UNIVERSITY of York

Discussion Papers in Economics

No. 15/04

Inequality and the composition of taxes

Andrew Pickering and Sheraz Rajput

Department of Economics and Related Studies
University of York
Heslington
York, YO10 5DD

Inequality and the composition of taxes

Andrew Pickering[†]   Sheraz Rajput[†]

March 2015

Abstract

This paper analyzes the political economics of the composition of taxes. Taxes may be levied on income, or on expenditure, and the median voter is pivotal in the theoretical framework analyzed. As in Meltzer and Richard (1981) income taxes increase with inequality. Conversely expenditure taxes first increase and then decrease with increasing inequality. The extent to which taxes are levied on income relative to expenditure unambiguously rises with inequality. Cross-country data exhibit a robust positive correlation between the extent to which taxes are levied on income relative to expenditure, and inequality. Consistent with the theory this relationship holds most significantly in stronger democracies.

Keywords: tax structure, inequality

JEL Codes: D78; E62; H20

– –

[†]Department of Economics, University of York, UK.

1 Introduction

What determines fiscal policy in democracies? A canonical theoretical result derived by Meltzer and Richard (1981), building on Romer (1975), is that the size of government increases with the degree of inequality in the pre-tax income distribution.

Cross country evidence testing the Meltzer and Richard (1981) hypothesis is predominantly unsupportive. For example Perotti (1996), Bassett et al (1999) and Persson and Tabellini (2003) all find that the size of government is either insignificantly and/or negatively related to measures of inequality. In response, new theories have emerged through which high levels of inequality can coexist with small government under democracy.[1] Benabou and Ok (2001) advanced the possibility that the prospect of upward income mobility may limit the demand for redistribution under rational expectations. Nonetheless, the 'Great Gatsby curve' (Krueger, 2012) undermines this argument somewhat as a full reconciliation with the data.

In the cross-country context there are many potential determinants of the total size of government, beyond the income distribution. Socioeconomic, historical and institutional differences may account for observed differences in government size, and indeed undoubtedly also co-determine differences in the income distribution. The broader literature on the size of government catalogues income levels (Wagner's law, analyzed in Ram, 1987), ideology (Pickering and Rockey, 2011), demographic change (Razin et al 2002), openness (Rodrik, 1998), country size (Alesina and Wacziarg, 1998) and fragmentation (Alesina et al, 1999). Public choice theory characterizes the size of government as the outcome of the power of a

[1] For example Persson (1995) and Benabou (2000).

bureaucracy that has the capacity to sustain itself (Niskanen, 1971), which also may differ across institutional settings. Persson and Tabellini (1999) and Persson et al (2000) stress the importance of constitutional rules in determining government size. Shelton (2007) provides an extensive survey and examination of this literature.

Consequently an alternative empirical literature instead focusses on testing the hypothesis within countries. Meltzer and Richard (1983) found some support for their hypothesis using data from the US states, and relatedly Alesina et al (2000) found that public employment was higher in US cities with greater levels of inequality. Borge and Rattsø (2004) found that the tax burden shifts from poll taxes to property taxes with greater income inequality across Norwegian local governments.

This paper revisits international evidence, but first asks a different, but basic, question: how does inequality affect the composition of taxes? Arguably total expenditure (and therefore total taxation under a balanced budget) may be determined institutionally, or more generally by factors other than the income distribution. But the total size of government is not the only policy lever. Even if the size of the public sector is taken as given, governments still face unresolved questions on the appropriate composition of taxes. Perhaps the most basic question here is the extent to which government raise taxes on income as opposed to expenditure. Indeed Crawford et al (2007) write that "(t)he appropriate balance between direct and indirect taxation — between income taxes and taxes on goods and services — is one of the oldest issues in public finance, but still imperfectly understood." There is of course an enormous literature analyzing optimal taxation, beginning with Diamond and Mirrlees (1971), but very little indeed in the way of a positive analysis of the political economics of the tax composition decision.

A related literature examines the adoption of particular tax instruments, both historically (Aidt and Jensen, 2009a and 2009b) and as an outcome or indeed a driver of the development process (Keen and Lockwood, 2010; Besley and Persson, 2014). However, this literature generally neglects the impact of inequality on the adoption process.

In this paper the composition of taxes is determined in a simple median voter framework. Taxes may be levied on income, or on expenditure. There are different tax collection costs (or deadweight losses) associated with both, but income taxes are more effective at redistributing than expenditure taxes. Because the median voter's income is less than their expenditure, a given level of additional redistribution costs more to them in consumption terms when financed by expenditure taxes than by income taxes. In the theoretical framework the preferred policy of the median voter is the unique Condorcet winner, despite the fact there are two policy instruments, because across individuals the ideal policy mix is unidimensional in income.[2] The results relating to income taxes are familiar. As with Meltzer and Richard (1981) greater inequality monotonically leads to higher income taxes. The results relating to expenditure taxes are novel. At low levels of inequality, increases in inequality also lead to higher tax rates because these are also redistributive (because the rich spend more than the poor hence pay more taxes), and at low tax levels the deadweight losses are relatively small. However, once inequality passes some threshold level, then there is a stronger desire for redistribution, even if this comes at the price of greater deadweight income-tax losses. The median voter now substitutes expenditure taxes for income taxes. Nonetheless, an unambiguous finding is that the composition of taxes, defined as the extent to which taxes

[2]This is the condition of 'intermediate preferences' identified by Grandmont (1978), also used by Borge and Rattsø (2004).

are levied on income relative to expenditure, will always rise with inequality.

Using cross-country data for tax composition from the WDI, and inequality data from the Texas Inequality Project, there is a robust positive correlation between the extent to which taxes are levied on earnings relative to expenditure and inequality. Moreover income taxes as a percentage of total taxes increase, whilst taxes on expenditure as a percentage of total taxes fall with increased inequality. The magnitude of the estimated effects are quite large. A one-standard deviation increase in inequality is associated with an increase in the ratio of taxes collected from income to taxes collected from expenditure of around half a standard deviation. These statistical relationships hold most significantly in countries with higher levels of democracy, in support of the mechanism proposed in this paper.

The next section provides a theoretical analysis of the political economics of income and expenditure taxation. Section 3 contains the empirical analysis and section 4 concludes.

