Distributional analysis of prospective 2009 US individual income taxes: current law and the candidates' tax plans

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Distributional Analysis of Prospective 2009 US Individual Income Taxes:

Current Law and the Candidates' Tax Plans

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Abstract

The purpose of this paper is to compare the distributional characteristics of two presidential candidates' proposed reforms to the US federal individual income tax. Using an anonymous sample of tax return data from the Brookings-Urban Institute Tax Policy Center and the Center's simulations of 2009 tax law and the two proposals, we compare the vertical and horizontal equity of the three individual income tax regimes. Surprisingly, there is very little difference among the three proposed individual income tax regimes in terms of vertical and horizontal equity. However, when the initial effective tax rate positions and economic incomes of each pair of taxpayers are compared to the new effective tax rate positions under the two proposals, we find that the Obama proposal makes the tax system more progressive than 2009 law. This change is much more pronounced than under the McCain proposal. On the other hand, when these initial positions are compared to the two proposals viz. a viz. horizontal equity, the McCain proposed tax system is more horizontally equitable than 2009 tax law, and more horizontally equitable than the Obama proposal is when compared to 2009 tax law.

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The data on 2009 economic income, taxes after credits due under 2009 tax law, and taxes after credits due under the Obama and McCain individual income tax regimes that are analyzed in this paper were provided by the Brookings-Urban Institute Tax Policy Center. In particular we wish to thank Jeff Rohaly and Khae Lim of the Center for providing the Tax Policy Center's summary micro-simulation file that contained economic income at 2009 levels, estimated 2009 individual income tax net liability, and estimated 2009 liabilities under the Obama and McCain individual income tax proposals as of September 5, 2008. The results of this analysis are the responsibility of the authors, and not attributable to their constituent institutions.

I. Introduction

The analysis of changes in current public tax and transfer policy is often divided into: 1] ascertaining the effects of such changes on the level of efficiency of the economy, 2] ascertaining the effects of such changes on the amounts of revenues provided to the fisc, and 3] ascertaining the effects of such changes on the burden and ultimate incidence of the new tax and transfer system compared to the original system. This third analysis is usually called "distributional analysis." Who pays for public services under current tax law, and who will pay under a new system is often of great public and therefore political interest.[2]

When choices are to be made among bundles of policies represented by politicians, it is important to provide as much information as possible to reduce uncertainty about the consequences of the adoption of these policies. The focus of this short note is on one policy, namely tax reform, and only on one aspect of this policy, namely the distributional effect of any such change. Succinctly put, our purpose is to compare the equity properties of current tax law, updated to reflect expected income growth and the certain changes in tax law for 2009, with the equity effects of the changes proposed by the two candidates for tax year 2009.

The data we use, provided by the Brookings-Urban Institute Tax Policy Center, is generated by an anonymous, random sample of 273,000 federal taxpayers that are weighted to represent the entire set of 156 million individual taxpayers in the economy. The Center obtained their data from the Statistics Division of the Internal Revenue Service, and then generated a match to Census Bureau survey data[3]. The main ingredients for our analysis taken from this data are the economic income[4], derived from tax forms and Census Bureau survey data in order to represent a taxpayer's overall ability to pay rather than the institutional notions used on tax forms such as adjusted gross income, and the taxes actually paid. The ratio of taxes paid to economic income is called the "effective tax rate," and represents the average tax rate (per dollar) for a taxpayer. The data is updated by the Center to reflect expectations concerning 2009 income using projections of the Congressional Budget Office.[5] When considering alternative tax plans, such as those proposed by the presidential candidates as of early September, 2008, the returns in the data are recalculated using the tax forms that would apply for these plans. An important assumption underlying the generation of this data is that the taxpayers do not change their behavior in response to the changes in incentives due to the changes in tax law.[6] There are two reasons for this unrealistic assumption. First, it tends to be accurate in the very short run, for example looking at one year into the future, as it takes some time for taxpayers to adjust their tax planning. Second, the estimates can be biased in many directions by making appropriate assumptions about reactions to changes in the tax code. Thus, we attempt to take a neutral stance.

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[2] Whether or not these three matters are empirically separable is not at issue. In principle, all three should be analyzed within a complete model of the economy. However, as a practical matter, both theoretical and empirical analyses typically specialize in examining one of the three effects in more detail than the others.

[3] In particular, the Center created a synthetic match to the most recent Current Population Survey as is done by the US Treasury and Congressional Budget Office.

