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Abstract

This paper provides a joint analysis of the output and distributional long term effects of various fiscal policies in the UK, using a Vector Autoregression approach. Our findings suggest that the output effects of fiscal policies are consistent with the Keynesian paradigm for both direct and indirect taxes but not for public spending. The estimated long term impact on GDP of increasing all type of expenditure and taxes analysed is negative and especially strong in the case of current expenditure. We also find significant distributional effects associated to fiscal policies, indicating that an increase in public spending and direct taxes reduces inequality while a raise in indirect taxes increases income inequality. Finally, the relationship between inequality and output is also explored.

Keywords

Fiscal policy, inequality, UK, VAR models
JEL Classification: C5, E6, H3

INTRODUCTION*

Fiscal policy has traditionally been considered an effective instrument to smooth cyclical behaviour and to ameliorate inequality through redistribution. Yet, we know relatively little about the macroeconomic effects of distinct fiscal policies. Moreover, since the non-Keynesian effects found by Giavazzi and Pagano (1990 and 1996) there is no consensus among economists as to the magnitude and even sign of these effects (Cappet, 2004; Perotti 2005).[1]

Little is also known about the distributional effects of overall government spending and taxation, with the notable exception of the redistributive effects of (direct) taxes and (monetary and in-kind) benefits, which do receive systematic attention, e.g. by the Office for National Statistics,[2] ever since the contributions by LeGrand (1982) and Goodin and LeGrand (1987), and have been underlined as one of the forces shaping the distribution of income over the Twentieth century (Atkinson, 1999).

In this paper we present new evidence on the long term effects of fiscal policy on GDP and inequality in the UK, the European country for which we have found the longest consistent time series on income inequality. Besides studying the effects of overall government spending and taxes, we also look at the effects of government spending components (i.e. current spending and public investment) and of the two types of tax: direct (on income) and indirect (on consumption). Thence, unlike previous studies, we are not only concerned about efficiency but also about equity, i.e. we study the effects of fiscal policy on the size and the distribution of the pie in the UK.

Recent contributions evaluate the macroeconomic effects of fiscal policy by means of vector autoregressive models (VAR), econometric techniques typically employed to assess the effects of monetary policy (Christiano et al., 1999 and 2005). However, most of these studies refer to the US and look at overall government spending and taxes (Perotti (2005) provides a survey of the literature). Moreover, none of the studies pays any attention to distributive issues. Yet, inclusion of income inequality is pertinent for at least two reasons. First, as stated in the opening sentence, fiscal policy is supposed to correct inequalities. Thus, the inclusion of income inequality in the empirical model allows us to investigate whether fiscal policy is indeed achieving such goal, or what fiscal policy instruments are contributing towards its achievement. Second, income inequality and economic growth determine each other. On the one hand, since the seminal contribution by Kuznets (1955) we have solid economic arguments to believe that growth shapes the distribution of income. On the other hand, a growing body of theoretical literature that originates in the early Nineties has suggested mechanisms through which income inequality may affect growth positively (see Benabou, 1996; Perotti, 1996). However, empirical studies typically ignore such endogeneity and investigate only one side of the relationship.[3] Our empirical strategy is based on VARs, which permits investigating the long term relationship between income inequality and growth, allowing for feedback effects (i.e. where both variables are endogenous).

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1 Conversely, estimates of the macroeconomic effects of monetary policy have received greater attention in the literature, surely due to the greater availability of high frequency statistical data, and in this case there exists agreement with respect to the resulting economic impact (Bernanke and Mihov, 1998).

2 The Office for National Statistics publishes an annual report on 'The effects of taxes and benefits on household income'. Such analysis was previously part of the economic report 'Economic Trends'.
See http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=10336 for more information.

3 See Acemoglu and Robinson (2002), Galor and Tsiddon (1996), Jha (1996) for studies on the Kuznets hypothesis, and Perotti (1996), Tanninen (1999), Castelló-Climent (2001) for studies on the influence of income distribution on economic growth.

Our findings suggest that output effects of fiscal policy are consistent with the Keynesian paradigm for taxes but not for public spending. That is, tax cuts increase output, but increasing public spending harms output. We also find significant distributional effects associated with fiscal policies, indicating that an increase in public spending and direct taxes reduces inequality while a raise in indirect taxes increases income inequality. In short, our findings reflect the standard efficiency-equity trade-off: the smaller the size of the government the larger the size of the pie, but the less equally distributed. The only fiscal policy that may break this trade-off is indirect taxation, since a cut in indirect tax reduces inequality without a cost in terms of output.

The paper is organized as follows. Section 2 describes the data, while methodological issues, such as the identification strategy and model specification are explained in Section 3. The estimated effects of government spending and taxes on output are presented in Section 4. This section also includes the disaggregated analysis of the long term effects of the two government spending and the two types of taxes. Distributional effects as well as the effects of inequality on growth are presented in Section 5. Several robustness checks are presented in Section 6, while Section 7 provides a summary of findings and some concluding remarks.

DATA

We use annual data for 1970-2005. The macroeconomic series are obtained from Eurostat (European Commission, 2007) and expressed in real terms (millions of 2000 euros).[4] In addition to output (Y) we consider two public spending categories covering about 89% of overall public expenditure (excluding interest payments) in the last decade, and two types of taxes covering about 91% of the total revenue. On the expenditure side, we consider current public expenditure, GC, (expenditure on goods and services and current transfers) and public investment, GFBC, which represent about 32.7 and 1.5% of GDP, respectively in the last decade; while on the revenue side we distinguish between direct tax revenue, TD, (from taxes on income and wealth, and payroll tax) and indirect tax revenues, TIND, (from taxes on output and imports) that amount to 23.5 and 13% of GDP, respectively.