2 Model

The model is a simple extension of Meltzer and Richard (1981) to include expenditure taxes. As in that paper, expenditure (x_i) is set equal to disposable income,

$$x_i = (1 - t_y)\, y_i + r \tag{1}$$

where t_y is the income tax rate, y_i is income, indexed i across the population and r is per capita redistribution. Consumption (c_i) is less than expenditure, because of the presence of

an expenditure/consumption tax (t_c), hence

$$c_i = (1 - t_c)\, x_i. \tag{2}$$

The budget is assumed to balance so that redistribution in per capita terms is financed from consumption and income tax revenue, requiring

$$r = t_c \overline{x} + t_y \overline{y}. \tag{3}$$

Furthermore at the aggregate level income equals expenditure, thus

$$\overline{x} = \overline{y}. \tag{4}$$

In order to maintain tractability the labor-supply decision is not formally modeled, hence maximization of utility amounts to maximization of consumption (because consumption is the only argument in the utility function). The pivotal voter/policymaker thus chooses the triple $\mathbf{q} = \{t_c, t_y, r\}$ in order to maximize their own consumption. Substituting in (4), (3) and (1) into (2) gives

$$c_i = (1 - t_c)\left[(1 - t_y)\, y_i + (t_c + t_y)\, \overline{y}\right] \tag{5}$$

hence the policy problem reduces to two dimensions (t_c and t_y). The important point of departure from Meltzer and Richard (1981) is that there are now two tax instruments being set. In general the Condorcet winner does not exist when the policy problem has two (or more) dimensions, but the structure presented can be re-expressed in terms of (unidimen-

sional) intermediate preferences which means that the choice of the median voter will be pivotal.[3] Grandmont (1978) showed that as long as voters only differ along one dimension (here, income), and that the indirect utility function ($W(\mathbf{q}; y_i)$) can be written as

$$W(\mathbf{q}; y_i) = J(\mathbf{q}) + K(y_i) H(\mathbf{q}) \tag{6}$$

then the choice of the median voter is a Condorcet winner. Clearly (5) conforms to (6). It is clear that equation (5) satisfies this requirement.

A final ingredient of the model is that mean income declines with taxes, capturing tax collection and/or 'deadweight' costs. To model this we follow Pickering and Rockey (2011) and posit that

$$\overline{y} = y^* \left(1 - \frac{\delta_y t_y \overline{y}}{y^*} - \frac{\delta_c t_c \overline{y}}{y^*}\right) \tag{7}$$

where y^* is potential income and δ_y and δ_c are parameters defining the sensitivity of actual (taxable) income respectively to income and consumption taxes. The parameters δ_y and δ_c represent deadweight losses, either incurred directly as the tax collection costs, and/or indirectly in terms of their effects on economic activity. These losses are non-negative, but in order to generate a meaningful policy tension are less than the tax revenue that may be raised, hence $0 < \delta_y < 1$ and $0 < \delta_c < 1$. δ_y in particular may vary across countries. High values could imply high income tax collection costs or a low income tax base. As discussed by Besley and Persson (2014), many countries cannot easily collect income taxes. Arguably both δ_c and δ_y may be higher in the presence of a significant informal economy. Whilst the

[3] See Persson and Tabellini (2000) pp. 25. Borge and Rattso (2004) also employ intermediate preferences to solve a two-dimensional policy problem.

informal economy is not modeled here, it is intuitive that it is more difficult to levy taxes (which would apply by construction to the formal sector) when the economic agents within the formal sector may easily migrate to the informal economy. $\bar{y}$, which here represents the formal economy, would fall more readily with increased taxation.[4] Nonetheless, across groups of countries that are economically and institutionally similar, one might expect that the cost parameters are also similar.

The median voter has income y_m, and we define $m \equiv \frac{\bar{y}}{y_m} > 1$. Maximization of (5) with respect to t_y, given (7) yields

$$t_c + t_y = \frac{(m-1)}{\delta_y m}. \tag{8}$$

This immediately delivers the well-known Meltzer and Richard (1981) that the total size of government (i.e. $t_c + t_y$) is increasing in inequality. Moreover when choosing t_y *for given* t_c the two instruments can be understood as perfect substitutes. Higher t_c permits lower t_y. However, t_c is not a given.

Maximization of (5) with respect to t_c, and using (8), yields

$$t_c = \frac{(m-1)\left[m\left(\delta_y - \delta_c\right) - (m-1)\right]}{m\left[\delta_y\left(m+1\right) - \delta_c\left(m-1\right)\right]}. \tag{9}$$

Note that no restrictions are required in order to ensure $t_c < 1$. It is trivially clear from (5) that the median voter will will not want to set expenditure taxes in excess of 100% as this will mean negative consumption. $t_c > 0$ requires $\delta_y - \delta_c > \frac{m-1}{m}$. For the median voter to desire positive expenditure taxes at all, there has to be a wedge between δ_y and δ_c. Were δ_y and δ_c equal, then income taxes would always (i.e. irrespective of m) be the preferred policy

[4] La Porta and Shleifer (2014) also argue that agents choose informality as a means of avoiding tax.

instrument. The reason for this is that when both types of tax are applied with equal cost (i.e. both incur the same output loss) then the only concern left is redistribution. Given the structure of the tax system, income taxes are inherently more redistributive (dollar for dollar) than consumption taxes. The latter always incur a cost to expenditure, which exceed the cost in terms of (own) income when income taxes are applied. However, when $\delta_y > \delta_c$, then the policy decision becomes more complex. Incomes taxes may be more redistributive, but if the costs are prohibitive, then it becomes optimal for the median voter to choose consumption taxes.

Combining equations (8) and (9) yields

$$t_y = \frac{(m-1)(\delta_y + \delta_c) + (m-1)^2}{\delta_y m [\delta_y (m+1) - \delta_c (m-1)]}. \tag{10}$$

As per Meltzer and Richard (1981) any degree of income inequality ($m > 1$) ensures positive income taxes. $t_y < 1$ in fact follows a fortiori from $\delta_y - \delta_c > \frac{m-1}{m}$. The proof of this is in the appendix. The intuition here is that δ_y is high enough such that income taxes will not be maximally set.[5]

The ratio of income to expenditure taxes is given by

$$\frac{t_y}{t_c} \equiv \tau = \frac{(\delta_y + \delta_c) + (m-1)}{\delta_y [m(\delta_y - \delta_c) - (m-1)]}. \tag{11}$$

The derivative of this expression with respect to m is unambiguously positive given $0 < \delta_c < \delta_y < 1$.[6] Increases in inequality lead to increases in income taxes relative to con-

[5] This can also be viewed as a shorthand for the plausible general equilibrium result in Meltzer and Richard (1981) that the labor supply will be sufficiently elastic at high income tax rates.

