_C \right\rangle$, $\left\langle N_{2001}^{g^{C01}}, F_C \right\rangle, \ldots,$ $\left\langle N_{2008}^{g^{C08}}, F_C \right\rangle$, where the superscripts g^{C00}, $g^{C01}, \ldots,$ g^{C08} indicate that posttax income schedules have been deformed by fitted deformation functions, reflecting the pretax income distribution differences between the actual distribution and the common base.

The reasoning behind the use and the practical implementation of the deformation functions can briefly be explained by the following. Let *F(x)* be the distribution function for pretax income for a given year, and let $u = u(x)$ be some attribute of a person or household having income x before tax. If *g(x)* is a mapping of pretax incomes into $\mathbb{R}^+$, the conjugate mapping

$u^g(x) = g(u(g^{-1}(x)))$, that is, $u^g = g \circ u \circ g^{-1}$, 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 $\ln(0, 1)$,[13] then as Dardanoni and Lambert (2002) have shown, the conjugate of the pretax/posttax income mapping $x \to n$ can be regarded as the transplant of the tax system into $\ln(0, 1)$. This can be done with the data of each year, 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 pretax distributional differences. In fact, whenever pretax income distributions differ in logarithms only by location and scale, and not only in the lognormal case, an appropriate reference distribution can be selected, and the comparisons made with tax systems that have been adjusted for over time differences in pretax location and scale. Empirically, one wants to find that, for each year t, there exist a_t and $b_t > 0$ such that the distribution of $a_t + b_t \ln(x)$ is sufficiently close to the chosen reference distribution, where x is pretax income. Thus, the method implies finding estimates of a_t and b_t 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 ordinary least squares regression, and the R^2 statistic becomes the relevant measure of goodness of fit. The posttax income values are then adjusted by the fitted deformation function $g_t(x) = e^{a_t} x^{b_t}$ before making comparisons of redistributive effect.

In practice, either the reference distribution holds high or low pretax income inequality ($b > 1$ or $b < 1$), the transformation into common base comparisons will narrow the spread in redistribution, compared to the standard year-specific approach, as the deformation function works harder on the pretax income distribution than on the posttax income distribution.

Measurement Challenges in Reform Periods: Timing Effects

Having established a baseline for identification of tax policy changes, a valid identification strategy must also address key characteristics of tax reforms, such as behavioral responses. It is widely accepted that tax changes influence behavior along several dimensions; see the three-tier behavioral response hierarchy by Slemrod (1992, 1995), under which real responses are the most sluggish, timing is the most responsive, and the third component, avoidance behavior, is somewhere in the middle. Fiscal manipulation in the form of income shifting has received much attention and takes different forms. For instance, Gordon and Slemrod (2000) discuss the changes in

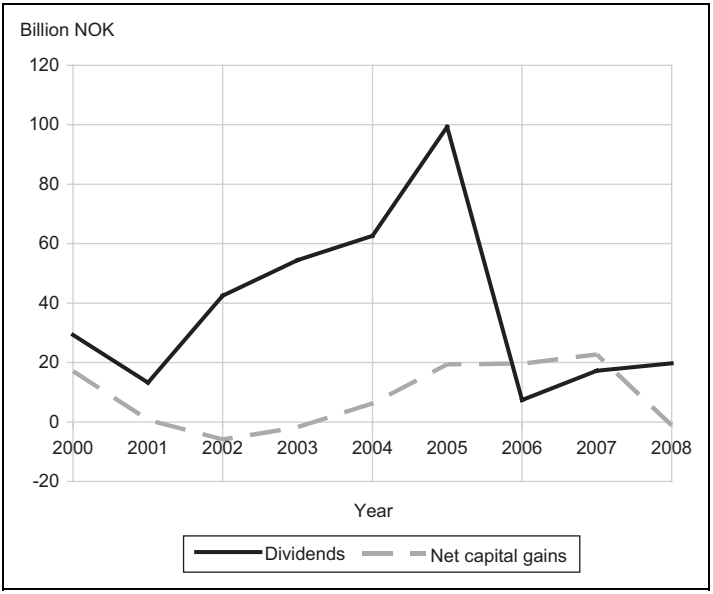

Figure 2. Development in dividends and net capital gains, 2000–2008

organizational form following the US Tax Reform Act of 1986 and implications for interpretations of responses to the reform.

The Norwegian tax reform of 2006, which was announced several years in advance, introduced incentives to step up dividends prior to the reform. Indeed, this caused strong timing effects, see Alstadsæter and Fjærli (2009).[14] In figure 2, we show the amount of dividend payments to households over the period 2000–2008. Dividend payments dropped in 2001 due to a temporary tax on dividends, and then rose steadily from 2002 and on, after the appointment of a government tax commission with the mandate to consider a new tax on dividends. Most of these extraordinary dividends were immediately reshuffled into the corporations as "new" equity or loans from the owners, and thus represented only formal transactions with the single purpose to convert retained profits into contributed equity or debt, which can be returned tax-exempt to the owners despite the presence of a future dividend tax. Alstadsæter and Fjærli show that the increase in dividends was accompanied by a corresponding increase in the debt-equity ratios and in the ratios of contributed equity. Thus, the hike in dividends prior to the implementation of the reform did not necessarily have a counterpart in increased corporate income. This demonstrates that descriptions of

distributional effects which do not address the measurement problem related to timing effects are in danger of giving a misleading picture of the underlying distribution of economic resources in the population.

For example, official income statistics (Statistics Norway 2010b) show that while inequality measured by the Gini coefficient was fairly stable around 0.23 to 0.24 from 1995 and on, it rose to 0.26 in 2000 (prior to the temporary and pre-announced dividend tax of 2001). Inequality fell back to 0.23 in 2002, then rose steadily and reached a peak of 0.33 in 2005, and finally dropped to 0.24 in 2006. The ratio of the share of income held by the top 20 percent compared to the bottom 80 percent shows a similar pattern, closely related to the time profile of aggregate dividends, displayed in figure 2.

In order to obtain a concept of income that is more robust against timing effects in the reported income, we calculate a new shareholder income measure by assigning to the owners their entitlement to after-tax profits of the firm, rather than using the traditional income concept based on households' dividends and net capital gains. The basic procedure is straightforward: we simply multiply after-tax profit by the individual ownership shares, using a shareholder register that comprises ownership data for all corporations and individual owners, see Statistics Norway (2009b).