High quality time-series on income inequality are not available for most EU or OECD countries, the IFS series we use being a notable exception. Usually long time series face many problems, as there are many methodological issues one should resolve before arriving at an inequality estimate: definition of recipient unit, income concept, coverage, type of dataset, etc.[5] Also, and importantly, the inequality index reported is often not satisfactory (i.e. does not satisfy certain standard properties).[6] All these difficulties might have precluded studies on the effects of fiscal policy from taking due account of such relevant variable (see Section 5).

4 The data is available at http://ec.europa.eu/economy_finance/publications /european_economy/2007/ statannex0107_en.pdf.

5 Time series on income inequality use various recipient units: households, individuals, income recipients or economically active persons; are based on different income definitions which may include different income sources, are measured before or after tax (and then, what taxes), before or after housing costs, take account of differing needs by using some equivalent scale (and then, what scale), etc. Coverage can be nationwide, limited to urban or rural areas, or to specific types of agents (e.g. employees, tax payers), and data may come from surveys or from administrative records, such as social security records or tax files.

6 It is not Lorenz-consistent or, at least, consistent with the Pigou-Dalton principle of transfers.

Our measure of income inequality (I) is the Gini coefficient, obtained from the IFS files (Brewer *et al*, 2007).[7] Since inequality indices entail different value judgements on income differences at the tails of the distribution (Lambert, 2001; Cowell, 1995 and 2000), which lead to different inequality orderings, we also employ another two inequality indices: the Mean Log Deviation (MLD) and the 10/90 percentile ratio—Section 6 briefly presents the results. The income measure used to estimate inequality is the household disposable equivalent income, which derives from the Family Expenditure Survey for the period 1970-1993 and from the Family Resources Survey for 1994-2005.[8]

Table 1 shows the evolution of relevant fiscal variables over the sample period. Current public expenditure represents the bulk of total expenditure and also tends to increase its relative weight, while public investment experiences a drastic reduction during the sample period. On the revenue side, the relative weight of both direct and indirect taxes is rather stable—see Clark and Dilnot (2002) for a complete description of the evolution of public spending and taxation in the UK.

Table 1. Fiscal data 1970-2005*

	1970	1980	1990	2000	2005	(1996-2005) average	Share
Public Expenditure	31.1	35.5	33.9	32.4	36.4	34.2	100
Current expenditure	26.4	32.9	31.6	31.1	34.5	32.7	95.6
Public Investment	4.7	2.6	2.3	1.3	1.9	1.5	4.4
Tax Revenue	36.9	36.0	36.0	37.5	37.3	36.5	100
Direct Taxes	22.7	23.1	24.1	24.2	24.6	23.5	64.4
Indirect Taxes	14.2	12.9	11.9	13.3	12.7	13.0	35.6

* Figures expressed as percentage of GDP; source is Eurostat.

Income inequality increased substantially over the sample period, mostly due to the dramatic increase experienced in the Eighties—between 1977 and 1990 the Gini coefficient increased by 10 percentage points. Atkinson (1999) attributes such steep rise to the increase in earnings dispersion, the decline in the number of families with incomes from work—resulting from the rise in unemployment,

7 The data is available at www.ifs.org.uk/bns/bn19figs.zip. The coverage of our income inequality series is not uniform over the whole period. Up to 2001 inequality applies only to Great Britain, while after that year inequality is measured for the whole UK. However, as the table below shows, the few income inequality estimates available for Northern Ireland suggest that inequality does not differ much between Britain and Northern Ireland. Moreover, population in Northern Ireland accounts for a very small proportion of the UK population—less than 3 per cent.

Income Inequality in Great Britain and Northern Ireland

	1985	1998/99	1999/00	2000/01
Great Britain	0.30	0.39	0.38	0.39
Northern Ireland	0.32	0.38	0.36	0.39

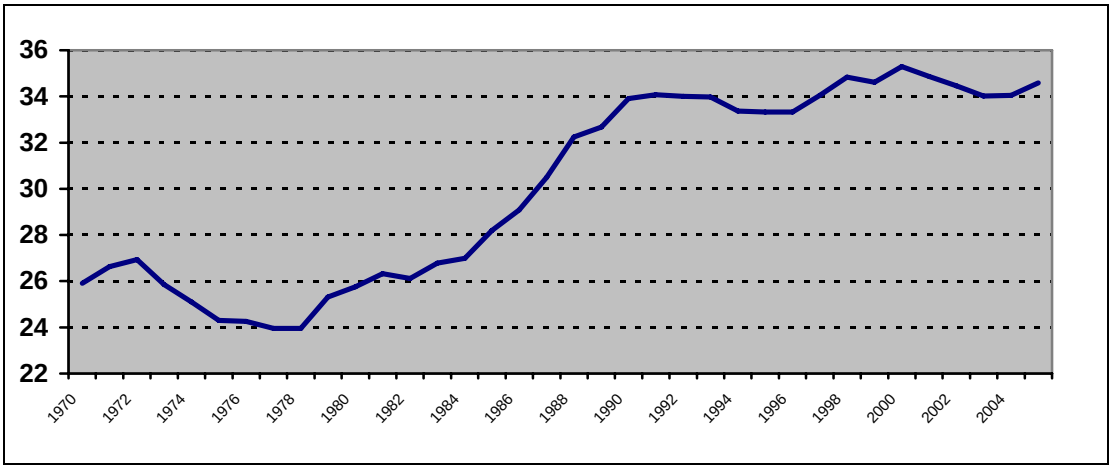
Income inequality measured after housing costs.

Source: Data for GB come from the IFS files. 1985 data for NI comes from Borooah and Mc Gregor (1990), while the other three years come from Hillyard et al. (2003)

8 Household income is rescaled or equivalised to take due account of the different needs of household with different size and composition. The scale factor employed is the 'modified OECD equivalent scale', which assigns weights of 1, 0.5 and 0.3 to the first, remaining adults and children of the household, respectively. Disposable income is measured *after* income tax, employee and self-employed National Insurance contributions, and council tax, and *before* housing costs—taking housing costs into account does not have any bearing on the estimates, see Section 6.

ageing of the population and decline in labour force participation—and to the reduced redistributional contribution of the government budget in the second half of the Eighties. Since the early 1990s, the changes in income inequality have been smoother, showing a timid increase over the second half of the Nineties, and a soft decrease since 2000 (see Figure 1).