[6] Details are in the appendix.

sumption taxes. The reason is that as inequality increases, then greater weight is placed on redistribution through income taxes for given tax collection (or deadweight output losses) costs.

It is also of interest to consider how income and expenditure taxes separately respond to increases in inequality. The more straightforward case is income taxes. In this instance there is no ambiguity: income taxes increase with inequality ($\frac{dt_y}{dm} > 0$ - as shown in the appendix), with exactly the same underpinning as that provided in Meltzer and Richard (1981) (who only consider income taxes).

On the other hand the response consumption taxes to increasing inequality is ambiguous. Taking for simplicity the case of $\delta_c = 0$, the derivative of (9) with respect to m is positive or negative depending on

$$(2\delta_y - 3)\, m^2 + 2m + 1 \gtrless 0.$$

Note that the first term is unambiguously negative, hence $\frac{dt_c}{dm} < 0$ for large values of m. The critical threshold is $m = \frac{1+\sqrt{4-2\delta_y}}{3-2\delta_y}$. At levels of inequality below this, increases in inequality lead to higher consumption taxes. At levels beyond the threshold, increases in inequality lead to lower consumption taxes. The intuition for this non-monotonicity lies in the fact that income taxes are more redistributive than consumption taxes. *Both* instruments achieve redistribution, but at low levels of inequality the median voter's income is comparatively close to mean income and the redistributive difference (at least for the median voter) between the two instruments is relatively small. Here increases in inequality result in both types of tax increasing, with the extent depending on the collection costs or deadweight losses associated with each instrument. As inequality increases, a stronger tension between the

two instruments arises and the median voter becomes disposed towards income taxes to the extent that they now substitute for consumption taxes. Even if income taxes entail higher deadweight losses, they are still preferred because of their capacity to redistribute.

Figure 1 depicts how taxes change with inequality under the (arbitrary) parameterization $\delta_y = 0.9$ and $\delta_c = 0.3$. The position of these curves change with these parameters, but the key properties always hold given the conditions outlined. Income taxes monotonically increase a la Meltzer and Richard (1981), whilst expenditure taxes first increase and then decrease with inequality. Note also that the gradient of the income tax curve is always higher than that of the expenditure tax curve, hence $\frac{d\tau}{dm} > 0$ at all levels of inequality.

The model in this section is very stylized and omits several key features of any real-world tax system. For example the marginal propensity to consume may fall with income. This particular consideration would render the expenditure tax as regressive rather than proportionate as above.[7] In a median voter model this would lead to (an augmentation of) a negative relationship between consumption taxes and inequality. Hence the prediction that τ increases with inequality would hold more strongly were this feature incorporated into the model.

Recent literature has highlighted the role that institutions such as the voting rule (Lizzeri and Persico, 2001 and Persson and Tabellini, 1999) or form of government (Persson et al., 2000) may play in determining policy, and in particular the size of government. These mechanisms, and mechanisms highlighting the role of inequality (as in the present paper) are not mutually exclusive. For example, one possibility could be that institutions determine

[7] In a simulation study Decoster et al (2010) find indirect (expeniture) taxes to be unambiguosly less progressive than other components of the tax system in European countries.

the total budget, whilst inequality determines the composition of taxes.

Other generalizations of the model could include a richer (more progressive?) set of income tax instruments and thresholds, and indeed also analyze the tax collection costs (or deadweight losses) more fully.

Despite its simplicity, the model still sheds light on the tax composition decision in a median voter model. The results relating to income taxes are familiar, with income taxes rising as before-tax inequality rises. The results relating to expenditure taxes are more novel. In particular when inequality is initially at low levels, then increased inequality will also lead to increased demand for expenditure taxes. The rich spend more, and greater taxes will serve to redistribute towards the poor. However, this mechanism is eroded as inequality increases. Tax levels and associated collection costs increase. The median voter now replaces expenditure taxes with income taxes and beyond a certain threshold of inequality further increases in inequality lead to reductions in expenditure taxes. Nonetheless, it is unambiguous that the ratio of income taxes to expenditure taxes increases as inequality increases.

3 Evidence

The main agenda here is to ask whether the composition of taxes across countries systematically changes with inequality. Cross-country income and expenditure tax revenue data are available from the World Development Indicators through 1990-2012. Despite over 20 years of data, there is much greater variation in the policy data, as well as in the inequality data discussed below, across countries than within countries.[8] Consequently we report

[8]For example, across the strong democracies (described below) the standard deviation of cross-country mean inequality is 6.24, whilst the average within-country standard deviation is 1.39. For the main policy

results from cross-country regressions using within-country averages. This at least has the advantage of removing any cyclicality from the data, which could also endogenously vary with inequality.

The main dependent variable is constructed from the ratio of the percentage of tax revenue taken from taxes on income, profits and capital gains and the percentage of tax revenue taken from taxes on goods and services, i.e.

$$\tau = \frac{t_y}{t_c} = \frac{\text{Taxes on income, profits and capital gains (\% of revenue)}}{\text{Taxes on goods and services (\% of revenue)}} \tag{12}$$

where both the numerator and denominator are taken from the World Development Indicators (WDI) database. Because in practice rates vary with different forms of income (and at different levels of income) and goods across countries, the aggregate measure here is a means of gauging the extent of taxes on income relative to taxes on expenditure. In the regression analysis below we use the natural logarithm of τ because there are a small number of outliers where the denominator in (12) is quite small.

As well as examining how $\ln(\tau)$ varies with inequality we also separately analyze how the separate tax measures are respectively affected by inequality. The model above unambiguously predicts a positive impact of inequality on $\ln(\tau)$ and t_y, whilst the effect on t_c is ambiguous.

The inequality measure used in the empirical analysis is the University of Texas Inequality Project's estimate of household income inequality (Galbraith and Kum, 2005). These data (denoted $UTIP$) are constructed using Theil's T statistic to measure pay inequality across

variable ($\ln(\tau)$ - described below) the standard deviation of the cross-country means is 1.02, whilst the average within-country standard deviation is 0.261.

sectors in each country.