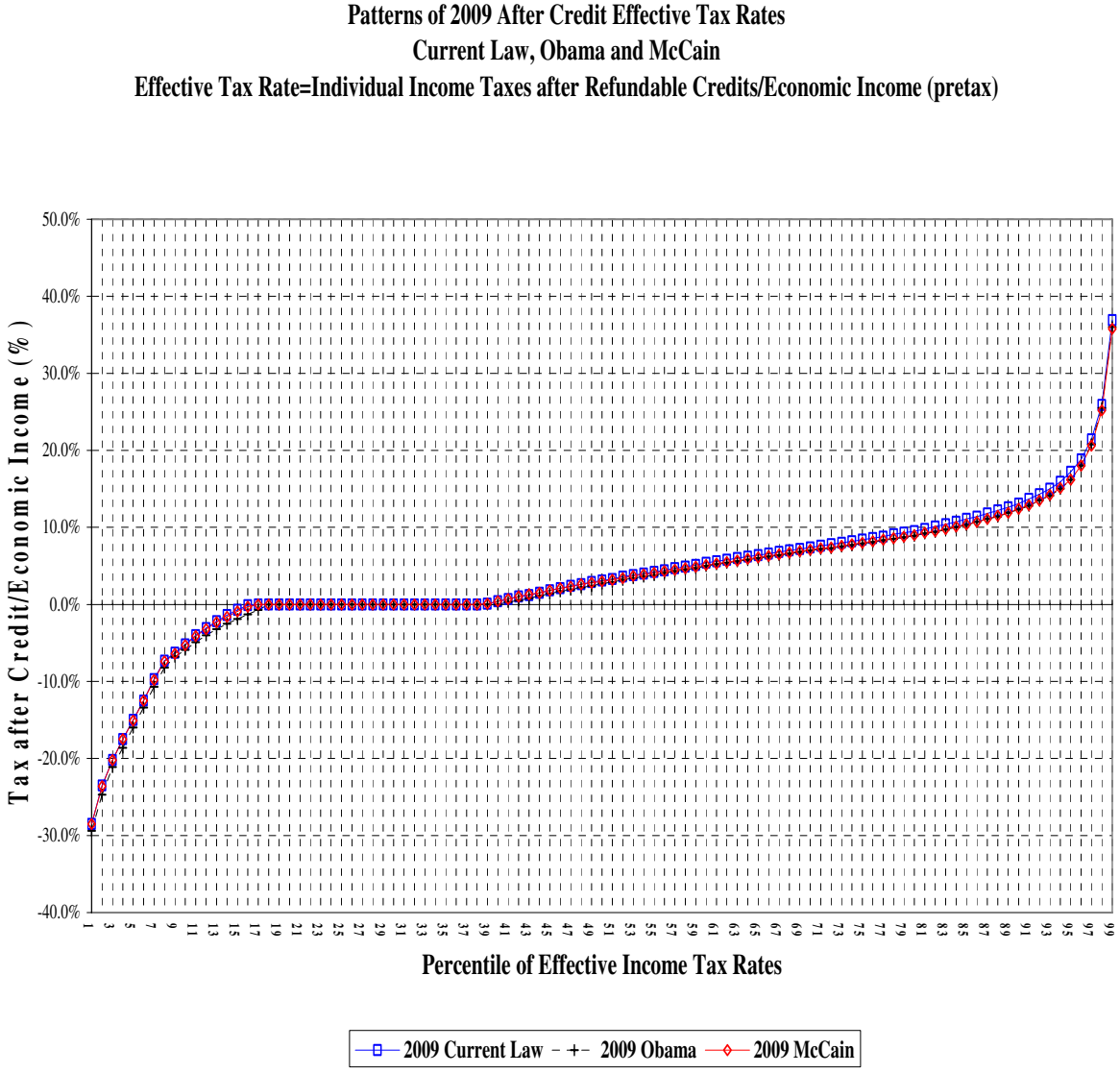
[4] For a precise definition of what is used in our data, see http://www.taxpolicycenter.org/numbers/displayatab.cfm?DocID=574

[5] See http://www.cbo.gov/doc.cfm?index=8917

[6] In economic jargon, we say that all elasticities are assumed to be zero.

For a preliminary look at what is going on in the data, we refer to Figure 1.[7] Here we have graphed the distribution of effective tax rates, as defined above, for 2009 under current law and for the tax plans of the two presidential candidates. What is obvious at the outset is that at least in terms of effective tax rates, it is hard to distinguish among the three. A second point of interest is the large percentage of returns that feature a zero effective rate, in other words they pay no tax.

Figure 1



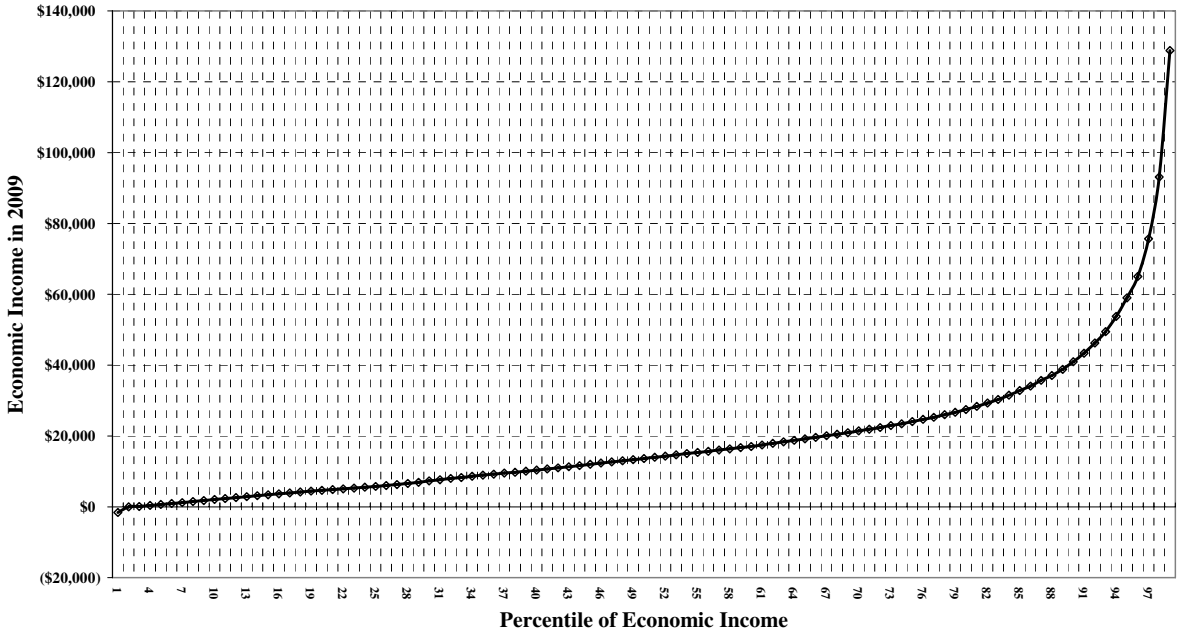
This figure does not have any information about what part of the income distribution those who pay no tax come from. To investigate this aspect of the tax system, we have created