Figure 1. Income inequality, 1970-2005*



* Gini coefficient expressed in percentage; source: IFS files

METHODOLOGICAL ISSUES

VAR models are particularly appropriate to estimate the medium and long term impact of public policy for at least three reasons. First, they take due account of the dynamic feedback between variables as well as their effect on other variables both in the short and long term. This is of primary importance when the delay between the policy change (e.g. raising taxes or cutting public investment) and its implementation and posterior impact is not negligible, as it usually occurs with fiscal policy. Moreover, the short and long term effects may differ in magnitude and sign. Second, VAR models are especially suitable when the variables of interest are endogenous, as it is the case at hand, where output, public expenditure, tax revenue and inequality are interrelated. Finally, VAR models are not too demanding on the data, which has surely contributed to the recent proliferation of empirical research on the macroeconomic effects of fiscal policy (Capet (2004), Kamps (2005), Marcellino (2006) and Perotti (2004, 2005)).

Previous studies have considered public expenditure and tax revenue as a whole. Yet, the distinct components of these two aggregates are likely to have different effects on output and inequality. For instance, public current spending might have large short term effects while public investment may have larger bearing in the longer run. Also, direct and indirect taxes are to influence inequality differently, since they differ in terms of tax level and progressivity, which are the two elements that determine the redistributive effect (Lambert, 2001). Unlike most previous studies, we employ data on the main two components of public spending and tax revenue, and thus are able to disentangle the effect of such components, which may operate in opposite directions. The inclusion of an inequality measure in the VAR specification allows the joint analysis of macroeconomic and distributive effects of fiscal policy, which constitutes a novel feature of our study.

In terms of the empirical implementation, we start by determining the order of integration of the variables. The unit root results are based on the ADF test, selecting the optimal number of lags according to the BIC test and including deterministic components when statistically significant. Test results suggest that all of the series are non-stationary in log-levels and stationary in first differences of log-levels. We, therefore, proceed to estimate a VAR model in first differences of log-levels.

Our VAR specification results from a compromise between parsimony and avoiding omitted variable bias. On the one hand, we would like to include all relevant variables in a large unconstrained VAR, and report the implied system of dynamic response functions. The drawback of such strategy is that it requires estimating a large number of parameters simultaneously. On the other hand, a specification with too few variables suffers from omitted variable bias. In the light of these considerations, we choose an intermediate strategy and consider four different models. The benchmark specification is the most parsimonious one and includes GDP (Y), overall government purchases (G=GC+GFBC), overall tax revenues (T=TD+TIND), and the Gini coefficient (I). The second model disaggregates revenue into direct and indirect taxes (G, Y, I, TD, TIND), the third model disaggregates public expenditure into current expenditure and public investment (GC, GFBC, Y, I, T), and finally the last model includes both fiscal variables disaggregated (GC, GFBC, Y, I, TD, TIND).

For the selection of the specifications of the VAR models, we use the AIC, BIC and maximum likelihood ratio tests. The VAR specification has several dimensions: the order of the VAR specification, the specification of the deterministic components, and the consideration of possible structural breaks. Test results suggest a first order VAR model with a linear constant and no trend for the four specifications we consider. Furthermore, we find no evidence of structural breaks during the period analyzed.[9] We also perform specification tests to check whether model residuals suffer from first-order autocorrelation, heteroscedasticity or non-normality. Test results, presented in Table 2, indicate that our models do not seem to have specification problems: at the 5% significance level there are no signs of residual autocorrelation, heteroscedasticity and non-normality.

Table 2. Specification tests (*p*-values) [a]

	Model 1	Model 2	Model 3	Model 4
Autocorrelation [b]	0.153	0.173	0.134	0.161
Heteroscedasticity [c]	0.304	0.587	0.863	0.722
Normality [c]	0.245	0.075	0.594	0.239

[a] Specification tests are based on the residuals from the estimation of unrestricted VAR(1)
[b] Multivariate Box-Pierce/Ljung-Box Q-statistics for residual serial correlation (Lütkepohl, 1991). Under the null of no serial correlation up to lag h=1, the test statistics is approximately distributed χ^2 with $[k^2(h-p)]$ degrees of freedom, where p is the VAR order and k the number of parameters to estimate.
[c] Multivariate extension of White's (1980) heteroscedasticity test (Doornik, 1996). Under the null of homoscedastic residuals the test statistic is asymptotically distributed χ^2 with $[10(8p+2)]$ degrees of freedom.
[d] Jarque-Bera normality test (Lütkepohl, 1991). Under the null of normally distributed residuals the test statistic is asymptotically distributed χ^2 with 2 degrees of freedom.

Our estimates of the effects of fiscal polices are based on the impulse response functions, which result from the VAR estimates. We consider the effects on the growth rate of output and income inequality of a one-off one percentage point shock in the growth rate of the fiscal policy variable. The impulse response functions converge rapidly—within the first five years—, and therefore the long-term effect of fiscal policy on output and income inequality growth is zero. In levels, however, such shocks bring about permanent effects on both output and inequality, since they cause permanent changes in the levels of the fiscal variables.

In order to accommodate the contemporaneous correlations among shocks in the different variables we follow the standard procedure in the literature and consider the Cholesky decomposition of the variance-covariance matrix of the estimated residuals [see, for example, Kamps (2005), Fatas and Mihov (2001), and Favero (2002)]. In order to determine the variable ordering used to identify our central case results, we turn to economic rationale and to previous evidence. However, as the ordering of the variables may affect the results, we also report the range of results for all alternative orderings.