One important determinant of the capacity to tax is the level of development, so a first control variables used in the regression analysis is the natural log of GDP per capita in constant chained PPP US$ ($\ln\left(\overline{y}\right)$) from the Penn World Tables. OECD membership ($OECD$) is also used as a further control, also to some extent capturing the level of development and institutional capacity. Because the alternative tax instruments may redistribute across generations to differing extents, demographic variables (the proportion of the population aged 15-64 and the proportion aged 65 and above) are also included in the analysis (denoted $PROP1564$ and $PROP65$). These data are all taken from the WDI.

Countries raise tax revenue through means beyond taxation on income and goods and services. One important source is revenue from customs and other import duties. For this reason the trade share (exports plus imports as a percentage of GDP - denoted $TRADE$) is also included in the regression analysis. In addition to these controls the log of the total population size ($\ln(POP)$, also from the WDI) is also included, to account for any scale (dis-)economies associated with particular types of tax collection.[9]

A final control variable is the quality of democratic institutions. The degree of democracy may affect policy variables directly, through channels other than that analyzed above, or indeed indirectly as a proxy for tax capacity. For this reason the $POLITY2$ democracy score is included in the regression analysis as standard. Moreover the median income earner more plausibly drives policy under pure democracy. For this reason the sample is split into countries which score highly on this measure and those that do not. The expectation is that inequality will be more strongly related to the policy variables in the more democratic

[9]Both the trade data and the population data come from the World Development Indicators.

subsample.

Table 1 contains descriptive statistics of the key variables used in the analysis below. Note first that there is considerable dispersion in both the tax variables. Countries differ meaningfully in terms of how they raise tax revenue. Across the whole sample, taxes on goods and services represent a higher fraction of total revenue than taxes on income. This reflects the fact that in low income countries, the capacity to raise income taxes is often limited. Indeed within the OECD members, income taxes are around 32% of revenue, whilst in the rest of the World income taxes are just 20% of revenue. These data are also consistent with Besley and Persson (2014).

The $UTIP$ data cover 129 countries, and numerically range from below 30 (the Czech Republic and Sweden) to 58.2 (Angola), with higher numbers representing greater inequality. Notably, these data are negatively correlated with GDP per capita, with a Pearson correlation coefficient of -0.66. Richer countries are measured (on average) to be more equal than poorer countries (see Galbraith, 2008 for a discussion). This highlights the importance of controlling for economic development, else the inequality measure will be proxying for other potential drivers of policy.

Before presenting the main results we first report regressions, in Table 2, where the size of government, as measured by average total tax revenue as a share of GDP, is regressed on inequality. This serves to recapitulate the consensus on the empirical evidence, or rather the lack of it, relating to the Meltzer and Richard (1981) hypothesis that the total size of government increases with before-tax income inequality. Column 1 is a simple regression with just inequality ($UTIP$) and GDP per capita used as regressors. In that regression, as well as column 2, in which the full controls are used, the size of government is not significantly

correlated with inequality.[10] Significance levels do not improve when the sample is split by the quality of democracy. Column 3 contains results for countries with strong democratic credentials, with an average polity2 democracy score of 7 or above through the sample period.[11] Column 4 contains results for countries with polity2 democracies scores of less than 7. In neither instance is any statistical relationship found between the size of government and inequality. These finding reflects those found for example in Perotti (1996), Bassett et al (1999) and Persson and Tabellini (2003).[12]

Table 3 contains results when $\ln(\tau)$ is used as the dependent variable. When looking at the full sample both excluding (column 1) and including (column 2) control variables there is a statistically significant positive association between the extent to which countries use income taxes relative to expenditure taxes and inequality. When the sample is separated according to $POLITY2 \gtrless 7$ (columns 3 and 4) it becomes clear that the positive relationship holds only under democratic regimes. This is consistent with the theory above, which relies on a complete franchise. If the median voter earns more than the median income then their inclination towards redistribution will be much weaker. When the democracy criterion is strengthened further, so that only countries with $POLITY2 > 8$ (column 5), the magnitude of the estimated coefficient increases and is statistically significant at the 1% level.[13]

Using the coefficient estimate from column 5 of table 3, a one standard deviation increase in inequality, as measured by $UTIP$, is statistically associated with an increase of 0.46 in

[10] The sample is slightly smaller because the $POLITY2$ data do not cover some of the countries included in column 1.

[11] This cut-off was chosen for the simple reason that it results in two equally sized subsamples.

[12] Specifically, in column 6 of Table 3.1 of Persson and Tabellini (2003) pp. 40. This regression uses the Deininger and Squire (1996) measure of the Gini coefficient.

[13] The 11 countries that get dropped in column 5 relative to column 3 are Argentina, Botswana, Colombia, Estonia, El Salvador, South Korea, Macedonia, Moldova, Paraguay, Romania and Turkey.

the policy variable $\ln(\tau)$, holding all else equal. Given that this is nearly a half of the raw standard deviation in the policy variable, the magnitude of the estimated correlation is sizable.

One possible concern with these results is the presence of outliers. To check sensitivity to these we computed DFFITS measures for each observation used in column 5 of table 3 following the procedure detailed in Welsch and Kuh (1977). Four observations exhibits DFFITS measures greater than one in magnitude - Bolivia, Brazil, Bulgaria and the US. Omission of any one, or indeed all four of these outliers does not change the results substantively. In all cases the estimated coefficient is positive with comparable magnitude and remains significant at the 1% level.

In Tables 4 and 5 results are presented respectively for t_y and t_c, the numerator and denominator in (12). In Table 4 the findings for income taxes (t_y) are quite similar to the results found for $\ln(\tau)$. Increases in inequality are generally found to be positively related with the extent to which income taxes are used within total taxes, but moreso in the stronger democracies. In countries where $POLITY2 \geq 7$, the estimated effect remains positive, though is not statistically significant, whilst in countries where $POLITY2 < 7$, the estimated relationship is in fact negative, though at a very weak significance level. When the stronger democratic requirement is applied (i.e. where $POLITY2 \geq 8$), the estimated effect increases and is statistically significant at the 5% level. Using the estimate of column 5, a one standard deviation increase in inequality, is statistically associated with an increase of 6.46 in t_y, holding all else equal. As with $\ln(\tau)$, this represent about half of a standard deviation in the policy variable, so again the magnitude of the estimated correlation is sizable.