Next, we need to calculate the tax on this imputed return. The increase in tax revenue from the shareholder income tax so far seems modest, which has to do with the sharp decline in dividends paid after the reform. The retention of profit within the firms (which we allocate to the owners using our alternative concept of income) will generate a corresponding tax upon future distribution. In order to calculate net after-tax shareholder income, this tax has to be estimated by its present value and amortized and converted into an annual amount before subtracting it from gross income. In the actual shareholder model of the present tax schedule, this is a rather complex task, as amounts below the rate-of-return allowance (henceforth, *RRA*) will generate a tax credit by carry forward of unused *RRA*'s with interest added. However, Sørensen (2005) demonstrates that the present value of the stream of after-tax dividends does not depend on its time profile, if the *RRA* is properly calculated.[15] Moreover, Fjærli and Raknerud (2009) show that if we let T_t denote the actual tax liability under the shareholder model under actual payout policy, r the interest rate, τ the tax rate, S the base for the calculation of *RRA* and π the after-tax profit, then, provided that any negative tax base will give a negative tax in any termination period t, we have that

$$(1+r)^{-t}T_t + (1+r)^{-t+1}T_{t-1} + \cdots + (1+r)^{-1}T_1 = (1+r)^{-t}\tau(\pi_t - rS_t) + \cdots + (1+r)^{-1}\tau(\pi_1 - rS_1).$$

The *RRA* is based on the simple principle that the shareholder can deduct an amount corresponding to the risk-free return of the share's acquisition cost. However, the practical implementation of the system is more complex. In the first year, the *RRA* equals the risk-free return, r, on the cost of acquisition, S_1: $\mathrm{RRA}_1 = rS_1$. The tax liability on dividends received in period t, D_t, is $T_t = \tau \max(0, D_t - \mathrm{RRA}_t)$. The *RRA* will evolve according to a difference equation, from $t = 2$ until the end of the period, Ω: $\mathrm{RRA}_t = rS_1 + (1+r)\max(0, \mathrm{RRA}_{t-1} - D_{t-1})$; that is, current *RRA* is the sum of the risk-free return on the cost price and the previous period's unused *RRA*, with interests added. The calculation of the tax liability in any given period requires information on the unused *RRA*, which in turn will affect future tax liabilities. Since we want to treat individuals equally and independent of when shareholder income is realized, we need to calculate the present value equivalent of the future tax liabilities related to current profit (which can be distributed now or in the future and can be realized as dividends or capital gains). To do this, we utilize the fact that the *RRA* shields the risk-free return from taxation, regardless of *when* shareholder income is realized. For example, if all profits are retained by the firm until the termination period Ω, that is, $D_t = 0$, for $t = 1, 2, \ldots, \Omega - 1$, the *RRA* in the termination period is $\mathrm{RRA}_\Omega = r[(1+r) - 1]S_1$, that is, equal to the accumulated interest of an initial investment in government bonds of S_1 in period 1.

Based on these results, our procedure for imputing shareholder income y for individual i at time t is $y_{it} = \gamma_{ikt}\pi_{kt-1}$, for $t < 2006$ (when y is tax exempt at the individual level), where γ_{ikt} denotes the ownership share of individual i in corporation k in income year t, entitling him or her to a share of the profit (π) earned in accounting year $t-1$, and $y_{it} = (1-\tau)(\gamma_{ikt}\pi_{kt-1} - rS_{t-1}) + rS_{t-1}$ for $t \geq 2006$. Measures of γ and π are derived from the Accounting Statistics for Nonfinancial Limited Companies (Statistics Norway 2010a) linked to individuals by using the Register of Shareholders (Statistics Norway 2009b), and then added up for all firms in the portfolio of individual i. rS is obtained from individual tax returns and includes the *RRA* for the entire portfolio. At $t \geq 2006$, y is taxed at the flat rate of 28 percent, and a negative tax base will give a negative tax, provided that total net income is positive.[16] This is in line with the normal treatment of negative income from self-employment and unlimited businesses.

Conceptually in terms of a common base evaluation, this extension does not alter the main framework. The new pairs employed in the over time evaluation can be seen as, $\left\langle (N^*)^{g^{C00^*}}_{2000}, F^*_C \right\rangle$, $\left\langle (N^*)^{g^{C01^*}}_{2001}, F^*_C \right\rangle, \ldots,$ $\left\langle (N^*)^{g^{C08^*}}_{2008}, F^*_C \right\rangle$, where the symbol * indicates that this approach differs from the standard common base evaluation of The Transplant-and-Compare Procedure section because of three modifications: the imputation of profits from the corporate sector changes the pretax income distribution, the post-tax income schedule is changed because the tax is calculated on basis of the new imputed income, and, finally, the (empirical) deformation functions also differ as they are based on new pretax income distributions. The imputation method does not account for wage responses from allocating retained earnings to the individuals after the reform. Thus, it is implicitly assumed that wage payments are independent of the size of the profit saved in the firm, which is questionable. We expect that after the reform, the capital income imputation method implies an overestimation of incomes levels at the high end of the income distribution, as increased capital transfers (in reality) may be counteracted by reduced wage incomes. However, one should note that it requires some control over the firm in order to shift income between wage and dividend payments, and that even though Thoresen and Alstadsæter (2010) find substantial income gains for owners of small businesses involved in shifts in organizational form, they find that only a modest share of business owners have been involved in these tax avoiding activities.[17]

Imputed Income from Owner-occupied Housing

Another measurement issue that often attracts concern is the calculation of income from housing; see, for example, Frick, Goebel, and Grabka (2007). Let us also therefore briefly explain the method that is used to impute income from owner-occupied housing, see Thoresen et al. (2011) for further details. There are three common approaches to imputing income from owner-occupied housing: the rental equivalence method, the user-cost or capital market approach, and out-of-pocket expenses. The latter method demands observations of the actual outlays on housing, which is usually found in consumer expenditure surveys. As other types of data are used here, the two relevant approaches are the rental equivalence method and the user-cost (or capital market) approach. The rental equivalence method is based on regression models that have rent as the dependent variable and

housing characteristics as the right-hand-side variables. As Røed Larsen (2009) has shown, the number of square meters and area of residence are the two most important characteristics, so that a rough measure of imputed rent can be obtained on the basis of these two variables alone.

The user cost associated with homeownership is the sum of forgone interest income, property taxes, a risk premium for housing investments, maintenance and depreciation costs, less the owner's nominal capital gain. Since in equilibrium, the user cost of housing should equal the income from housing, the user cost can thus be taken as a measure of imputed income from housing. However, unless one has information about actual maintenance and depreciation costs and so on, there are many parameters that need to be given imputed values.

The capital market approach is based on the same type of reasoning, but is simpler to employ. The starting point is the alternative use of capital in the capital market. Application of the capital market approach is often founded on the current market value of owner-occupied housing, H, and outstanding mortgages, M, which needs to be deducted from the estimated market value. The implicit rate of return will equal a safe market rate of return on an equal value of investment. Instead of applying a nominal interest rate to total net home value, we use that in our data the actual nominal interest paid on mortgages is directly measured, while we calculate the gross return to housing. A problem with this approach is that it does not take into account any potential depreciation of the building.

In our imputation, we have used two alternative rates of return, one is a stable real rate of return of 3 percent plus inflation, which is a middle value of those found in the literature; see Saunders et al. (1992) and Frick, Goebel, and Grabka (2007). The other is a floating nominal rate of return, measured as the money market rate. However, as the results for the two different assumptions regarding rates of return are rather similar, we only present results for the stable 3 percent real rate of return plus inflation.

Since 2005, Statistics Norway has developed estimates for market values of houses based on regression methods, see Statistics Norway (2009a). Since these procedures differ somewhat from year to year, we have used the joint information from all years to determine the approximate size of the house in square meters. This variable has then been multiplied by the area (at city or municipality level) and a dwelling-specific house price to provide a consistent measure of market value over time. For the years before 2005, housing values have been imputed backward,

using information about size and house prices for families who according to their tax values for housing appear to have remained in the same dwelling over time.