[7] We exclude from our analysis throughout this paper 1,063 of the 273,496 tax returns provided by the Center whose effective tax rates are less than -100% or greater than +100%. These outliers account for .8% of 2009 population taxes.

Figure 2. For this graph, we focus on (projected) tax returns for 2009 under current law. We graph the economic income distribution for those who pay no taxes. It is interesting to note that the taxpayers who pay no taxes come from many parts of the economic income distribution.

Figure 2

Distribution of 2009 Economic Income
for Taxpayers with Zero Effective Tax Rate under 2008 Tax Law
(1st through 99th percentiles displayed)



A more systematic examination of tax equity requires us to look at many other slices of both the economic income and tax liability distributions, as well as how the two distributions are related. That is what we attempt next, in Section 2. Section 3 describes the specifics of how our summary measures work in practice; Section 4 presents aggregate and per-capita income and revenues; Section 5 implements the index number characterizations of current law and the presidential candidates' tax plans. Finally Section 6 briefly outlines our conclusions from the analysis.

2. Summary Measures of Tax Equity

The availability of anonymous samples of tax return information in the US and other industrialized countries, when coupled with the capacity to simulate static or accounting portrayals of how a new tax system might change the burden of taxation, has enabled analysts to describe who will pay more, less, or the same amount for public services under a different or "reformed" tax system. Often such changes are described as desirable or more equitable; however, the underlying criteria for measuring equity are often obscured in reaching such conclusions. For example, both the US Treasury and the Joint Committee on Taxation, US Congress, routinely report how many taxpayers, by income class, face higher and lower taxes under proposed Tax System B compared to current law (Tax System A); the average dollar

amount per return, by income class, of such changes; and the change in tax burden for hypothetical tax returns. Such calculations imply that tax policy makers can judge the desirability or political acceptability of Tax System B by examining, for example, whether or not the number of taxpayers experiencing a tax reduction exceeds the number of taxpayers experiencing a tax increase.

For social scientists, such counts of "winners and losers" are rather primitive characterizations of the distributional effects of tax policy changes. From a positive point of view, one must distinguish at the outset between extrapolations from the current distribution of taxes, and those observed after the new tax system takes effect and taxpayers have adjusted their behavior to the new set of implied incentives (as discussed above). More fundamental, however, is the matter of defining more precisely, and then measuring, what "equity" means. Traditionally, distinctions have been made between measuring the vertical and horizontal equity of tax systems based on whether the pre-tax incomes of taxpayers are different (in which case vertical equity is at issue) or similar (in which case horizontal equity is at issue), as well as distinctions between distributions of before and after-tax income which have become more or less equally distributed as a result of a change in tax law. Presumably, with precise definitions of equity, and their systematic application to data, one can reach some conclusions about the equity implications of changes in tax law.

Musgrave and Musgrave [1989, p. 223] provide the following definitions.

Vertical Equity - The degree to which taxpayers with higher ability to pay in fact pay more in taxes.

Horizontal Equity - The degree to which taxpayers in identical circumstances pay the same taxes.

It is clear that these definitions describe an ideal; that is, which tax systems are completely equitable, and therefore should be ranked highest by any index number describing the concept. For instance, Dalton [1925] realized that any index number implied a particular ideal distribution of income. Thus, the ordering of tax systems needs to be completed to have a well-specified index number. Since real world tax systems are rarely completely equitable, methods for comparing the relative degree of vertical and horizontal equity embodied in tax systems are needed to make the definitions and theory empirically relevant.

Measures of income inequality have been used for the evaluation of tax systems for a long time. For example, Musgrave and Thin [1948] propose and use several such measures. These simple, univariate index numbers can address questions related to the change in the before and after tax income distributions generated by a tax system, but cannot deal with questions of vertical and horizontal equity, which generally involve the before and after tax welfare of each individual, and how a tax system changes the relative position of an individual in the distribution of income. Nevertheless, axiomatic characterizations of measures of income inequality are nontrivial; see, for example, Thon [1972].