In the case of income taxes, some of the results relating to the control variables are

of interest. The proportion of the population aged over 65 years is consistently negatively related to income taxes. This is consistent with the findings of Razin, Sadka and Swagel (2002) who found a robust negative relationship between labor tax rates and the dependency ratio. Another regularity in Table 4 is the positive relationship with income per capita. As discussed in Besley and Persson (2014) this likely reflects the greater capacity to tax in richer countries. A further result is that the extent of democracy is positively associated with the extent to which income taxes are used. If income taxes (relative to other forms of taxation) are more progressive, then given the plausible assumption that democratization means that the median voter becomes relatively poorer, then this relationship would be expected.

Table 5 presents the results relating to t_c, the extent to which taxes raised through expenditure on goods and services as a percentage of total revenue. In contrast to income taxes, increases in inequality are generally found to be negatively related with the extent to which expenditure taxes are used, especially in the stronger democracies. In countries where $POLITY2 \geq 7$, the estimated relationship is positive and statistically significant at the 10% level, whilst in countries where $POLITY2 \geq 8$, the estimated effect is statistically significant at the 5% level. Arguably this could reflect a compositional effect: greater t_y must mean less taxes raised elsewhere as a percentage of the total, hence correlations may be reversed for t_c. Nonetheless, because there are other meaningful sources of revenue the results for t_c are not just simply a mirror image for t_y. Indeed the raw correlation between the two data series used is only -0.08 (for the subsample of democracies with $POLITY2 \geq 8$ it is still only -0.18).

Using the estimate of column 5 of Table 5, a one standard deviation increase in inequality is statistically associated with an reduction of 5.06 in t_c, holding all else equal. This represent

38% of a standard deviation in t_c, so whilst this is slightly less than that found for t_y this is still a sizable effect.

Again the results relating to the control variables are of worthy of some discussion. In contrast to income taxes there is a negative relationship with income per capita - likely reflecting tax capacity, and the ability to raise taxes through income taxes in particular. However, there are also some interesting differences between the results for t_y and t_c. For example, unlike the case of income taxes the demographic variables are not consistently related with t_c. There is also a consistent negative relationship between t_c and trade (though this relationship is not statistically strong). Globalization may constrain countries' capacity to tax goods and services - indeed arguably this puts more pressure on countries without the capacity to tax elsewhere (see Khattry and Rao, 2002, and Baunsgaard and Keen, 2010). Interestingly, and as found with t_y the extent of democracy is positively associated with the extent to which expenditure taxes are used. Essentially revenue sources outside of t_y and t_c are increasingly relied upon, the weaker the level of democracy. Given that both forms of taxes are progressive (in the weak sense that both instruments require the rich to pay more), this finding is consistent with the model presented above.

In relation to income taxes the theory above generates an unambiguous hypothesis. Greater inequality results in greater use of income taxes as a source of revenue. The data are supportive of this hypothesis, at least in strong democracies. However, the hypothesis relating to how taxes on expenditure are related to inequality are more nuanced. Increases in inequality are proposed to increase expenditure tax rates at low levels of inequality, and once some threshold level of inequality is reached, then the relationship becomes negative. In the empirical analysis the relationship is unambiguously negative. To test for this potential

non-monotonicity a quadratic term in $UTIP$ is included in the analysis. Table 6 contains the results, in column 1 for the full sample, in column 2 for countries with $POLITY2 \geq 7$ and in column 3 for countries with $POLITY2 \geq 8$. In all three cases the estimated sign on the point estimate for the linear term ($UTIP$) is positive, whilst the sign on the point estimate for the quadratic term ($UTIP^2$) is negative, consistent with the theory above. However, in all three cases the results are statistically insignificant.

One possible way of reconciling these results with the model would be to argue that the observed inequality levels in the sample predominantly (or completely) exceed the threshold value in the model. It is also possible that the model fails to fully account for the effect of inequality on expenditure taxes. As noted towards the end of Section 2 the marginal propensity to consume may fall with income, which could lead to an unambiguous negative relationship. More mundanely, it is also possible that identification of a clear non-linear relationship would go beyond the capacity of the available data.

4 Conclusion

This paper analyzes how the composition of taxes is determined in a simple median voter framework. Taxes may be levied on income, or on expenditure, as in the case of a sales tax. In the framework used the median voter is a Condorcet winner despite the fact there are two policy instruments. The results relating to income taxes are familiar. As with Meltzer and Richard (1981) greater inequality monotonically leads to higher income taxes.

The results relating to expenditure taxes are novel. At low levels of inequality, increases in inequality lead to higher expenditure tax rates. Even though expenditure taxes are not

as effective at redistributing as income taxes, there is still a redistributive impetus embodied within an expenditure tax, as the rich spend more than the poor. If expenditure taxes are preferred for separate reasons, perhaps because of smaller deadweight losses or collection costs, then the standard argument - that greater inequality leads to higher taxes - also applies to expenditure taxes.

However, once inequality passes some threshold level, then there is a stronger desire for redistribution, even if this comes at the price of greater deadweight losses. The median voter now substitutes income taxes for expenditure taxes. Nonetheless, an unambiguous finding is that the composition of taxes, defined as the extent to which taxes are levied on income relative to expenditure, will rise with inequality.

Using cross-country data for tax composition from the WDI, and inequality data from the Texas Inequality Project, there is a robust positive correlation between the extent to which taxes are levied on income relative to expenditure and inequality. Moreover income taxes as a proportion of total taxes increase with inequality, whilst expenditure taxes as a proportion of total taxes fall with inequality. Given the nature of cross-country data, and in particular unobserved heterogeneity across countries, it is not possible to say that these are causal relationships. Nonetheless, the fact that the empirical results hold most strongly for countries with higher levels of democracy, is supportive of the mechanism proposed in this paper.

Appendix

Proof that $t_y < 1$.

Using (10), then $t_y < 1$ requires that

$$(m-1)(\delta_y + \delta_c + (m-1)) < \delta_y m [\delta_y (m+1) - \delta_c (m-1)].$$

In turn this implies:

$$(m-1)(\delta_y + \delta_c + (m-1)) < \delta_y m [\delta_y + \delta_c + m(\delta_y - \delta_c)]$$

hence

$$(m - 1 - \delta_y m)(\delta_y + \delta_c) < \delta_y m^2 (\delta_y - \delta_c) - (m-1)^2.$$

Substituting in the minimum value $\delta_y - \delta_c = \frac{m-1}{m}$ into the RHS then a fortiori,

$$(m - 1 - \delta_y m)(\delta_y + \delta_c) < (m-1)(\delta_y m - (m-1))$$

and

$$(m - 1 - \delta_y m)(\delta_y + \delta_c) < (m-1)(\delta_y m - (m-1))$$

which must hold because $\delta_y - \delta_c > \frac{m-1}{m}$ strongly implies that $\delta_y > \frac{m-1}{m}$.