Official income statistics from Statistics Norway for posttax incomes have not controlled for interest rate expenses, mostly due to the lack of realistic estimates of the return from housing. Now, having established a broader income measure, these expenses are deducted. In terms of the common base approach, the house income extension is conceptually equal to the inclusion of firm income, see Measurement Challenges in Reform Periods: Timing Effects section.

Changes in Marginal Tax Rates Influence the Pretax Income Distribution

Changes in marginal tax rates on wage income will affect the pretax income distribution, meaning that changes in the tax schedule generating posttax income (N) influence the pretax distribution function F. Ignoring behavioral effects may conceal important contributions. Such effects are reflected by the distribution function F, but the effects are not explicitly identified, as pretax incomes are influenced by a number of factors, such as demographical changes, cyclical effects, developments in transfers and pensions, and so on. The following describes how the behavioral adjustments are identified and brought into consideration within a common base framework.

There are different ways to isolate the contribution from labor supply adjustments and other adjustments.[18] For instance, the labor supply module of the tax-benefit model system LOTTE (Aasness, Dagsvik, and Thoresen 2007) can be used to predict effects on working hours and incomes, as done when discussing revenue costs of the reform in Thoresen, Aasness, and Jia (2010).

An alternative procedure is employed here, based on utilizing results from Aarbu and Thoresen (2001) and Thoresen, Vattø, and Aarbu (2011) in combination with the nonbehavioral tax-benefit routine of the LOTTE model system.[19] The tax-benefit model is employed to calculate posttax income under two different conditions: in the first alternative, incomes in 2004 (prereform)[20] are projected to 2006 and taxed according to 2006 tax-laws, whereas in the second alternative, incomes are not only projected to 2006; they are also adjusted in accordance with predicted responses, represented by the elasticities derived by Aarbu and Thoresen (2001) and Thoresen, Vattø, and Aarbu (2011). They estimate elasticities for taxable income and earned income, respectively, with respect to the net-of-tax rate

(one minus the marginal tax rate), based on income data. Even though the two studies differ in that one focuses on taxable income and the other earned income (in addition to using information from two different reform periods), these measures are broader measures of behavioral response to tax changes than working hours alone (Feldstein 1995). Here, we employ the elasticity estimates to identify wage income responses, which means that we (conceptually) apply the earned income elasticity of Thoresen, Vattø, and Aarbu.[21] As the results of Thoresen, Vattø, and Aarbu indicate a rather low response, results are assessed for a low-response alternative of 0.1 but also for two alternatives, an elasticity estimate of 0.2, which is one of the main estimates of Aarbu and Thoresen (2001; but for a different income concept), and a high-response alternative of 0.3, which is more in accordance with results of the international literature within this field; see the survey by Saez, Slemrod, and Giertz (2009). Figure 1 shows the net-of-tax rate changes for different income groups, which, when multiplied by the overall elasticity estimate, determine the income growth rates that are entered into the tax-benefit model.

As the behavioral effects already are included in the pretax income distributions, the conceptual exposition of this tax policy contribution deviates from the description seen so far. In terms of a standard (no common base) comparison, we depart from an income distribution not affected by behavioral responses, that is, the 2004 pretax income distribution, where the individual position in the distribution of wage income defines the net-of-tax rate change and the corresponding wage response. The two pairs of measures of redistributional effects are both based on 2004 incomes being projected to 2006 and exposed to the 2006 tax schedule; the only difference between them is the behavioral response that are used to establish the pretax income distribution, symbolized by λ, which also influences the posttax income schedule, as denoted by the superscript (N^{λ}_{2006}): $\left\langle N_{2006}, F^{p^{06}}_{2004} \right\rangle$ and $\left\langle N^{\lambda}_{2006}, F^{\lambda p^{06}}_{2004} \right\rangle$. The identification of the contribution from behavioral responses is simply the difference between the pairs: $\left\langle N^{\lambda}_{2006}, F^{\lambda p^{06}}_{2004} \right\rangle - \left\langle N_{2006}, F^{p^{06}}_{2004} \right\rangle$.

Moreover, this can be turned into a common base comparison by a deformation based on the differences between $F^{\lambda p^{06}}_{2004}$ and $F^{p^{06}}_{2004}$, which means that the relevant common base measure is $\left\langle (N^{\lambda}_{2006})^{g^{\lambda}}, F_C \right\rangle - \left\langle N_{2006}, F_C \right\rangle$, where the deformation function g^{λ} reflects the difference between the pretax income distributions due to behavioral responses, as denoted by the

superscript λ. The determination of the deformation function is based on identifying location and scale parameters, as already described (in The Transplant-and-Compare Procedure section).

Is the Tax Schedule More Redistributive After the Reform?

Data

The primary source of data for this study is the Income Statistics for Households (Statistics Norway 2010b). These statistics hold register-based information on the whole population, derived primarily from information retrieved from all income tax returns in the Directorate of Taxes' Register of Personal Taxpayers but also from other administrative registers, such as data from the Labour and Welfare Organisation. The Income Statistics for Households succeeded the Income Statistics for Persons and Families recently, when household data were obtained from registers too, with the establishment of the Ground Parcel, Address and Building Register in 2004 (Statistics Norway 2009a). Prior to that information about household income was obtained through a sample survey, as households were interviewed about household composition.

The household is often considered as the basic economic unit for decisions and allocations concerning distributional aspects, but for the purpose of this study, covering the period 2000–2008, the data limitations mean that we only have register-based household information for all Norwegians for the latter part of the time span. As it is preferable to have data for the whole population throughout the period, income at the family level is used as the main measure. However, we have verified that the description of redistributional effects (as measured by the Reynolds–Smolensky index) for 2000–2008 is independent of whether sample survey household data or register-based family data are used, see Thoresen et al. (2011).

Note also that in all presentations of results incomes are measured in "equivalent values," which means that the nominal values of aggregate income of the family have been weighted by an equivalence scale (the square root of the number of family members). The representation of each family when obtaining summary measures of redistributional effects depends on the number of family members. This is often characterized as employing the individual as the unit of analysis. Thus, incomes have been readjusted for interpersonal comparison, similarly to what Ebert (1997) denotes as method 3.

A main reason for the preference for register data is that they alleviate a broad connection to firm data. As denoted, an important ambition of the present analysis is to control for the timing effects influencing dividend payouts, which means that information on firm results must be linked to individuals in some way. Here, this is achieved by connecting information about profits from the Accounting Statistics for Nonfinancial Limited Companies (Statistics Norway 2010a) to individuals, using the Register of Shareholders (Statistics Norway 2009b) as the bridge between firms and individual owners.

The tax-benefit model LOTTE (Aasness, Dagsvik, and Thoresen 2007), which is applied to derive estimates for the contribution from behavioral adjustments, uses the Income Statistics for Households as the main data source, and there is close correspondence between tax simulation results and actual tax payments, as they are recorded in data.