The modern development of index numbers of horizontal and vertical equity is based on several principles. First, the theory is driven by axiomatic characterizations of the index numbers in question. These necessary and sufficient conditions provide information on the value

judgments underlying the empirical use of an index. Second, the index number must be amenable to application to the empirical rather than statutory tax schedule. As Gouveia and Strauss [1994] demonstrate, and as is intuitively obvious, taxpayers with the same economic income might pay different taxes, due to the various exemptions, deductions, and credits allowed by a tax system. This also requires that the index number account for the attributes of taxpayers, since provisions that apply to nobody should not affect the index number. In fact, as Berliant and Strauss [1996] suggest, index numbers do not order tax systems; they order pairs consisting of a tax system and a taxpayer attribute distribution.

In terms of the modern theory of index numbers, it is of course important to expose their underlying value judgments. This is not the appropriate venue for this endeavor, so we refer the interested reader to the bibliography.

3. Operational Measures of Vertical and Horizontal Equity

To give the reader a general idea of how these summary measures of income or tax equity work in practice, we describe here the specification of the ones we have developed as an example, as we are most familiar with these. The algebra detailing the specification of our index numbers can be found in Appendix I. The algebra detailing the specification of many index numbers found in the literature, including the Gini coefficient, can be found in Appendix II. For each of them, cites are given to literature found in the bibliography that both describe the calculation of the index numbers and provide characterizations of them from axioms. In the next section, we compute all of these for 2009 under current law and for the presidential candidates' proposals, subject to all of the assumptions we have made.

The first step in describing how our index numbers are constructed is to define the classifications of progressivity and horizontal equity.

It is important at this juncture to discuss a crucial assumption. We take as given a partition of the income distribution into cells of "equals" for the purpose of separating horizontal and vertical comparisons. We also take as given a partition of the set of effective tax rates into cells, which is used to distinguish "similar" effective tax rates for proportional comparisons.

Clearly the index number values depend on the precise nature of these partitions. For the purposes of giving the intuition for the index numbers as well as developing the theory behind them, we take the partitions to be part of the assumptions and hence exogenous. Obviously the theory applies for any admissible partition structure. From an empirical standpoint, the values of the index numbers can change with the width or mesh of the partitions. In earlier work, Berliant and Strauss [1983], we experimented with the partition structure to determine the consistency of the conclusions upon characterizing the effects of various tax reforms. From an empirical perspective, we use relatively narrow bands of the income distribution and check for sensitivity.

The use of exogenously determined cells of "equals" is clearly a strong assumption. But it also has a strong implication. Unlike the remainder of the literature, our framework allows us to make a sharp and clear-cut distinction between horizontal and vertical equity, both conceptually and empirically.

To describe our index measures of vertical equity and inequity, we follow Wertz [1975, 1978] and partition comparisons between pairs of taxpayers who are not "equals" into three groups: the fraction of pairs of taxpayers for whom a given tax system is progressive, the fraction of pairs of taxpayers for whom a tax system is proportional, and the fraction of pairs of taxpayers for whom a tax system is regressive. As these will be the vertical measures, we consider only pairs of taxpayers who are not "equals." Below, when the construction of horizontal index numbers is described, only pairs of taxpayers who are "equals," the remainder, are used. We shall construct the three vertical measures so that they sum to 1.

A (vertical) comparison of a pair of taxpayers is "progressive" when both the income and effective tax rate of one taxpayer are greater than the income and effective tax rate of the other taxpayer. A (vertical) comparison of a pair of taxpayers is "proportional" when the incomes of two taxpayers are different, but the effective tax rates are the same. Finally, a (vertical) comparison is "regressive" when one taxpayer has a larger income but a lower effective tax rate than the other taxpayer in the pair-wise comparison. Counting the number of paired comparisons that are progressive and dividing by the total number of paired comparisons between taxpayers with different incomes (the vertical comparisons) yields the unweighted progressive index. Similar computations yield the unweighted proportional and regressive index numbers.

Table 1 displays the classifications of these "static" vertical and horizontal equity comparisons of pairs of taxpayers, denoted 1 and 2, in terms of their incomes (Y) and effective tax rates, t. By "static" we mean the equity classification of one tax system.

Table 1
Vertical and Horizontal Equity Classifications for
***Static* Berliant-Strauss Index Numbers**

	Vertical Equity Classifications	Horizontal Equity Classifications
[1]	[2]	[3]
Incomes Y, Persons 1,2 and Effective Tax Rates t	$Y_1 > Y_2$	$Y_1 = Y_2$
$t_1 > t_2$	"Progressive"	"Inequity"
$t_1 = t_2$	"Proportional"	"Equity"
$t_1 < t_2$	"Regressive"	"Inequity"

To ascertain the extent to which taxes are distributed progressively, proportionately, and regressively, we take into account not only the number of occurrences of each type of comparison, but also the degree of income and effective tax rate disparities. Our subjective

judgment is that it matters when scoring such comparisons whether taxpayer A with an effective tax rate of 20% and taxpayer B with an effective tax rate of 15% have similar or very different incomes. Thus the actual measurement involves the weighting of each comparison count by the absolute difference in income of each pair of taxpayers.

Similar considerations argue for taking into account the extent of differences in effective tax rates. That is, it seems to matter, if taxpayer A has an income twice that of taxpayer B, just how similar (or different) the effective tax rates are for the two taxpayers. For example, should A have an income of $30,000 and B have an income of $15,000, the 'progressiveness' of the tax system would seem to differ if in the first instance the respective effective tax rates were 28% and 20% while in the second instance effective tax rates of 32% and 18% Clearly, the former would seem to be less progressive than the latter.