9 Introducing a structural break in 1980, as suggested in Perotti (2005), does not alter our main findings.

In particular, for our benchmark model we assume that: (i) public spending does not react contemporaneously to shocks to the other variables in the system; (ii) output is affected contemporaneously by shocks to public spending, but does not react contemporaneously to shocks to inequality or taxation; (iii) inequality is affected contemporaneously by shocks to both public spending and output, but does not react contemporaneously to shocks to taxation, and finally (iv) tax revenue is affected contemporaneously by shocks to all other variables in the system.

This set of assumptions on the contemporaneous relationship between the variables presumes that demand effects dominate, which justifies the contemporary effect of public spending on output. However the reverse is not plausible since, unlike tax revenue, government spending—and especially public investment—is largely unrelated to the business cycle. Because of the large decision and implementation lags caused by the budgetary process, decisions on public spending are undertaken before the public sector obtains information about the actual performance of the economy.

Changes in public spending may have an immediate impact on individuals' income, and thence on the distribution of income, even more so if such changes concern cash benefits. Arguably income inequality changes may also have contemporaneous effects on public spending, if only because of means-tested benefits. However, income conditioned programmes (or social expenditure) account only for a rather limited portion of overall spending[10].

As suggested above, we also presume a contemporaneous impact of output on tax revenue, which operates through the tax base: in the very short term, changes in tax revenue are due exclusively to changes in the tax base—i.e. output. However, the opposite effect (of revenue on output) occurs only in the longer term: changes in tax revenues do not have contemporaneous effects on output because the former come only through changes in tax rates, and the political process implies substantial delays between consideration and implementation.

Output changes are not usually distributionally neutral, thus affecting income inequality. On the other hand, output is most likely to respond to changes in inequality only in the longer term, since the (relevant) transmission mechanisms identified in the literature—e.g human capital accumulation with imperfect financial markets, endogenous fiscal policy or the joint education-fertility decision—need their time to operate (Benabou, 1996; Perotti, 1996).[11]

As argued above, in the very short term changes in the tax base are the only likely source of changing tax revenue, and the tax base is only likely to change as a result of output or distributional changes. Thus, it seems plausible to assume that tax revenue reacts contemporaneously to inequality and output shocks.

The ordering that results from these assumptions, for the central case of the benchmark specification is: public spending, output, inequality and tax revenue. It is worth noting that alternative orderings do not have a major bearing on our results, as range of results reported in parentheses show—see Table 3.

As to the ordering of the variables in the disaggregated models 2 to 4, we force the two components of public spending (GC, GFBC) as well as the two types of taxes (TD, TIND) to enter the specification one after the other (i.e. allowing no other variable in between the two). Further to the assumptions made for the benchmark model, we identify the central case of the disaggregated models by means of the following assumptions. On the revenue side, we assume that direct tax revenue does affect contemporaneously indirect tax revenue, but does not react contemporaneously to shocks to the latter. Shocks to direct tax alters disposable income, which in turn may lead to consumption changes, and

10 In 2005, income related benefits amounted to 10.7% of total government expenditure, according to the information provided by the Department for Work and Pensions and the Pre Budget Report.

11 Since our analysis refers to a democratic country, the channel based on the relationship between income distribution and socio-political instability is not considered relevant.

thus to changes in the revenue from indirect taxation. Hence, the ordering of the tax variables in the central case of models 2 and 4 is (TD, TIND). On the expenditure side, we assume that current spending precedes public investment. This assumption reflects the standard view that budgetary decisions on public investment are conditioned by decisions on current spending, while the reverse is not true. As a result, the ordering of the expenditure variables in the central case of models 3 and 4 is (GC, GFBC). Models 2 (G, Y, I, TD, TIND) and 3 (GC, GFBC, Y, I, T) include five variables and allow for (4! x 2 =) 48 possible orderings,[12] which yield the range of results reported in Table 3. For the central case results of the most disaggregated model 4 the order of the variables is (GC, GFBC, Y, I, TD, TIND), and the range of results is obtained from (4! x 2 x 2 =) 96 alternative ordinations.

OUTPUT EFFECTS OF FISCAL POLICY

This section presents estimated output elasticities derived from the accumulated impulse response functions that obtains from the Choleski decomposition. These elasticities measure the long-term accumulated effect on output of a one percentage point initial shock on the fiscal variable under consideration. To assess the comparative effects of different fiscal shocks we also report marginal products.

The elasticities reported in Table 3 suggest that expansionary fiscal policy has a negative long-term effect on output. Note also that estimated elasticities are very robust across orthogonalization strategies. Our estimates are consistent with previous UK evidence given in Perotti (2005). Tax elasticities are also in line with previous evidence for the largest Euro area countries (Marcellino, 2006) and the US (Blanchard and Perotti, 2002). However, our negative public spending elasticity estimates for the UK are in contrast with the positive elasticities reported in these two studies for Germany, France, Italy, Spain and the US.

Table 3. GDP long term elasticities. Central case and (range of results)

	Model 1	Model 2	Model 3	Model 4
Public Spending	-0.613	-0.627		
	(-0.434 / -0.686)	(-0.425 / -0.815)		
Current spending			-0.559	-0.560
			(-0.100 / -0.630)	(-0.098 / -0.707)
Public investment			-0.014	-0.015
			(-0.014 / -0.078)	(-0.015 / -0.075)
Overall Tax Revenue	-0.242		-0.230	
	(-0.220 / -0.329)		(-0.210 / -0.343)	
Direct Tax Revenue		-0.182		-0.170
		(-0.115 / -0.218)		(-0.144 / -0.196)
Indirect Tax Revenue		-0.091		-0.078
		(0.002 / -0.258)		(-0.016 / -0.241)