Redistribution 2000–2008 by Year-Specific Measures

Before presenting the results of the common base approach, let us first address measures of redistribution over time in a traditional form, that is, in terms of measures of redistribution where inequality of pretax and posttax income have been calculated separately for each year, to obtain year-specific measures of redistribution, as measured by the Reynolds–Smolensky index (see The Transplant-and-Compare Procedure section). Results are shown for different definitions of pretax income and posttax income schedules; see also the sample summary statistics in table 1.

If we depart from a "narrow definition" of income, as used when presenting official estimates of income inequality in Norway, see Statistics Norway (2010b), figure 3 forms the background for what we observe in terms of redistributional effects.[22] In order to relate income component changes over time to effects on income distributions, in figure 3, we describe income factor shares for decile 1, deciles 2 through 9, and decile 10, for three years of the period of analysis. Note that individuals are ranked by (equivalent) posttax income, whereas income shares refer to components of total pretax income. The figure clearly shows the changing significance of capital income (which includes dividends as a major component) for persons in decile 10 over time, increasing to over 30 percent in 2004, followed by a substantial reduction in 2008, down to approximately 17 percent after the introduction of tax on dividends at the individual level. It also belongs to this picture, as already noted, that dividend income is an income component that almost exclusively benefits people at the high end of the income

Table 1. Sample Summary Statistics, Average in Deciles, 2000–2008

	Year	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	Total
Family size	2000	1.97	2.29	2.59	2.87	3.01	3.04	3.07	3.10	3.13	3.12	2.82
	2001	2.03	2.30	2.57	2.85	2.98	3.01	3.05	3.08	3.13	3.09	2.81
	2002	2.04	2.30	2.55	2.81	2.95	3.00	3.03	3.07	3.12	3.10	2.80
	2003	2.08	2.33	2.53	2.77	2.91	2.97	3.02	3.05	3.10	3.09	2.78
	2004	2.06	2.32	2.50	2.73	2.89	2.96	3.00	3.06	3.10	3.09	2.77
	2005	2.07	2.32	2.48	2.69	2.86	2.93	2.99	3.03	3.08	3.08	2.75
	2006	2.16	2.32	2.47	2.67	2.83	2.92	2.97	3.02	3.06	3.02	2.74
	2007	2.15	2.30	2.44	2.62	2.79	2.89	2.95	3.01	3.05	3.01	2.72
	2008	2.03	2.40	2.77	3.04	3.16	3.19	3.19	3.19	3.19	3.14	2.93
	2000	74,760	132,183	168,047	202,770	235,906	267,802	302,582	346,074	410,869	746,791	288,779
	2001	77,533	138,332	175,703	211,827	246,431	279,996	316,340	361,405	428,134	695,430	293,113
	2002	80,191	144,850	183,996	221,895	258,152	293,692	332,044	379,661	450,589	807,059	315,213
Pretax	2003	81,333	148,151	187,857	226,157	263,339	299,985	339,568	388,615	462,356	856,927	325,429
income	2004	83,353	151,053	191,715	231,104	269,718	307,619	348,520	399,150	475,483	921,095	337,881
	2005	85,232	155,027	197,575	239,080	279,785	319,912	363,423	418,046	502,511	1,157,364	371,795
	2006	94,512	165,112	209,622	252,980	295,087	336,376	381,126	436,599	519,574	858,534	354,952
	2007	100,286	177,042	225,660	272,822	318,333	363,052	412,041	473,385	566,244	975,651	388,452
	2008	124,631	218,125	276,060	324,851	368,590	412,485	462,192	525,352	621,706	1,030,030	436,402
	2000	69,789	115,954	139,048	161,098	181,848	201,960	223,523	250,141	289,396	518,435	215,119
	2001	71,936	120,929	145,446	168,747	190,564	211,867	234,368	261,737	301,604	460,588	216,779
	2002	74,316	126,585	152,218	176,809	199,961	222,763	247,168	276,350	319,476	573,072	236,872
Posttax	2003	75,335	130,041	155,925	180,447	204,223	227,828	253,051	283,325	327,996	618,206	245,638
income	2004	77,189	132,686	158,830	183,758	208,197	232,418	258,344	289,734	335,814	666,461	254,343
	2005	79,265	137,385	165,177	191,855	218,161	244,114	272,386	307,065	359,321	874,665	284,939

(continued)

Table 1. (continued)

	Year	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	Total
	2006	87,282	145,158	174,386	202,666	230,034	256,839	285,827	320,919	371,955	572,029	264,709
	2007	92,586	155,420	187,854	218,954	248,787	278,082	309,726	348,262	405,359	650,480	289,551
	2008	115,374	188,936	226,883	259,145	287,964	316,723	348,483	388,373	447,221	688,459	326,756
	2000	661	192	286	508	792	1,217	1,827	3,271	7,192	165,217	18,116
	2001	1,460	286	375	587	896	1,300	1,870	3,121	6,275	65,443	8,161
	2002	1,259	260	455	736	995	1,496	2,261	3,984	8,460	248,248	26,815
Dividend	2003	969	280	457	706	1,106	1,616	2,536	4,434	9,896	312,440	33,444
income	2004	990	290	453	820	1,168	1,819	2,927	5,022	10,716	360,789	38,499
	2005	945	236	499	786	1,265	1,861	3,201	5,705	13,016	588,993	61,651
	2006	273	152	227	460	604	833	1,234	2,014	3,883	31,359	4,104
	2007	426	182	368	562	846	1,233	1,999	3,587	7,265	80,837	9,731
	2008	3,320	493	855	1,102	1,510	2,222	3,411	5,465	11,884	121,747	15,201
	2000	2,337	717	1,210	1,962	2,185	3,347	5,387	6,944	12,123	158,302	19,451
	2001	8,997	2,074	2,187	2,574	2,970	4,358	4,812	11,625	16,606	130,939	18,714
	2002	−2,983	−2	−61	114	1,089	1,417	3,173	4,529	8,636	131,733	14,764
Imputed	2003	−4,591	−338	316	−563	2,091	666	1,456	4,012	9,151	148,932	16,113
dividend	2004	−2,646	222	232	992	1,256	1,481	2,896	4,875	9,692	231,627	25,063
income	2005	−11,516	−34	430	996	1,527	2,035	3,833	5,634	10,539	197,088	21,053
	2006	7,810	2,686	3,197	5,199	6,982	9,276	13,363	18,397	29,018	157,512	25,344
	2007	24,968	6,346	6,454	9,269	10,228	12,285	20,227	28,762	53,257	391,933	56,373
	2008	22,244	7,313	9,527	9,819	14,489	17,136	25,511	38,192	71,232	401,619	61,708
	2000	11,854	17,312	23,931	29,739	33,699	36,992	40,237	44,559	50,558	61,805	35,069
	2001	13,270	18,584	25,253	31,000	35,488	38,558	42,151	46,207	52,290	63,513	36,631
	2002	13,738	19,475	26,510	32,594	36,900	40,512	43,769	48,090	54,447	66,873	38,291

(continued)

Table 1. (continued)

	Year	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	Total
Housing income	2003	13,980	19,649	26,838	32,731	36,946	40,513	43,992	48,224	54,205	66,676	38,375
	2004	15,206	21,793	29,779	36,810	41,418	45,399	49,132	53,751	60,121	73,170	42,658
	2005	15,973	22,772	31,722	39,228	44,212	48,556	52,908	57,876	64,533	78,691	45,647
	2006	18,644	25,118	33,929	40,603	45,587	49,529	53,449	58,609	64,817	80,005	47,029
	2007	19,820	27,644	36,972	44,321	49,482	54,619	59,015	64,667	72,350	89,671	51,856
	2008	18,449	30,621	41,295	47,875	52,998	57,335	61,607	66,393	73,804	92,022	54,240

Note: Sample sizes 2000–2008: 4,570,621; 4,591,217; 4,617,453; 4,640,541; 4,667,003; 4,699,664; 4,681,134; 4,737,171, and 4,799,239.