To account for such differences in effective tax rates, we weight the comparisons by the ratio of effective tax rates rather than the differences in effective tax rates. We use the ratio for several reasons. First, using the ratio differentiates more effectively between a pair of effective tax rates that are close to each other nominally but not relatively. A pair of effective tax rates of 10% and 14% would seem to be much more disparate than a pair of effective tax rates of 46% and 50%. While the differences are both 4%, the former pair of tax rates clearly displays more disparity. Second, using the ratio of rates deals with proportional comparisons when forming the weights for each comparison operation. If one were to form a weight based on the difference in effective tax rates, the weight would be zero, whereas by using the ratio the weight becomes unity.[8]

The weighted vertical index numbers are formed as follows. For each progressive comparison, weight by the difference in incomes and the ratio of effective tax rates, and sum over progressive comparisons. Repeat this procedure for both regressive and proportional comparisons as well. Divide each of these sums by the total weighted sum over all vertical comparisons.

Horizontal equity, unlike vertical equity, does not admit of multiple classifications. Simply put, horizontal equity means either that equals are treated the same, or not. Accordingly, we shall measure the extent to which two persons' effective tax rates are different or are identical. Again, following Wertz [1975], we classify each comparison of a pair of taxpayers who are deemed to be "equals." If a pair of taxpayers who are "equals" in terms of income face different effective tax rates, then this is an inequitable comparison for the tax system in question. All other comparisons between pairs of taxpayers who are "equals" are classified as horizontally equitable comparisons. Dividing these counts by the total number of horizontal paired comparisons, comparisons between taxpayers deemed to be equals (operationally, in terms of income), the unweighted horizontal equity and inequity index numbers are obtained. By weighting each paired comparison by the ratio of effective tax rates in order to account for the extent of inequitable treatment by a tax system, and then performing the same calculations as for the unweighted horizontal index numbers, the weighted equity and inequity index numbers are obtained. Notice that each weighted count is divided by the sum over all horizontal comparisons of weighted counts.

[8] In order to account for possible negative effective tax rates that result from the refundable earned income tax credit, the weighting uses the ratio of the *ranks* of the effective tax rates.

The weighted horizontal and vertical measures are obtained by making all possible comparisons among pairs of taxpayers, and accumulating the weighted comparisons of each type of classification. In this sense, the horizontal and vertical measures are quite distinct from each other, and the classification system is exhaustive. Note that in the case of the vertical comparisons, a tax system may be said to have simultaneously progressive, regressive, and proportional components to it. This occurs because comparisons are relative, and the comparisons are numerous. For n individuals in an economy, there are n(n-1) total comparisons.

What we call "dynamic" index numbers are used to compare two tax systems, which we call A and B. We assume that economic income is independent of which tax system, A or B, is imposed. In an application in a companion paper, plan A is the federal income tax system, while plan B is the total income tax system consisting of both federal and state taxes. The question asked is as follows. Given that both the federal and state tax systems are imposed, what is the marginal effect on equity of the state tax system? We refer to Berliant and Strauss [1993] for more details on both the description and application of these dynamic index numbers.

Table 2 provides a summary of the classifications from our "dynamic" index numbers; by "dynamic" we mean the equity classification and comparisons of taxpayers 1 and 2, with incomes Y_1 and Y_2, under two tax regimes, A and B.

Table 2
Vertical Equity Classifications for *Dynamic* Berliant-Strauss Index Numbers
Tax System B Compared to Tax System A (Current Law) [9]

[1]	[2]	[3]	[4]
Incomes Y, Persons 1,2 and Effective Tax Rates t^A , t^B	$\frac{t_1^B}{t_1^A} > \frac{t_2^B}{t_2^A}$	$\frac{t_1^B}{t_1^A} = \frac{t_2^B}{t_2^A}$	$\frac{t_1^B}{t_1^A} < \frac{t_2^B}{t_2^A}$
$Y_1 > Y_2$	"More Progressive"	"No Change"	"Less Progressive"
$Y_1 < Y_2$	"Less Progressive"	"No Change"	"More Progressive"

[9] Berliant and Strauss (1983, 1985,1993, and 1996).

4. Characteristics of 2009 Income, Tax Data and Proposed Tax Legislation

In 2009, the Brookings-Urban Institute Tax Policy Center projects that economic income will be $12.4 trillion dollars in 2009 prices. Current tax law is projected to create $1.189 trillion of net, after-tax credit liabilities or an average of $7,478 per tax return. This represents an average effective tax rate of 9.6%. The two presidential income tax proposals, as of September 5, 2008, are quite similar with the Obama proposal creating $1.150 trillion in 2009 net tax liability, and the McCain proposal creating $1.121 trillion in 2009 net tax liability. Compared to projected 2009 tax law, the Obama proposal in 2009 would cut individual income taxes an average of $249 per return, while the McCain proposal would cut individual income taxes an average of $429 per return. (See Table 3 below).