Proof that $\frac{d\tau}{dm} > 0$.

Differentiating (11) with respect to m leads to the condition

$$m(\delta_y - \delta_c) - m - 1 - (\delta_y - \delta_c - 1)(\delta_y + \delta_c + m - 1) > 0.$$

Simplifying yields the condition

$$\delta_y - \delta_c + (\delta_y + \delta_c)(1 - (\delta_y - \delta_c)) > 0$$

which unambiguously holds given $0 < \delta_c < \delta_y < 1$.

Proof that $\frac{dt_y}{dm} > 0$.

Differentiating (10) with respect to m leads to the condition

$$\left(m^2 - 1 + \delta_y + \delta_c\right) X - m(\delta_y - \delta_c)(m-1)(\delta_y + \delta_c + m - 1) > 0$$

where $X \equiv \delta_y(m+1) - \delta_c(m-1)$. After some algebra, this can be rearranged as

$$2(m-1)m(\delta_y - \delta_c) + (\delta_y + \delta_c)\left\{m^2[1 - (\delta_y - \delta_c)] + 2m(\delta_y - \delta_c) + (\delta_y + \delta_c)\right\} > 0.$$

This unambiguously holds given $0 < \delta_c < \delta_y < 1 < m$.

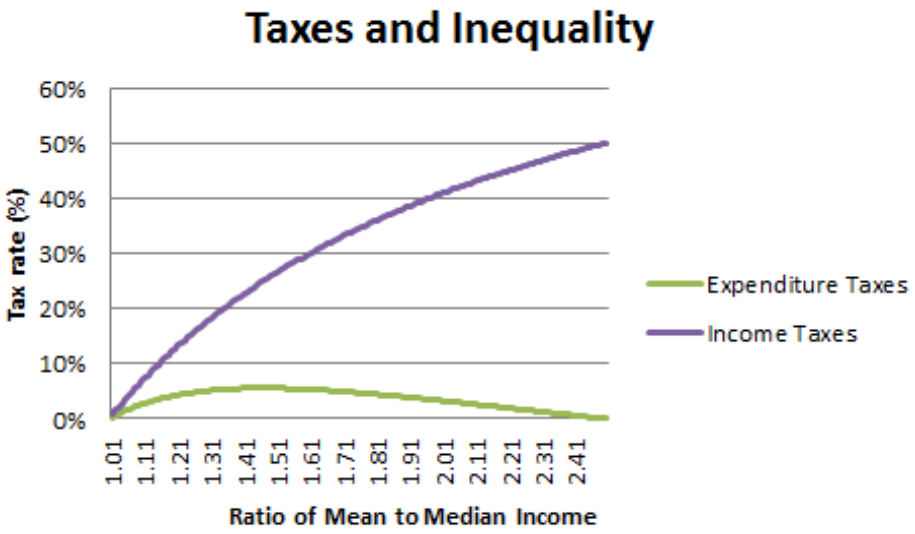

Figure 1: How Expenditure and Income Taxes change with Inequality

Table 1. Descriptive Statistics

	# obs	mean	s.d.	min	max
t_y	158	22.26	12.12	0.604	64.36
t_c	160	29.07	13.47	0.108	75.07
$\ln(\tau)$	157	-0.24	0.98	-2.80	4.57
$\ln(\overline{y})$	166	8.63	1.26	5.60	11.22
$UTIP$	129	44.03	6.49	29.08	58.25
$PROP1564$	194	61.23	6.57	48.52	76.78
$PROP65$	194	7.00	4.62	0.81	18.39
$TRADE$	191	86.69	47.42	2.15	360.5
$OECD$	213	0.138	0.333	0	1
$\ln POP$	213	15.07	2.36	9.16	20.96
$POLITY2$	165	3.03	6.20	-10	10

The data are within-country averages between 1990-2014. t_y denotes taxes on income, profits and capital gains (as a % of revenue) - taken from the World Development Indicators (WDI). t_c denotes taxes on goods and services (as a % of revenue) - also taken from the WDI. $\tau = \frac{t_y}{t_c}$. $\overline{y}$ is real GDP at chained PPPs in millions of 2005 US dollars per capita - taken from the Penn World Tables. $UTIP$ is the University of Texas Inequality Project estimate of household income inequality $PROP1564$ and $PROP65$ are respectively the proportion of the population aged between 15 and 64, and 65 and above. $TRADE$ is imports plus exports as a percentage of GDP. $OECD$ is a dummy variable denoting OECD membership. POP is the country population size $POLITY2$ is a measure of democracy provided by the Polity IV project, with 10 denoting the highest level of democracy, and -10 denoting the highest level of autocracy.

Dep Var: $\frac{t}{y}$	(1)	(2)	(3)	(4)
$UTIP$	-0.177	0.077	0.089	0.190
	(0.147)	(0.198)	(0.209)	(0.301)
$\ln(\bar{y})$	1.155	0.737	3.032^{*}	-1.384
	(0.786)	(1.368)	(1.599)	(1.595)
$OECD$		1.810	1.542	0.225
		(2.803)	(3.242)	(3.577)
$PROP1564$		-0.195	-0.212	-0.023
		(0.174)	(0.219)	(0.292)
$PROP65$		0.183	-0.236	0.516
		(0.204)	(0.298)	(0.367)
$TRADE$		0.019	-0.033	0.047
		(0.022)	(0.024)	(0.039)
$\ln(POP)$		-1.460^{***}	2.489^{***}	-1.127^{*}
		(0.432)	(0.683)	(0.578)
$POLITY2$		0.254^{*}	0.987	0.103
		(0.150)	(0.886)	(0.162)
Obs	119	112	56	56
Sample	Full	Full	Polity2>7	Polity2<7
R^2	0.11	0.29	0.37	0.25

Table 2: Estimation Results - the size of government

Notes: Cross country regressions of total tax revenue as a percentage share of GDP including $\ln(\bar{y})$, $PROP1564$, $PROP65$, $TRADE$, $\ln(POP)$ and $POLITY2$ as control variables described in the text. Robust standard errors are reported in parentheses. *, **, and *** respectively denote significance levels at 10%, 5% and 1%.