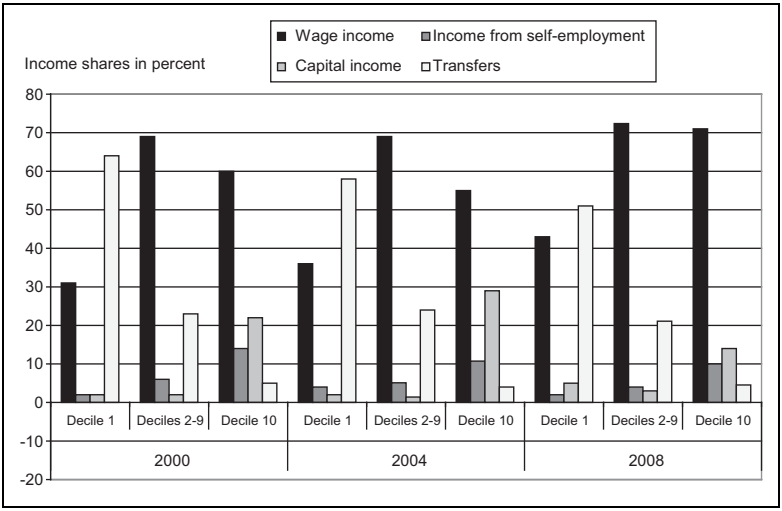

Figure 3. Pretax income components as share of decile income when individuals are ranked by posttax (equivalized) household income, in 2000, 2004, and 2008

distribution. For example, 95 percent of dividends were received by individuals in decile 10 in 2004. Even though most of the increase in the wage income share in decile 10 in 2008 (mechanically) follows from the large drop in capital income that year, we also see an increase in wage income, which may indicate that the reduction in capital income is counteracted by increased wage income after the reform.

In figure 4, the pattern of dividend payments is reflected by the depiction of redistributional effects according to the standard definition of income.[23] After the 2006 tax reform, less dividends are transferred to households, which is signified by a compression of pretax income. Further, as the pretax income inequality reduction is not counteracted by disproportional reductions in posttax income, which would have happened if the transfer had been taxed before the reform, this effect is carried over to a substantial reduction in posttax income inequality, also assisted by the tax on dividends after the reform (even though this latter effect is small, as the tax base have been eroded; see figure 2). The tax relief on high wage income (see figure 1 for rate reductions) is not strong enough to neutralize this effect. Remember also that the reform implied increases in wage income standard deductions, which improves the tax system's redistributional effects.

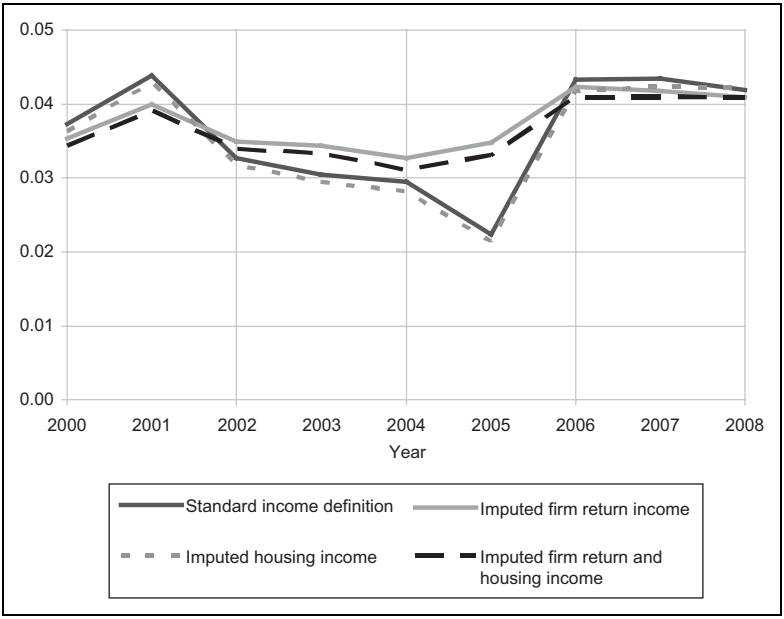

Figure 4. Redistributional effect (Reynolds–Smolensky index) 2000–2008, measured by four definitions of income

The measures of redistribution for alternative definitions of income basically show the same development over the period, as for the standard income definition. This is shown in figure 4 for three alternatives: an alternative where actual dividends and capital gains are replaced by calculated ownership returns, an income concept with imputed income from housing, and a third alternative, which combines the two extensions. However, when firm profit is imputed to the owners, and taxed by approximately 48 percent over a normal rate of return after the reform, the increase in redistribution arises from a different reason: now the increased taxation of dividends after the reform is the main explanation (and not the reduction in dividends as is the case for the standard income definition). When smoothing out the capital income timing effects, the increase in the Reynolds–Smolensky index from 2005 to 2006 according to the standard income definition is substantially reduced: about two-thirds of the increase can be attributed to timing effects.

Another complication when measuring tax policy effects, the behavioral effect of tax changes, will be discussed in terms of common base results shortly.

Common Base Results

The description of redistribution in figure 4 is restricted in the sense that the identification of the tax policy contribution to the observed redistributional effect is hard to seize. In order to establish a common baseline from which the policy makers' tax redistributional efforts to the results can be evaluated, we show results for a common base evaluation (Dardanoni and Lambert 2002) of the reform, where measures of redistribution for each year are adjusted for pretax inequality differences; see The Transplant-and-Compare Procedure section.[24] Thus, a number of regressions have been carried out, selecting the first year of the period (2000) as the base year; the findings of Lambert and Thoresen (2009) suggest that this method provides results that (for practical purposes) are independent of the choice of base. The R^2 statistic becomes the relevant measure of goodness of fit: we find estimates that generally are very high, often close to 1 and never below 0.98.

After controlling the posttax schedules for the fitted deformations, we obtain a common base evaluation of the period, described in figure 5, for four definitions of income (corresponding to figure 4). Compared to the results of figure 4, the normalizations reduce the redistributional effects in years with higher pretax income distributions, as the nonequiproportionate compression reduces the pretax income distribution more than the posttax income schedule. However, given that the variation in the inequality of pretax income distribution is limited over the (narrow) period under investigation, the results are rather similar to the results for the year-specific measures.