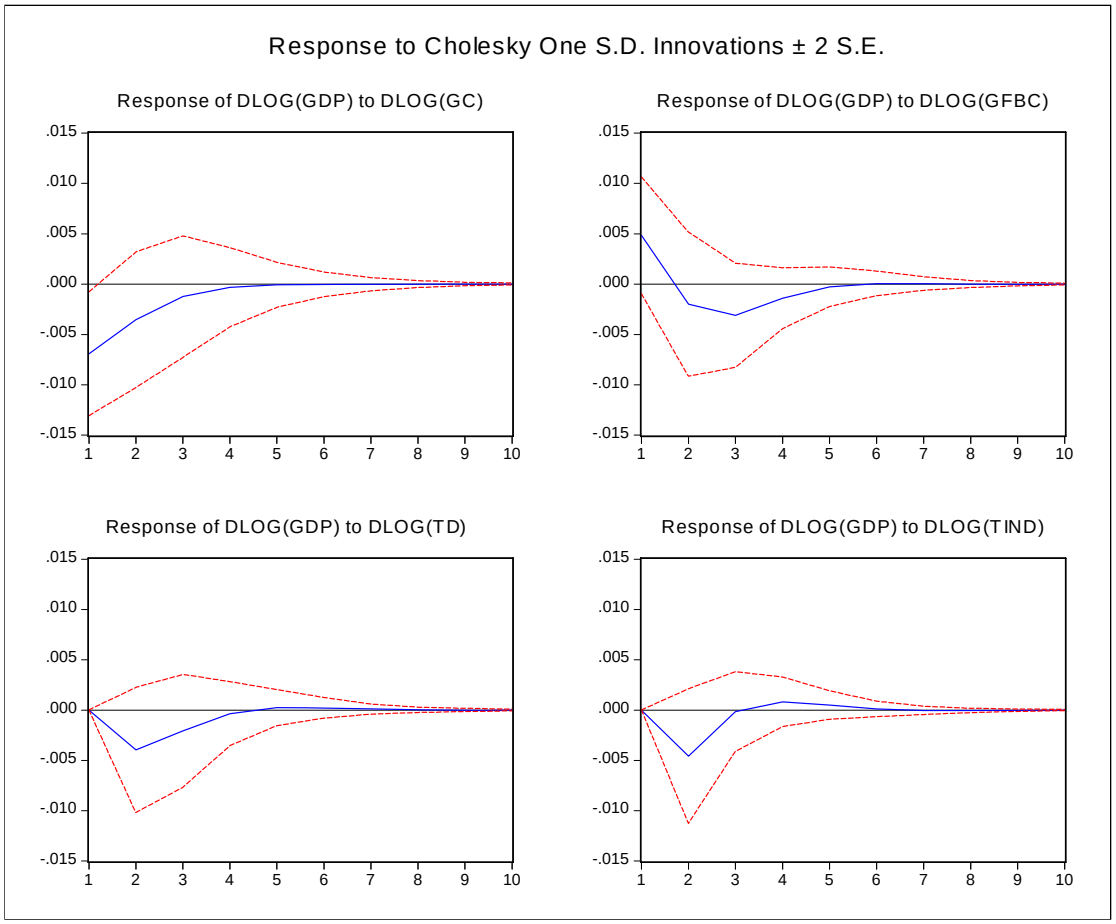
The disaggregated analysis by components reveals the differential response of output to shocks to the different expenditure components and types of taxes. On the expenditure side, the public investment elasticity of output is much smaller than the current public spending elasticity, as shown in Table 3 and the response functions of Figure 2. The negative impact of public capital on GDP is consistent with the estimates of Perotti (2004) for the UK, while it contrasts with the positive (but also small) elasticity estimates found by Kamps (2005), also for the UK. On the revenue side, shocks to direct taxes obtain a much larger response of output, relative to shocks to indirect taxes, whose effects on output are not very robust across orthogonalization strategies. Accordingly, shocks to indirect taxation seem to involve no clear effects on economic activity, while shocks to direct taxation are

12 The number of alternative orderings is not (5!=) 120 because no variable can be placed between TD and TIND for model 2, or between GC and GFBC for model 3.

clearly contractionary in the long term. However, results should be taken with caution since impulse responses are not very precisely estimated, as the 5% standard errors bands in Figure 2 show.

Overall, our findings suggest that output effects of fiscal policies are consistent with the Keynesian paradigm for both direct and indirect taxes but not for public spending, be it current public spending or public investment.

Figure 2. GDP responses to shocks on current expenditure, public investment, direct taxes and indirect taxes



MARGINAL PRODUCTS

Table 4 presents marginal products, calculated in the conventional manner from the elasticities and the ratios of the fiscal variables to GDP. We use average ratios for the last ten years of the sample period, which allows us to interpret the marginal products as the accumulated long-term effects of policies implemented at the end of the sample period, and avoids contamination by business cycle effects. The marginal products are calculated considering the accumulated response of output to an initial shock in the fiscal variables as in Blanchard and Perotti (2002) and Mountford and Uhlin (2005).

Marginal products clearly illustrate the significant non Keynesian effects resulting from an increase in public expenditure: a shock in expenditure of one euro reduces output in the long term by nearly two euros. By spending components, current spending achieves an impact which is twice as large as that of public investment. On the other hand, Keynesian effects dominate in the case of an increase in taxation, indicating that output decreases significantly as a result of increases in tax revenue. In this case, both types of taxes show similar marginal products.

Marginal products allow us to identify the impact of budget-neutral fiscal policies, i.e., simultaneous increases in expenditure and tax revenue. The effect on output of such policies is always negative irrespective of the type of policy implemented, but especially so when current expenditure is used.

Thus, the results presented in this section provide new empirical evidence for the UK that suggest negative impacts of increasing the size of the public budget, irrespective of the expenditure component or type of tax used to achieve such budget increase.