Table 3
Total and Mean Amounts of
Taxes and Income Concepts in 2009

Tax Law	2009 Revenues	Mean 2009 Revenues	Effective Tax Rates on Economic Income
Current Law 2009	$1,189,525,900,000	$7,478	9.6%
2009 Obama	$1,149,891,000,000	$7,229	9.3%
2009 McCain	$1,121,362,900,000	$7,049	9.0%
Change Analysis			% Change from 2009 Law
2009 Obama – 2009 Tax Law	-$39,634,900,000	-$249	-0.3%
2009 McCain – 2009 Tax Law	-$68,163,000,000	-$429	-0.5%
Ratio Analysis of Proposals			
Obama/Current Law	96.7%		
McCain/Current Law	94.3%		
McCain/Obama	97.5%		
2009 Income Concepts	2009 Income Amounts	Mean 2009 Income	
Economic Income	$12,395,339,000,000	$77,922	
Cash Income	$11,335,215,000,000	$71,258	
AGI	$9,172,756,300,000	$57,664	

Source: authors' tabulations of September 5, 2008 Brookings-Urban Institute Tax Policy Center micro-data file.

5. Application of the Summary Measures of Tax and Income Equality to 2009 Data Under Current Law and Under the Presidential Candidates' Proposals

Next we provide the empirical complement to our discussion of the development of index numbers. First, we present in Table 3 the analysis using our static, weighted vertical and horizontal index numbers.

Table 4

***Static* Berliant-Strauss Index Numbers of Vertical and Horizontal Equity**
US Federal Individual Income Tax in 2009, Obama and McCain Tax Proposals

Static Index Numbers			
Paired Vertical Comparisons	**Current Law in 2009**	**Obama in 2009**	**McCain in 2009**
% of Weighted Comparisons Progressive	82.57%	82.26%	81.66%
% of Weighted Comparisons Proportional	16.02%	16.36%	16.88%
% of Weighted Comparisons Regressive	1.41%	1.39%	1.46%
Total Weighted Static Vertical Comparisons	100.000%	100.000%	100.000%
Paired Horizontal Comparisons	**Current Law in 2009**	**Obama in 2009**	**McCain in 2009**
% of Weighted Comparisons: Equity	9.54%	9.15%	9.55%
% of Weighted Comparisons: Inequity	90.46%	90.850%	90.45%
Total Weighted Static Horizontal Comparisons	100.000%	100.000%	100.000%

Source: authors' index number calculations with Brookings-Urban Institute Tax Policy Center, September 5, 2008 micro-simulation file.

It is quite clear that the changes make some difference, but the differences are small in magnitude. The basic reason is that tax reforms leave most of the entrenched system in place. This is consistent with our previous work with index numbers applied to tax reform, and in contrast with the actual history of index number values over long periods. We also note that under current law, the Bush regime tax cuts expire in 2010. Only the McCain plan retains these cuts, but none of this will be apparent in 2009.

These conclusions are reinforced by our calculation of other index numbers for the 3 regimes. These index numbers are based primarily on the after tax income distribution; the details of their derivation and calculation along with their sources in the literature can be found in Appendix II.

Table 5
Other Index Numbers based on After Tax Income

Other Index Measures based on After Tax After Tax Credit Economic Income	Current 2009 law after tax after credit economic income using 2009 cutpoints	Obama 2009 Income Tax Proposal after tax after credit economic income using proper after tax income cut points	McCain 2009 Income Tax Proposal after tax after credit economic income using proper after tax income cut points
Average After Tax Income	$70,475	$70,724	$70,904
VARIANCE =	1.31E+10	1.30E+10	1.33E+10
CO. OF VAR. =	1.63E+00	1.61E+00	1.63E+00
MEAN DIFF. =	4.21E+03	4.22E+04	4.24E+04
GINI =	5.97E-01	5.96E-01	5.98E-01
ATK. GINI =	2.98E-01	2.98E-01	2.99E-01
CO. OF CONCEN =	5.97E-01	5.96E-01	5.98E-01
ATKINSON .3 =	1.98E-01	1.97E-01	1.99E-01
ATKINSON .7 =	4.50E-01	4.49E-01	4.51E-01
KOLM =	7.02E+03	7.04E+04	7.06E+04
REL. MN. D.#1 =	8.75E-01	8.75E-01	8.78E-01
REL. MN. D.#2 =	4.38E-01	4.38E-01	4.39E-01
THEIL #1 =	-1.82E+01	-1.82E+01	-1.82E+01
THEIL #2 =	3.45E+14	3.46E+14	3.47E+14
THEIL #3 =	9.87E+00	9.88E+00	9.88E+00
STD. DEV. LOG =	1.83E+00	1.83E+00	1.84E+00
LOG VARIANCE =	1.37E+01	1.37E+01	1.37E+01
AVG RATE INDX =	1.22E-01	1.24E-01	1.20E-01

Source: authors' index number calculations with Brookings-Urban Institute Tax Policy Center, September 5, 2008 micro-simulation file.

The dynamic index numbers are much more sensitive to changes in tax law. We detail these in Table 6.

Table 6

***Dynamic* Unweighted Berliant-Strauss Index Numbers of Vertical and Horizontal Equity**

Changing from the US Federal Individual Income Tax in 2009, to the Obama and McCain Tax Reform Proposals

Paired Vertical Comparisons	**Changing from Current 2009 Law to Obama in 2009**	**Changing from Current 2009 Law to McCain in 2009**
% of Comparisons Becoming More Progressive	33.44%	25.01%
% of Comparisons Becoming More Proportional	43.38%	35.28%
% of Comparisons Becoming More Regressive	23.18%	39.71%
% Total Comparisons	100.000%	100.00%
Paired Horizontal Comparisons	**Changing from Current 2009 Law to Obama in 2009**	**Changing from Current 2009 Law to McCain in 2009**
% of Comparisons Becoming More Equitable	29.44%	49.45%
% of Comparisons Becoming More Inequitable	70.56%	50.55%
Total Dynamic Comparisons	100.000%	100.000%

Source: authors' index number calculations with Brookings-Urban Institute Tax Policy Center, September 5, 2008 micro-simulation file.