The common base evaluations of figure 5 clearly suggest that the tax reform of 2006 improved the redistributional effects of the personal income tax. Independent of the choice of income definition, we see that the tax schedule is more redistributive after the reform. For instance, the redistributional effect of the tax system is approximately 15 percent higher in 2008 than in 2000 according to the wider definition of income (including imputed firm returns and housing income). Similar to the results of figure 4, the explanation to the increased redistribution after the reform depends on the definition of income: for the standard income definition, the main reason is the reduction in dividend payments, whereas for income definitions

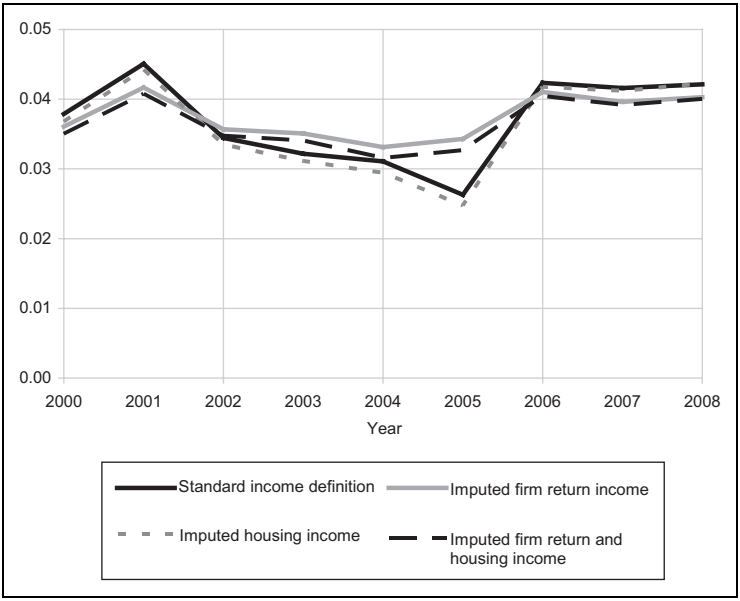

Figure 5. Common base redistributional effect (Reynolds-Smolensky Index) 2000–2008, measured by four definitions of income

involving imputed firm returns, it is the (latent) taxation of dividends which drives results.

Moreover, given that the ambition of the present analysis is to identify the effects of tax policy changes, we have also calculated how the income adjustments due to the reduced marginal tax rates have influenced the evaluation of common base redistributional efforts. As this effect is "hidden" in the pretax income distribution, it is identified by applying three alternative tax behavioral estimates to adjust wage incomes according to the changes in marginal tax rates. The new wage measures have in turn been fed into a tax-benefit model calculation; see further details in A "Common Base" Evaluation Strategy for the Measurement of Tax Policy Effects section. As expected, this effect has little influence on the overall tax redistribution. Effects are strongest for the largest elasticity estimate, 0.3, but even for that alternative the overall redistributional effect in 2006[25] is reduced by less that 0.2 percent. There are several reasons for this rather small effect: first, the additional income increases due to the responses are modest;

second, the income growth starts at median income levels; at NOK380,000 or USD59,000 (see figure 1 for schedule changes); and third, even though the top marginal tax rates have been reduced, there is still significant progression working through the surtax system which moderates the effect from pretax income growth on posttax income distributions.

Conclusion

We have used a methodology for evaluating redistributional effects of a tax reform with special application to the Norwegian tax reform of 2006. The Norwegian reform offered an interesting illustration of the method as income earners at the high end of the scale both were punished by the new tax on dividends and benefited from the reduction in marginal tax rates on wage income, so that the total distributional effect was genuinely uncertain.

The method is founded on a measure of income redistribution where inequality in pretax income is assessed against changes in posttax income distributions, before and after the tax reform. The evaluation strategy may thus be used to show how the question, "Is a tax schedule more redistributive after a reform?" can be answered with the use of different sources of micro data. As we have argued, our method has several advantages. First, it facilitates the task of identifying the contribution from behavioral effects such as labor supply responses. Second, income measurement problems can be dealt with in a consistent and transparent manner. With respect to the Norwegian tax reform of 2006, it was timing effects in dividend income that represented the main challenge. Finally, since the ambition is to single out the contribution of tax policies *per se*, a common base procedure is applied.

When applying this methodological framework on data before and after the Norwegian tax reform of 2006, we find that the reform has improved the tax schedule's redistributive effect. This main conclusion survives for alternative definitions of income, for instance controlling for timing effects and behavioral responses to the reform. The explanation to the increased redistribution after the reform depends on the definition of income: for the standard income definition, the main reason is the reduction in dividend payments, whereas for income definitions involving imputed firm returns, it is the (latent) taxation of dividends which drives results. Income adjustments due to the reduced top marginal tax rates appear to have had little influence on the overall tax redistribution.

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Notes

1. See Sørensen (1994, 2005), Cnossen (2000), Boadway (2004), and Genser and Reutter (2007) for more on dual income tax systems.
2. The rates for business owners were higher because social insurance contribution rates were higher, 10.7 percent rather than 7.8 percent. However, under the split model, for imputed wage income above NOK434,000 (USD70,000 according to the exchange rate for 1992), the social security tax goes down to 7.8 percent for business owners as well.
3. The figure for the marginal tax rate on dividends in 2006 is derived as follows. Capital income is taxed at a 28 percent rate at the corporate level, and the remaining 72 percent is transferred to the individual and taxed at 28 percent (above the rate of return allowance), resulting in a combined rate of 20.16 percent (0.72×0.28), which is then added to the corporate level rate.
4. Note that there was a temporary tax on dividends in 2001, which influences redistributional effect patterns of the period under consideration, 2000–2008. The dividend tax schedule of 2001 was somewhat different compared to the system introduced by the 2006 tax reform: 11 percent tax above a threshold.
5. We use an exchange rate of one US dollar for 6.418 NOK, the average exchange rate in 2006.
6. All thresholds are adjusted to 2006 levels.
7. The changes were phased in during 2005, which explains why 2004 represents the prereform year.