Dep Var: $\ln(\tau)$	(1)	(2)	(3)	(4)	(5)	(6)
$UTIP$	0.076^{***}	0.027^{*}	0.047^{*}	0.021	0.071^{***}	0.007
	(0.016)	(0.016)	(0.024)	(0.023)	(0.021)	(0.022)
$\ln(\bar{y})$	0.428^{***}	0.733^{***}	0.859^{***}	0.561^{***}	1.014^{***}	0.629^{***}
	(0.259)	(0.138)	(0.286)	(0.193)	(0.299)	(0.163)
OECD		0.374	0.038	-1.204^{***}	0.161	-0.736^{*}
		(0.313)	(0.432)	(0.418)	(0.390)	(0.408)
$PROP1564$		-0.068^{***}	-0.031	-0.035	0.019	-0.048^{*}
		(0.022)	(0.041)	(0.028)	(0.047)	(0.025)
$PROP65$		-0.082^{***}	-0.072^{**}	-0.166^{***}	-0.094^{**}	-0.148^{***}
		(0.024)	(0.029)	(0.041)	(0.036)	(0.034)
$TRADE$		0.001	0.000	0.002	0.001	0.001
		(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
$\ln POP$		0.127^{**}	0.160^{*}	0.119	0.229^{**}	0.088
		(0.058)	(0.093)	(0.087)	(0.100)	(0.080)
$POLITY2$		-0.012	0.122	-0.008	0.115	-0.010
		(0.015)	(0.115)	(0.023)	(0.117)	(0.020)
Obs	117	111	56	55	45	66
Sample	Full	Full	$POLITY2 \geq 7$	$POLITY2 < 7$	$POLITY2 \geq 8$	$POLITY2 < 8$
R^2	0.19	0.43	0.54	0.48	0.62	0.48

Table 3: Estimation Results - the composition of taxes

Notes: As for Table 2.

Dep Var: t_y	(1)	(2)	(3)	(4)	(5)	(6)
$UTIP$	0.524^{*}	0.185	0.586	-0.045	0.995^{**}	-0.060
	(0.300)	(0.307)	(0.496)	(0.448)	(0.435)	(0.391)
$\ln(\bar{y})$	4.576^{***}	6.770^{***}	8.078^{**}	5.523^{*}	15.254^{***}	4.530^{**}
	(1.538)	(1.856)	(3.232)	(2.954)	(3.947)	(2.237)
OECD		7.277	5.686	-3.330	7.307	-4.244
		(4.703)	(6.861)	(7.190)	(6.833)	(6.516)
$PROP1564$		-0.453	0.146	-0.257	0.403	-0.224
		(0.321)	(0.577)	(0.520)	(0.838)	(0.433)
$PROP65$		-1.351^{***}	-1.360^{**}	-1.952^{**}	-2.067^{***}	-1.728^{***}
		(0.420)	(0.602)	(0.733)	(0.750)	(0.615)
$TRADE$		0.016	-0.037	0.034	-0.055	0.038
		(0.025)	(0.052)	(0.033)	(0.053)	(0.030)
$\ln POP$		1.921^{**}	1.101	2.006^{*}	1.404	1.885^{*}
		(0.815)	(1.517)	(1.093)	(1.549)	(1.041)
$POLITY2$		0.539^{**}	3.322^{*}	0.733^{*}	0.602	0.485
		(0.266)	(1.724)	(0.387)	(3.460)	(0.319)
Obs	118	112	56	56	45	67
Sample	Full	Full	$POLITY2 \geq 7$	$POLITY2 < 7$	$POLITY2 \geq 8$	$POLITY2 < 8$
R^2	0.11	0.31	0.43	0.48	0.51	0.27

Table 4: Estimation Results - income taxes

Notes: As for Table 2.

Dep Var: t_c	(1)	(2)	(3)	(4)	(5)	(6)
$UTIP$	-0.892^{***}	-0.317	-0.591^{*}	-0.174	0.779^{**}	-0.001
	(0.268)	(0.302)	(0.342)	(0.445)	(0.364)	(0.429)
$\ln(\bar{y})$	-4.130^{***}	-7.488^{***}	-9.416^{***}	-5.202	-8.226^{**}	-6.819^{**}
	(1.493)	(2.093)	(3.232)	(3.844)	(3.400)	(2.876)
OECD		-1.394	1.508	32.98^{***}	-2.470	15.39
		(4.318)	(4.135)	(8.105)	(3.837)	(9.746)
$PROP1564$		0.891^{**}	0.603	0.517	0.034	0.629
		(0.373)	(0.447)	(0.631)	(0.521)	(0.509)
$PROP65$		0.296	0.212	1.270	0.297	1.277^{**}
		(0.416)	(0.358)	(0.775)	(0.389)	(0.619)
$TRADE$		-0.026	-0.031	-0.034	-0.039	-0.015
		(0.023)	(0.031)	(0.035)	(0.034)	(0.032)
$\ln POP$		-1.091	-2.172^{**}	-0.541	-2.538^{**}	-0.202
		(0.833)	(0.923)	(1.453)	(0.998)	(1.255)
$POLITY2$		0.464	0.326	0.614	0.220	0.429
		(0.287)	(1.437)	(0.446)	(1.851)	(0.377)
Obs	118	111	56	55	45	66
Sample	Full	Full	$POLITY2 \geq 7$	$POLITY2 < 7$	$POLITY2 \geq 8$	$POLITY2 < 8$
R^2	0.12	0.24	0.45	0.33	0.47	0.31

Table 5: Estimation Results - expenditure taxes

Notes: As for Table 2.

Dep Var: t_c	(1)	(2)	(3)
$UTIP$	0.032	0.645	0.988
	(1.867)	(2.093)	(1.903)
$UTIP^2$	−0.004	−0.016	−0.022
	(0.022)	(0.027)	(0.025)
$\ln(\bar{y})$	−7.463***	−9.549***	−8.681**
	(2.075)	(2.613)	(3.532)
OECD	−1.295	1.631	−1.939
	(4.528)	(4.156)	(3.825)
$PROP1564$	0.881**	0.555	−0.024
	(0.373)	(0.462)	(0.519)
$PROP65$	0.306	0.174	0.239
	(0.406)	(0.362)	(0.400)
$TRADE$	−0.026	−0.031	−0.039
	(0.022)	(0.032)	(0.035)
$\ln POP$	−1.106	−2.171**	−2.628**
	(0.831)	(0.935)	(1.015)
$POLITY2$	0.457	0.411	0.066
	(0.295)	(1.493)	(1.837)
Obs	111	56	45
Sample	Full	$POLITY2 \geq 7$	$POLITY2 \geq 8$
R^2	0.24	0.45	0.47

Table 6: Estimation Results

Notes: As for Table 2.