6. The Bottom Line

As hinted at by the static index numbers, the Obama plan results in more progressivity than the McCain plan, but also in less horizontal equity than the McCain plan. The differences in equity impacts of the two proposals becomes more pronounced when we keep track of taxpayers' initial position. Using our dynamic index numbers, we find that the Obama plan results in the tax system becoming more progressive 33% of the time compared to 25% for McCain, whereas under the McCain proposal those in the same economic income position find their effective tax rates becoming more equal 49% of the time while only 29% of the time under the Obama plan. Such a tradeoff between vertical and horizontal equity was suggested in some of our earlier work. However, the message to take home from this exercise is that the changes to current law proposed by the candidates do not have a large impact on the equity of the tax system in 2009. It is possible that changes in the underlying economic position of many taxpayers, resulting from the effects of financial market turmoil on the real economy, may be more consequential than the tax proposals of both candidates. After all, the bail out of financial institutions is expected to involve $700 billion or 59% of initially projected 2009 federal individual income tax liability.

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Appendix I

Algebraic Statement of Vertical and Horizontal Berliant-Strauss Index Numbers

m = # of effective rate classes

n = # of economic income classes

N_i^j = population in economic income class *i,* rate class *j*

Y_i^j = average income in economic income class *i*, rate class *j*

D_i^j = the number of taxpayers in income class i, and change in effective tax rate class j

q = the number of change in effective tax rate classes

$$V = \sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k<j}^{q}\sum_{h<i}^{n}\left(D_i^j D_h^k\right)+\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k>j}^{q}\sum_{h>i}^{n}\left(D_i^j D_h^k\right) +$$

$$\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{h=1,h\neq i}^{n}\left(D_i^j D_h^j\right) + \sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k<j}^{q}\sum_{h>i}^{n}\left(D_i^j D_h^k\right)+\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k>j}^{q}\sum_{h<i}^{n}\left(D_i^j D_h^k\right)$$

1. Total Weighted Vertical Comparisons:

$$\Delta = \sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k=1}^{m}\sum_{h=1,h\neq i}^{n}\left[N_i^j N_h^k \max\left(\frac{j}{k},\frac{k}{j}\right)[|Y_i^j - Y_h^k|]\right]$$

2. Weighted Progressive Vertical Index:

$$\frac{1}{\Delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k<j}^{m}\sum_{h<i}^{n}\left(N_i^j N_h^k\right)\frac{j}{k}\left|Y_k^j - Y_h^k\right| + \frac{1}{\Delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k>j}^{m}\sum_{h>i}^{n}(N_i^j N_h^k)\frac{k}{j}\left|Y_i^j - Y_h^k\right|$$

3. Weighted Proportional Vertical Index:

$$\frac{1}{\Delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{h=1,h\neq i}^{n}\left(N_i^j N_h^j\left|Y_i^j - Y_h^j\right|\right)$$

4. Weighted Regressive Vertical Index:

$$\frac{1}{\Delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k<j}^{m}\sum_{h>i}^{n}\left(N_i^j N_h^k\right)\frac{j}{k}\left|Y_i^j - Y_h^k\right| + \frac{1}{\Delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k>j}^{m}\sum_{h<i}^{n}\left(N_i^j N_h^k\right)\frac{k}{j}\left|Y_1^j - Y_h^k\right|$$

5. Weighted Horizontal Inequity Index:

$$\frac{1}{\delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k=1}^{m}\left[N_i^j N_i^k \max\left(\frac{j}{k},\frac{k}{j}\right)\right]$$

Where δ is the sum of all horizontal comparisons, and is expressed:

$$\delta=\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k=1,k\neq j}^{m}\left[N_i^j N_i^k \max\left(\frac{j}{k},\frac{k}{j}\right)\right]+\sum_{j=1}^{m}\sum_{i=1}^{n}\left[N_i^j\left(N_i^j-1\right)\right]$$

6. Weighted Horizontal Equity Index:

$$1-\left[\frac{1}{\delta}\sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{k=1,k\neq j}^{m}\left[N_i^j N_i^k \max\left(\frac{j}{k},\frac{k}{j}\right)\right]\right]$$

7. Unweighted Dynamic Progressive Vertical Index:

$$\frac{1}{V}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k<j}^{q}\sum_{h<i}^{n}\left(D_i^j D_h^k\right)+\frac{1}{V}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k>j}^{q}\sum_{h>i}^{n}\left(D_i^j D_h^k\right)$$

8. Unweighted Dynamic Proportional Vertical Index:

$$\frac{1}{V}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{h=1,h\neq i}^{n}\left(D_i^j D_h^j\right)$$

9. Unweighted Dynamic Regressive Vertical Index:

$$\frac{1}{V}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k<j}^{q}\sum_{h>i}^{n}\left(D_i^j D_h^k\right)+\frac{1}{V}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k>j}^{q}\sum_{h<i}^{n}\left(D_i^j D_h^k\right)$$