8. This adjustment in the schedule has a clear redistribution improving effect. The increase in the maximum deduction, which is an effective constraint for most tax payers, implies a larger reduction in average tax rates for persons at low levels of income.
9. Changes in indirect taxes are often seen as "blunt instruments" for redistribution, as noted by Stern (1990) and Creedy (2003).
10. Similar views have been expressed by contributors to the Mirrlees review; see Banks and Diamond (2010).
11. For instance, we could have used the model presented in Dagsvik and Jia (2010) in combination with the approach suggested in Dagsvik and Karlstrøm (2005) to obtain money metric utility measures of distributional effects with respect to wage earners. However, given the ambition of an overall assessment, we would need realistic models for a number of other groups as well.
12. Departing from the following abbreviated form of the welfare premium (λ): $\lambda = (1 - at)\bar{n}\Pi_R$, where at is the average tax rate, $\bar{n}$ is the average posttax income and $\Pi_R$is the measure of redistribution. Usually, mean income is held fixed, irrespective of whether the old or the new tax schedule is in place; this issue will be further discussed later when measuring behavioral effects.
13. 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.
14. Kari, Karikallio, and Pirttilä (2009) find similar results prior to the introduction of a preannounced dividend tax in Finland.
15. On the other hand, if there is an equity premium, then shareholders will discount their future taxes at a higher rate than the risk-free interest rate used in the calculation of the *RRA*. Fjærli and Raknerud (2009) show that this represents an incentive to postpone dividend payments (i.e., dividend taxes). This is a permanent effect of the new shareholder tax, which also calls for an alternative business income definition for measurement of inequality.
16. The need to limit total net income to the positive domain is purely of technical consideration for calculation of measures of redistribution.
17. One reason for that is that incentives vary with respect to the human capital intensity of the firm. However, it should be noted that there are limitations in data, which imply that the number of businesses involved in organizational shifts is underestimated.
18. Tax evasion and noncompliance are normally seen as more responsive margins that we ideally would like to identify the effects on; see the survey by Slemrod and Yitzhaki (2004). However, given that the Norwegian tax reform involved both increased tax on dividend income and reduced tax on labor income, we do not have any clear picture of how adjustments in

evasion behavior influence income distributions. Johns and Slemrod (2010) find that the ratio of aggregate misreported income to true income generally increases with income, but report that the ratio of underreported tax to true tax is higher for lower-income tax payers, which is due to particularly strong effects just above the taxpaying threshold.

19. Be aware that this choice implies that responsiveness at the extensive margin is neglected. Even though participation is high in Norway, even for females, see Kalb and Thoresen (2010), and we observe shrinking participation elasticities (as also noted by Blau and Kahn [2007] for the United States) when comparing estimation results based on data for 1997 and 2004 (results reported in Thoresen, Aasness, and Jia 2010; Thoresen, Vattø, and Aarbu 2011, respectively), we observe significant positive participation elasticities.
20. Remember that 2005 was a middle year when marginal tax rate reductions were phased in.
21. The econometric specification of Thoresen et al. (2011) includes a control for income shifting, which means that the elasticity estimates can be interpreted as net of income shifting responses.
22. Capital losses/gains are normally included in the official definition of income in the Nordic countries, but they are excluded from the measures which figure 3 is based on.
23. Since data cover the whole population, note that neither in connection to the results of figure 4, nor in the following, we present estimates for standard errors.
24. An alternative would be to employ a "fixed-income" procedure along the lines of Kasten, Sammartino, and Toder (1994) and Thoresen (2004). We suspect that fixed-income approach would be more problematic to use, especially for the standard definition of income, as the effect of the tax on dividends would differ dependent on which year that is used as a base (for instance, 2001 or 2005).
25. Similar calculations could have been done with respect to the two other postreform years. However, as tax schedules are unaltered, this would not add anything to the main finding.

References

Aarbu, Karl O., and Thor O. Thoresen. 2001. "Income Responses to Tax Changes—Evidence from the Norwegian Tax Reform." *National Tax Journal* 54:319–35.

Aasness, Jørgen, John K. Dagsvik, and Thor O. Thoresen. 2007. "The Norwegian Tax-benefit Model System LOTTE." In *Modelling Our Future: Population Ageing, Health and Aged Care*, *International Symposia in Economic Theory and*

Econometrics, edited by Anil Gupta, and Ann Harding, 513–18. Amsterdam: Elsevier Science, North-Holland.

Alstadsæter, Annette, and Erik Fjærli. 2009. "Neutral Taxation of Shareholder Income? Corporate Responses to an Announced Dividend Tax." *International Tax and Public Finance* 16:571–604.

Banks, James, and Peter Diamond. 2010. "The Base for Direct Taxation."In *Dimensions of Tax Design: the Mirrlees Review,* edited by James Mirrlees, Stuart Adam, Timothy Besley, Richard Blundell, Stephen Bond, Robert Chote, Malcolm Gammie, Paul Johnson, Gareth Myles, and James Poterba, 548–648. Oxford, UK: Oxford University Press.

Bargain, Olivier, and Tim Callan. 2010. "Analysing the Effects of Tax-Benefit Reforms on Income Distribution: A Decomposition Approach." *Journal of Economic Inequality* 8:1–21.

Bishop, John A., K. Victor Chow, John P. Formby, and Chih-C. Ho. 1997. "Did Tax Reform Reduce Actual US Progressivity? Evidence from the Taxpayer Compliance Measurement Program." *International Tax and Public Finance* 4:177–97.

Blau, Francine D., and Lawrence W. Kahn. 2007. "Changes in the Labor Supply Behavior of Married Women: 1980–2000." *Journal of Labor Economics* 25:393–438.

Blundell, Richard, Thomas MaCurdy, and Costas Meghir. 2007. "Labor Supply Models: Unobserved Heterogeneity, Nonparticipation and Dynamics." In *Handbook of Econometrics,* Vol. 6A, edited by James J. Heckman and Edward E. Leamer, 4667–775. Amsterdam, Netherlands: Elsevier.

Boadway, Robin. 2004. "The Dual Income Tax System—An Overview." *CESifo DICE Report* 2:3–8.

Bø, Erlend E., Peter J. Lambert, and Thor O. Thoresen. Forthcoming. "Horizontal Inequity under a Dual Income Tax System: Principles and Measurement." *International Tax and Public Finance*.

Clark, Tom, and Andrew Leicester. 2004. "Inequality and Two Decades of British Tax and Benefit Reforms." *Fiscal Studies* 25:129–58.

Cnossen, Sijbren. 2000. "Taxing Capital Income in the Nordic Countries: A Model for the European Union?" In *Taxing Capital Income in the European Union–Issues and Options for Reform*, edited by Sijbren Cnossen, 180–213. Oxford, UK: Oxford University Press.

Creedy, John. 1996. *Fiscal Policy and Social Welfare*. Cheltenham, UK: Edward Elgar.

Creedy, John, 2003. "Non-Uniform Consumption Taxes: A 'Blunt Redistributive Instrument'?" In *Fiscal Policy, Inequality and Welfare*, Research on Economic Inequality, Vol. 10, edited by Yoram Amiel and John A. Bishop, 1–19. Amsterdam: Elsevier.

Dagsvik, John K., and Zhiyang Jia. 2010. "Labor Supply as a Choice among Latent Job Opportunities: A Practical Empirical Approach." Revised version of Discussion Papers 550, Statistics Norway, Oslo, Norway.

Dagsvik, John K., and Anders Karlstrøm. 2005. "Compensating Variation and Hicksian Choice Probabilities in Random Utility Models that are Nonlinear in Income." *Review of Economic Studies* 72:57–76.

Dardanoni, Valentino, and Peter J. Lambert. 2002. "Progressivity Comparisons." *Journal of Public Economics* 86:99–122.

Ebert, Udo. 1997. "Social Welfare when Needs Differ: An Axiomatic Approach." *Economica* 64:233–44.

Elmendorf, Douglas W., Jason Furman, William G. Gale, and Benjamin H. Harris. 2008. "Distributional Effects of the 2001 and 2003 Tax Cuts: How Do Financing and Behavioral Responses Matter." *National Tax Journal* 61:365–80.