Table 4. GDP Marginal Products. Central case and (range of results)

	Model 1	Model 2	Model 3	Model 4
Public Spending	-1.77	-1.81		
Current spending			-1.69	-1.69
Public investment			-0.88	-0.94
Overall Tax Revenue	-0.65		-0.62	
Direct Tax Revenue		-0.76		-0.71
Indirect Tax Revenue		-0.68		-0.59

WEIGHTED MARGINAL PRODUCTS

Marginal products of the spending and revenue components presented in Table 4 do not take due account of the relative importance of each component within overall spending or tax revenue. Table 5 reports the impact (in euro) on output of a one euro shock to fiscal revenue or spending, distributed according to the relative shares of spending and revenue components.[13] The weighted marginal product of current spending accounts for nearly the entire impact of a one euro shock to overall public spending on output. Such a large contribution of current spending results from its larger weight on overall spending as well as its much larger (unweighted) impact. As regards tax revenue, the weighted impact of direct tax revenue accounts for most (two thirds) of the impact of a one euro shock to overall tax revenue on output. Now the larger share of direct taxes revenue is mostly responsible for the larger weighted effect of this type of tax.

Finally, notice that estimated impacts are consistent, since weighted marginal products of overall public spending and overall tax revenue (in bold) do not differ much across models, i.e. effects on aggregate variables do not change when computed using their components.

Table 5. Weighted GDP Marginal Products

	Model 1	Model 2	Model 3	Model 4
Public Spending	**-1.77**	**-1.81**	***-1.65***	***-1.66***
Current spending			-1.61	-1.62
Public investment			-0.04	-0.04
Overall Tax Revenue	**-0.65**	***-0.73***	**-0.62**	***-0.67***
Direct Tax Revenue		-0.49		-0.46
Indirect Tax Revenue		-0.24		-0.21

DISTRIBUTIONAL EFFECTS OF FISCAL POLICY

As pointed out in the Introduction, our analysis goes beyond mean output effects and also looks at distributive effects, which is one of our contributions. The inclusion of income inequality in our VAR models, allows us to estimate the long term distributional effects of fiscal policy—together with the output effects. As Table 6 shows, public expenditure has a sizeable negative effect on income

13 We use average relative shares over the last ten years of the sample period, reported in Table 1.

inequality, i.e. it reduces inequality. While the effect of the two public spending components goes in the same (negative) direction, it is worth noting that the effect of current spending is much larger than that of investment—elasticities being nearly twice as large for current spending.[14]

Table 6. Inequality Elasticities.
Central case and (range of results)

	Model 1	Model 2	Model 3	Model 4
Public Spending	-1.193	-1.189		
	(-0.722 / -1.193)	(-0.606 / -1.189)		
Current spending			-1.346	-1.307
			(-0.807 / -1.346)	(-0.675 / -1.332)
Public investment			-0.070	-0.070
			(-0.037 / -0.139)	(-0.019/ -0.129)
Overall Tax Revenue	0.187		0.112	
	(0.243 / 0.147)		(0.204 / 0.042)	
Direct Tax Revenue		-0.144		-0.219
		(-0.130 / -0.243)		(-0.218 / -0.284)
Indirect Tax Revenue		0.268		0.249
		(0.500 / 0.243)		(0.501 / 0.226)

The inequality effect of taxes is much smaller and positive—i.e. the elasticity of inequality with respect to tax revenue is positive. As expected, though, direct and indirect taxation yield opposite effects on inequality—see Figure 3. The negative effect of direct taxation is due to its progressive structure. With a progressive tax, increases in direct tax revenue—be it through increases in the tax base, in the overall average tax rate, or in the progression of the tax structure—yield larger redistributive effect, and thus, lower inequality (Lambert, 2001). However, the negative effect of direct tax revenues is offset by the positive effect of indirect tax revenues. This effect however cannot be attributed to the direct impact of a regressive tax on income since VAT, the largest component of indirect tax revenue, does not directly alter disposable income—which is the income definition we use to measure inequality (see Section 2).[15] The positive long term elasticity is consistent with a situation where the elasticity of savings with respect to indirect taxation is larger for poorer than for richer individuals.[16] In a world where individuals either consume or save, when as a result of a tax increase consumption becomes more expensive relative to savings, people tend to save more, as long as both options are normal goods. Now, assuming that the elasticity of savings with respect to indirect taxation is larger for poorer than for richer individuals, a positive shock to indirect taxation implies a larger savings increase for the rich relative to the poor, which in turn and in the longer term results in a larger income inequality—that is, provided there is a positive relationship between current savings and future income.

Note that while indirect tax revenue is much smaller than direct tax revenue (see Table 1), indirect taxation has a larger effect on inequality. This may be explained by the degree of regressivity of