10. Unweighted Dynamic Horizontal Inequity Index:

$$\frac{1}{\gamma}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k=1,k\neq j}^{q}\left[D_i^j D_i^k\right]$$

Where γ is the sum of all unweighted dynamic horizontal comparisons:

$$\gamma = \sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k=1,k\neq j}^{q}\left[D_i^j D_i^k\right] + \sum_{j=1}^{m}\sum_{i=1}^{n}\left[D_i^j\left(D_i^j - 1\right)\right]$$

11. Unweighted Dynamic Horizontal Equity Index:

$$1-\left[\frac{1}{\gamma}\sum_{j=1}^{q}\sum_{i=1}^{n}\sum_{k=1,k\neq j}^{q}\left[D_i^j D_i^k\right]\right]$$

Appendix II

Algebraic Statement of Other Index Numbers

n = # of economic income classes

a = # of after-tax income classes

m = # of effective rate classes

N_i^j = population in economic income class i, rate class j

Y_i^j = average income in economic income class i, rate class j

Z_i = average income in after-tax income class i

P_i = population in after-tax income class i

POP = total population

INC = total after-tax income

Equation = Index Number		**Reference**
(06) = Average after-tax income		
(07) = Variance		Kondor 1975
(08) = Coefficient of variation		Atkinson 1970; Fields and Fey 1975
(09) = Mean difference		Kendall 1947
(10) = Gini Coefficient		Pyatt 1976
(11) = Atkinson Gini		Atkinson 1970
(12) = Coefficient of concentration		Kondor 1975
(13) = Atkinson		Atkinson 1970 AT1:ϵ = .3 AT2:ϵ = .7
(14) = Kolm		Kolm 1976
(15) = Relative mean deviation #1		Atkinson 1970
(16) = Relative mean deviation #2		Kondor 1975
(17) = Theil #1		Bouguignon 1979
(18) = Theil #2		Fields and Fei 1979; Theil 1967
(19) = Theil #3		Theil 1967
(20) = Standard deviation of logarithms		Atkinson 1970
(21) = Logarithmic variance		Kondor 1975
(22) = Kuznets ratio = (15)		Fields and Fei 1979
(23) = Average coefficient of variation of effective rates		

Algebraic Statement of Other Index Numbers

(06) = $INC/POP = AVINC$

(07) = $\frac{1}{POP}\sum_{i=1}^{a}\left(Z_i - AVINC\right)^2 * P_i = VAR$

(08) = $\sqrt{VAR}\ \ / AVINC$

(09) = $\frac{1}{POP^2}\ \ \sum_{i=1}^{a}\sum_{j=1}^{i-1} P_i * P_j * \left|Z_i - Z_j\right|$

(10) = $MD/AVINC = GINI$

(11) = $GINI/2$

(12) = $\frac{1}{AVINC * POP * (POP-1)}\sum_{i=1}^{a}\sum_{j=1}^{i-1}\ \left|Z_i - Z_j\right| * P_i * P_j$

(13) = 1 - $\frac{1}{AVINC}\ \left[\sum_{i=1}^{n} N_i\left(Z_i\right)^{1-\varepsilon} / POP\right]^{\frac{1}{1-\varepsilon}}$

(14) = $1000*\log\left(\sum_{i=1}^{a}\exp\left[\left(AVINC - Z_i\right)*\frac{1}{1000}\right]\frac{P_i}{POP}\right)$

(15) = $\frac{1}{POP}\sum_{i=1}^{a}\left|\frac{Z_i}{AVINC} - 1\right| * P_i = RMD1$

(16) = RMD1*/2*

(17) = $\sum_{i=1}^{a} P_i * X_i * \log\left(X_i\right)$
Where $X_i = Z_i / INC$

(18) = $\sum_{i=1}^{a} P_i * Z_i * \log\left(POP * Z_i\right)$

(19) = $\frac{1}{POP}\sum_{i=1}^{a} Sign\left(Z_i\right) * P_i * \log\left(\left|Z_i\right|\right) = THEIL3$

(20) = $\frac{1}{POP}\sum_{i=1}^{a} P_i * \left(\log\left(\left|Z_i / AVINC\right|\right)\right)^2$

$$(21) = \frac{1}{POP}\sum_{i=1}^{a} Sign\left(\left(Z_i\right) * \log\left(\left|Z_i\right|\right) - THEIL3\right)^2 * P_i$$

$$(22) = \sum_{i=1}^{a} P_i * \left|\frac{Z_i}{INC} - \frac{1}{POP}\right| = RMD1$$

$$(23) = \frac{1}{POP}\sum_{i=1}^{a}\left\{\left[\frac{\sum_{j=1}^{m} N_i^{j\,2}}{\sum_{j=1}^{m} N_i^j * j}\right] * \left[\frac{\sum_{j=1}^{m}\sum_{k=j+1}^{m}\left(j-k\right)^2 * N_i^k * N_i^j}{\sum_{j=1}^{m}\sum_{k=j+1}^{m}\left(N_i^k * N_i^j\right) + \frac{1}{2}\sum_{j=1}^{m} N_i^j * \left(N_i^j - 1\right)}\right]^{\frac{1}{2}}\right\}$$