Feldstein, Martin. 1995. "The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act." *Journal of Political Economy* 103:551–72.

Fjærli, Erik, and Arvid Raknerud. 2009. "The Investment and Financing Decisions of Closely Held Firms when there is a Tax on the Equity Premium." Discussion Papers 594, Statistics Norway, Oslo, Norway.

Frick, Joachim R., Jan Goebel, and Markus M. Grabka. 2007. "Assessing the Distributional Impact of 'Imputed Rent' and 'Non-Cash Employee Income' in Micro Data, Comparative EU statistics on Income and Living Conditions: Issues and Challenges." Eurostat Methodologies and Working Papers, Eurostat, Luxembourg.

Genser, Bernd, and Andreas Reutter. 2007. "Mowing Towards Dual Income Taxation in Europe." *FinanzArchiv: Public Finance Analysis* 63:436–56.

Gordon, Roger H., and Joel B. Slemrod. 2000. "Are 'Real' Responses to Taxes Simply Income Shifting between Corporate and Personal Tax Bases?" In *Does Atlas Shrug*, edited by Joel B. Slemrod, 240–80. New York: Russell Sage.

Jenkins, Stephen. 1995. "Accounting for Inequality Trends: Decomposition Analyses for the UK, 1971–86." *Economica* 62:29–63.

Johns, Andrew and Joel B. Slemrod. 2010. "The Distribution of Income Tax Compliance." *National Tax Journal* 63:397–418.

Kalb, Guyonne, and Thor O. Thoresen. 2010. "A Comparison of Family Policy Designs of Australia and Norway Using Microsimulation Models." *Review of Economics of the Household* 8:255–87.

Kaplow, Louis, and Steven Shavell. 2002. *Fairness versus Welfare*. Cambridge, MA: Harvard University Press.

Kari, Seppo, Hanna Karikallio, and Jukka Pirttilä. 2009. "The Impact of Dividend Taxation on Dividends and Investment: New Evidence Based on a Natural Experiment." CESifo Working Paper No. 2756, Munich, Germany.

Kasten, Richard, Frank Sammartino, and Eric Toder. 1994. "Trends in Federal Tax Progressivity." In *Tax Progressivity and Income Inequality*, edited by Joel B. Slemrod, 9–50. Cambridge, MA: Cambridge University Press.

King, Mervyn A. 1983. "Welfare Analysis of Tax Reforms Using Household Data." *Journal of Public Economics* 21:183–214.

Lambert, Peter J. 1993. *The Distribution and Redistribution of Income*. 2nd ed. Manchester, UK: Manchester University Press.

Lambert, Peter J., and Thor O. Thoresen. 2009. "Base Independence in the Analysis of Tax Policy Effects: With an Application to Norway 1992–2004." *International Tax and Public Finance* 16:219–52.

Nygård, Odd E., and Thor O. Thoresen. 2009. "Fordeling av skattebyrden 1995–2006." Appendix 5 in NOU 2009:10, 362–373. *Fordelingsutvalget*, Oslo, Norway.

Pechman, Joseph A., and Benjamin A. Okner. 1974. *Who Bears the Tax Burden*. Washington, DC: The Brookings Institution.

Reynolds, Morgan, and Eugene Smolensky. 1977. *Public Expenditures, Taxes, and the Distribution of Income: The United States, 1950, 1961, 1970*. New York: Academic Press.

Røed Larsen, Erling. 2009. "From Data to Levy Design: The Five Stages of Implementing Housing Taxes." Discussion Papers 596, Statistics Norway, Oslo Norway.

Saez, Emmanuel, Joel B. Slemrod, and Seth H. Giertz. 2009. "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: a Critical Review." NBER Working Paper No 15012, National Bureau of Economic Research, Cambridge, MA.

Saunders, Peter, Timothy M. Smeeding, John Coder, Stephen Jenkins, Johan Fritzell, Aldi M. Hagenaars, Richard Hauser, and Michael Wolfson. 1992. "Non-cash Income, Living Standards, Inequality and Poverty: Evidence from the Luxembourg Income Study." Discussion Papers No 35, Social Policy Research Center (SPRC), The University of New South Wales, Australia.

Sen, Amartya. 1997. "From Income Inequality to Economic Inequality." *Southern Economic Journal* 64:384–96.

Slemrod, Joel B. 1992. "Do Taxes Matter? Lessons from the 1980s." *American Economic Review* 82:250–6.

Slemrod, Joel B. 1995. "Income Creation or Income Shifting? Behavioral Responses to the Tax Reform Act of 1986." *American Economic Review Papers and Proceedings* 85:175–80.

Slemrod, Joel B, and Shlomo Yitzhaki. 2004. "Tax Avoidance, Evasion, and Administration." In *Handbook of Public Economics*, Vol. 3, edited by Alan J.

Auerbach and Martin Feldstein, 1425–70. Amsterdam: Elsevier Science, North-Holland.

Sørensen, Peter B. 1994. "From the Global Income Tax to the Dual Income Tax. Recent Tax Reforms in the Nordic Countries." *International Tax and Public Finance* 1:57–79.

Sørensen, Peter B. 2005. "Neutral Taxation and Shareholder Income." *International Tax and Public Finance* 12:777–801.

Statistics Norway. 2009a. "Dwelling Stock," http://www.ssb.no/english/subjects/10/09/boligstat_en/

Statistics Norway. 2009b. "Stock Statistics," http://www.ssb.no/english/subjects/11/01/aksjer_en/

Statistics Norway. 2010a. "Account Statistics. Annual Reports for Non-Financial Limited Companies," http://www.ssb.no/regnaksje_en/

Statistics Norway. 2010b. "Income Statistics for Households," http://www.ssb.no/ifhus_en/

Stern, Nicholas. 1990. "Uniformity versus Selectivity in Indirect Taxation." *Economics and Politics* 2:83–108.

Thoresen, Thor O. 2004. "Reduced Tax Progressivity in Norway in the Nineties. The Effect from Tax Changes." *International Tax and Public Finance* 11:487–506.

Thoresen, Thor O., and Annette Alstadsæter. 2010. "Shifts in Organizational Form under a Dual Income Tax System." *FinanzArchiv* 66:384–418.

Thoresen, Thor O., Jørgen Aasness, and Zhiyang Jia. 2010. "The Short-Term Ratio of Self-Financing of Tax Cuts: an Estimate for Norway's 2006 Tax Reform." *National Tax Journal* 63:93–120.

Thoresen, Thor O., Erlend E. Bø, Erik Fjærli, and Elin Halvorsen. 2011. "Evaluating the Redistributional Effects of Tax Policy Changes: With an Application to the 2006 Norwegian Tax Reform." Discussion Papers 648, Statistics Norway, Oslo Norway.

Thoresen, Thor O., Trine E. Vattø, and Karl O. Aarbu. 2011. "Tax Changes and Income Responses of Wage Earners. Quasi-Experimental Evaluation and Labor Supply Model Simulation Suggest that Norwegians are Less Responsive." Paper presented at the 67th Congress of the International Institute of Public Finance, Ann Arbor, Michigan, August 10, 2011.

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