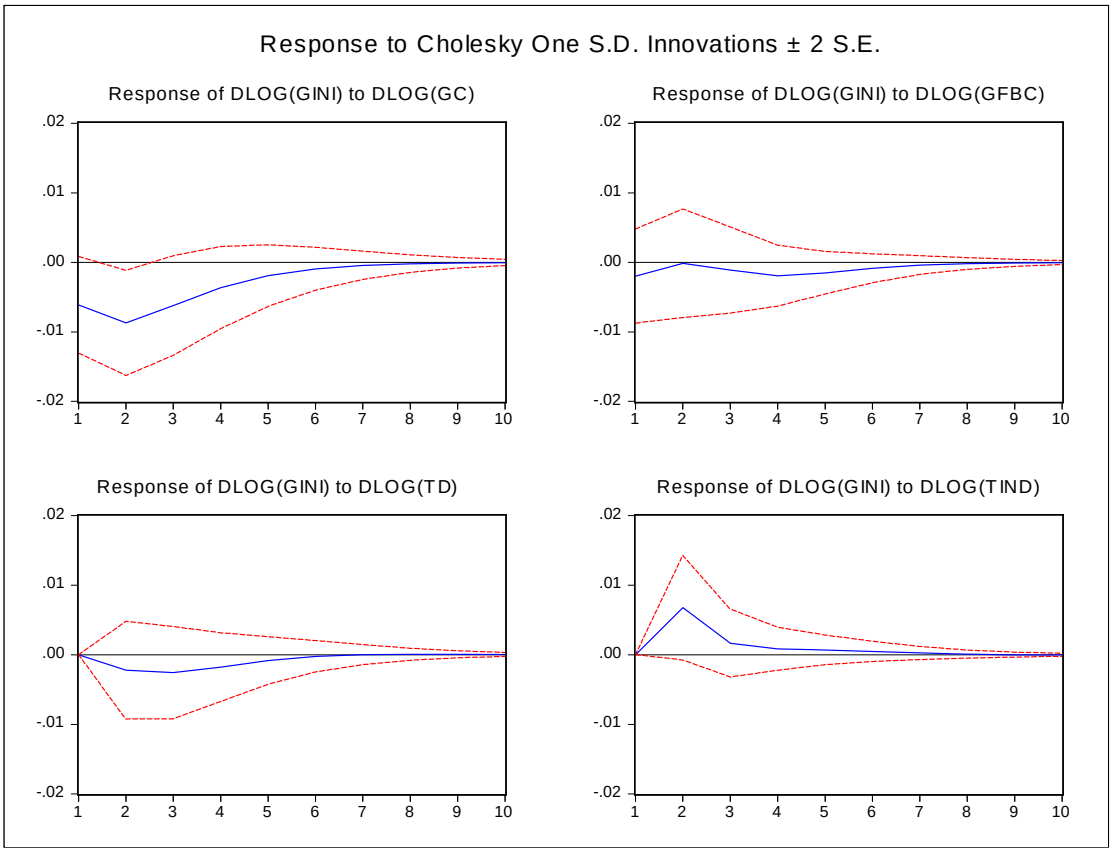
14 Calderon and Serven (2004) and Calderon and Chong (2004) also provide evidence on the negative impact of public investment on inequality for an extended group of countries.

15 Our finding of an overall negative effect of the tax system on inequality contradicts at face value the findings systematically reported by analyses of the impact of the tax benefit system on household disposable income performed annually by the Office for National Statistical. The differences, however, are surely due to the different definition of income —we employ income net of direct taxes, while other studies base their conclusions on an income definition which is net of direct and indirect taxes—, and the time span over which effects are considered —while our concern is on long run effects, other studies analyse only very short term (one year) effects.

16 To the best of our knowledge there is no direct empirical evidence on these elasticities. However, our conjecture is that poorer people's savings are more sensitive to indirect tax increases since they spend a larger share of their budget in basic consumption, whose demand is rather inelastic. Thus, increases in the final price of such goods do not modify consumption but (reduce) savings.

indirect taxes relative to the mild progressivity of direct taxes, which results from rather proportional social security contributions and more progressive income tax.

Figure 3 – Inequality responses to shocks on current expenditure, public investment, direct and indirect taxes



In sum, our findings are consistent with previous evidence, which focuses on the effects of public spending or of taxes and benefits on household incomes (Wolff and Zacharias, 2007; Office for National Statistics, 2007). Notwithstanding this, one should bear in mind that these studies differ not only in important methodological aspects, such as the income definition or the unit of analysis, but also in their scope—covering only some taxes and cash and in-kind benefits. Finally, note that estimated elasticities are robust to the orthogonalisation strategy.

The inclusion of income inequality in our VAR models also allows us to investigate the relationship between income inequality and output. Over the last two decades, a number of influential studies have argued rather convincingly about the importance of considering the impact that raising inequality may have on output, suggesting that inequality may have detrimental effects on output due to, for instance, financial markets imperfections hindering human capital accumulation or more redistributive policies that result from inequality increases. Our estimates provide empirical support to such hypotheses, since the output elasticity with respect to inequality is negative.[17] That is, increasing income inequality hinders economic growth in the long run. However, the reverse effect (of output on

17 The estimated elasticity is -0.135 in the most disaggregated model, and appears very robust to different specifications and orthogonalisation strategies.

inequality) is positive. That is, output shocks have detrimental effects on income inequality.[18] The two effects taken together thus imply that a positive shock on output might be offset by the negative effects of the higher income inequality resulting from the initial shock.

SENSITIVITY ANALYSES

This section reports the results from three sensitivity analyses performed to check the robustness of our main results. First, we exclude inequality from the analysis. Second, we employ different inequality indices, and third, we change the definitions of the income variable over which inequality is measured to adjust for housing costs. Recall that in addition to these three robustness checks, in previous sections we have also checked that our main results are robust to changes in the ordering of the variables in the VAR models, and to introducing a structural break in 1980, as it is done in related literature.

SENSITIVITY TO EXCLUDING INEQUALITY IN THE CENTRAL CASE

Previous studies do not take into account inequality when computing the long term effect of fiscal policy on output. As argued above, since long term elasticities incorporate feedback effects, inequality may magnify or mitigate some of the effects of other variables that accumulate into the estimated overall long term impact on output. Thus, we would expect estimated long term impacts on output to differ, depending on the inclusion in or exclusion of inequality from the analysis. However, it is difficult to predict ex-ante the direction of change. Notwithstanding that, Table 7 shows that long term elasticities are rather insensitive to the inclusion of inequality.