References

Aidt, Toke S., and Peter S. Jensen (2009a). The taxman tools up: An event history study of the introduction of the personal income tax. *Journal of Public Economics* 93(2): 160-175.

Aidt, Toke S., and Peter S. Jensen (2009b). Tax structure, size of government, and the extension of the voting franchise in Western Europe, 1860-1938. *International Tax and Public Finance* 16: 362-394.

Alesina, Alberto, Reza Baqir and William Easterly (1999). Public goods and ethnic divisions. *Quarterly Journal of Economics* 114 (4): 1214–1284.

Alesina, Alberto, Reza Baqir and William Easterly (2000). Redistributive public employment. *Journal of Urban Economics* 48: 219–241.

Alesina, Alberto, and Romain Wacziarg (1998). Openness, country size and government. *Journal of Public Economics* 69 (3), 305–321.

Bassett, William F., John P. Burkett and Louis Putterman (1999). Income distribution, government transfers, and the problem of unequal influence. *European Journal of Political Economy* 15: 207-228.

Baunsgaard, Thomas, and Michael Keen (2010). Tax revenue and (or?) trade liberalization. *Journal of Public Economics* 94(9-10): 563-577.

Benabou, Roland (2000). Unequal societies: Income distribution and the social contract. *American Economic Review* 90: 96-129.

Benabou, Roland, and Efe A. Ok (2001). Social mobility and the demand for redistribution: The POUM hypothesis. *Quarterly Journal of Economics* 116(2): 447-487.

Besley, Timothy, and Torsten Persson (2014). Why do developing countries tax so little? *Journal of Economic Perspectives* 28(4): 99-120.

Borge, Lars-Erik, and Jørn Rattsø (2004). Income distribution and tax structure: Empirical test of the Meltzer–Richard hypothesis. *European Economic Review* 48: 805-826.

Crawford, Ian, Michael Keen and Stephen Smith (2010). VAT and excises. pp. 275–362 in James Mirrlees and others (eds.), *Dimensions of tax design: The Mirrlees Review*. Oxford: Oxford University Press for the Institute for Fiscal Studies.

Decoster, André, Jason Loughrey, Cathal O'Donoghue and Dirk Verwerft (2010). How regressive are indirect taxes? A microsimulation analysis for five European countries. *Journal of Policy Analysis and Management* 29(2): 326-350.

Deininger, Klaus, and Lyn Squire (1996). Measuring income inequality: A new database. *World Bank Economic Review* 10: 565-591.

Diamond, Peter, and James A. Mirrlees (1971). Optimal taxation and public production I: Production efficiency, II Tax rules. *American Economic Review* 61: 8–27 and 261–78.

Galbraith, James K. (2008). Inequality and economic and political change. UTIP Working Paper No. 5, the University of Texas Inequality Project.

Galbraith, James K., and Hyunsub Kum (2005). Estimating the inequality of household incomes: A statistical approach to the creation of a dense and consistent global data set. *Review of Income and Wealth* 51: 115-143.

Grandmont, Jean-Michel (1978). Intermediate preferences and the majority rule. *Econometrica* 46(2): 317-330.

Keen, Michael, and Ben Lockwood (2010). The value added tax: Its causes and consequences. *Journal of Development Economics* 92(2): 138-151.

Khattry, Barsha, and Mohan Rao (2002). Fiscal faux pas? An analysis of the revenue implications of trade liberalization. *World Development* 30: 1431-1444.

Krueger, Alan (2012). The rise and consequences of inequality. Presentation made to the Center for American Progress, January 12th. http://piketty.pse.ens.fr/files/Krueger2012.pdf.

La Porta, Rafael, and Andrei Shleifer (2014). Informality and development. *Journal of Economic Perspectives* 28(4): 109-126.

Lizzeri, Alessandro, and Nicola Persico (2004). The provision of public goods under alternative electoral incentives. *American Economic Review* 91(1): 225-239.

Meltzer, Allan H, and Richard, Scott F. (1981). A rational theory of the size of government. *Journal of Political Economy* 89: 914-927.

Meltzer, Allan H, and Richard, Scott F. (1983). Tests of a rational theory of the size of government. *Public Choice* 41: 403-418.

Niskanen, William A. (1971). *Bureaucracy and representative government.* Chicago: Aldine Atherton.

Perotti, Roberto (1996). Growth, income distribution and democracy: What the data say. *Journal of Economic Growth* 1: 149-188.

Persson, Mats (1995). Why are taxes so high in egalitarian societies? *Scandinavian Journal of Economics* 97(4): 569-580.

Persson, Torsten, Gérard Roland, and Guido Tabellini (2000). Comparative politics and public finance. *Journal of Political Economy* 108(6): 1121-1161.

Persson, Torsten, and Guido Tabellini (1999). The size and scope of government: Comparative politics with rational politicians. 1998 Marshall Lecture. *European Economic Review* 43: 699-735.

Persson, Torsten, and Guido Tabellini (2000). *Political economics: Explaining economic policy.* MIT Press, Cambridge MA.

Persson, Torsten, and Guido Tabellini (2003). *The economic effects of constitutions.* MIT Press, Cambridge MA.

Pickering, Andrew C., and James Rockey (2011). Ideology and the Growth of Government. *Review of Economics and Statistics* 93(3): 907-919.

Ram, Rati (1987). Wagner's hypothesis in time-series and cross-section perspectives: Evidence from "real" data for 115 countries. *Review of Economics and Statistics* 69(2): 194-204.

Razin, Assaf, Efraim Sadka and Phillip Swagel (2002). The aging population and the size of the welfare state. *Journal of Political Economy* 110(4): 900-918.

Rodrik, Dani (1998). Why do more open economies have bigger governments? *Journal of Political Economy* 106(5): 997–1032.

Romer, Thomas (1975). Individual welfare, majority voting, and the properties of a linear income tax. *Journal of Public Economics* 8: 329-340.

Shelton, Cameron A. (2007). The size and composition of government expenditure. *Journal of Public Economics* 91: 2230-2260.

Welsch, Roy E., and Edwin Kuh (1977). Linear regression diagnostics. NBER Working Paper no. 173.