Table 7. GDP long term elasticities, without (above) and *with* (below) the inequality variable

	Model 1	Model 2	Model 3	Model 4
Public Spending	-0.672	-0.680		
	-0.613	*-0.627*		
Current spending			-0.607	-0.606
			-0.559	*-0.560*
Public investment			-0.015	-0.015
			-0.014	*-0.015*
Overall Tax Revenue	-0.232		-0.221	
	-0.242		*-0.230*	
Direct Tax Revenue		-0.187		-0.176
		-0.182		*-0.170*
Indirect Tax Revenue		-0.070		-0.066
		-0.091		*-0.078*

SENSITIVITY TO USING OTHER INCOME INEQUALITY INDICES RATHER THAN THE GINI COEFFICIENT

Throughout the paper we use the Gini coefficient to measure income inequality. Since inequality indices entail different value judgements on income differences at the tails of the distribution (Lambert, 2001; Cowell, 1995 and 2000), which in turn may lead to different inequality orderings,

18 The estimated elasticity is 0.062 in the most disaggregated model, and appears very robust to different specifications and orthogonalisation strategies.

next we check if estimated long term effects on output are robust to different inequality indices: the Mean Log Deviation (MLD) and the 10/90 percentile ratio—which do not satisfy the most basic properties that good measures are supposed to fulfil (Amiel and Cowell, 1992), but are often used in macro empirical research.

As the estimated long term elasticities reported in Table 8 show, output effects are robust to different inequality measures. Estimates using different inequality indices have the same sign and very similar size.

Table 8. Robustness of GDP long term elasticities, to different inequality indices (Gini, MLD, 90/10 ratio)

	Model 1	Model 2	Model 3	Model 4
Public Spending				
Gini coefficient	-0.613	-0.627		
MLD	-0.644	-0.654		
90/10 Ratio	-0.625	-0.635		
Current spending				
Gini coefficient			-0.559	-0.560
MLD			-0.587	-0.586
90/10 Ratio			-0.573	-0.574
Public investment				
Gini coefficient			-0.014	-0.015
MLD			-0.015	-0.015
90/10 Ratio			-0.016	-0.017
Overall Tax Revenue				
Gini coefficient	-0.242		-0.230	
MLD	-0.252		-0.228	
90/10 Ratio	-0.271		-0.236	
Direct Tax Revenue				
Gini coefficient		-0.182		-0.170
MLD		-0.189		-0.175
90/10 Ratio		-0.192		-0.173
Indirect Tax Revenue				
Gini coefficient		-0.091		-0.078
MLD		-0.087		-0.074
90/10 Ratio		-0.099		-0.079

SENSITIVITY TO INCOME INEQUALITY WHEN INCOME IS MEASURED AFTER HOUSING COSTS

Since the share of the family budget that goes to pay for housing related expenditures (rent, bills, etc) is substantial and not the same across the income distribution, studies typically report main results before and after housing costs have been deducted (Brewer et al. (2007), and references cited therein). We have also used income definitions with and without housing costs and have found robust output and inequality effects, as Tables 9.1 and 9.2 show. All estimated elasticities have the same sign and very similar size—but for two tax elasticities of inequality, which show the same sign but different size.

Table 9.1 Robustness of GDP long term elasticities to different definitions of income. Income inequality After Housing Costs (above) and *Before Housing Costs* (below)

	Model 1	Model 2	Model 3	Model 4
Public Spending	-0.644	-0.655		
	-0.613	*-0.627*		
Current spending			-0.586	-0.583
			-0.559	*-0.560*
Public investment			-0.015	-0.016
			-0.014	*-0.015*
Overall Tax Revenue	-0.239		-0.221	
	-0.242		*-0.230*	
Direct Tax Revenue		-0.181		-0.169
		-0.182		*-0.170*
Indirect Tax Revenue		-0.080		-0.070
		-0.091		*-0.078*

Table 9.2 Robustness of Inequality long term elasticities to different definitions of income. Income inequality After Housing Costs (above) and *Before Housing Costs* (below)

	Model 1	Model 2	Model 3	Model 4
Public Spending	-1.002	-0.962		
	-1.193	*-1.189*		
Current spending			-1.309	-1.224
			-1.346	*-1.307*
Public investment			-0.030	-0.030
			-0.070	*-0.070*
Overall Tax Revenue	0.164		0.024	
	0.187		*0.112*	
Direct Tax Revenue		-0.192		-0.312
		-0.144		*-0.219*
Indirect Tax Revenue		0.276		0.240
		0.268		*0.249*

CONCLUSIONS

Distributional aspects of economic policies have been traditionally assessed through their impact on economic growth. However, it is widely accepted by now that economic growth alone does not shape the income distribution, and that qualitative aspects of economic growth are probably more important than economic growth per se. Similarly, when it comes to fiscal policy, composition—as well as size—matters for economic growth and income inequality. That is, the composition of public expenditure between, say, public investment and current consumption, as well as the mix of direct and indirect taxes used to raise revenue are central to determining the impact of public policy on growth and income distribution.

Notwithstanding this, most macroeconomic studies of fiscal (and monetary) policy constantly overlook the distributional effects, and do not offer a disaggregated analysis of expenditure and revenue. In contrast to previous work, this paper provides a joint analysis of the output and

distributional long term effects of fiscal policy in the UK. Moreover, our study explicitly looks at the differential incidence of the various components of fiscal policy, both from the expenditure and the revenue side. Our empirical strategy is based on VAR models, which permit investigating the long term effects allowing for feedback effects.

Our findings suggest that output effects of fiscal policy are consistent with the Keynesian paradigm for taxes but not for public spending. That is, tax cuts increase output, but increasing public spending harms output. We also find significant distributional effects associated to fiscal policies, indicating that an increase in public spending and direct taxes reduces inequality while an increase in indirect taxes increases income inequality. In short, our findings reflect the standard efficiency-equity trade-off: the smaller the size of the government the larger the size of the pie, but the less equally distributed. The only fiscal policy that may break this trade-off is indirect taxation, since a cut in indirect tax reduces inequality without harming output. Our findings on output effects are, broadly speaking, consistent with previous empirical evidence (Perotti, 2005; Kamps, 2005), while, to the best of our knowledge, the estimated effects on inequality are new.

Sensitivity analyses indicate that our macroeconomic results are robust to the inclusion of income inequality, while both output and inequality effects appear robust to different identifying assumptions on the contemporaneous effects between variables, and to changes in the inequality measure and the definition of income.

From a policy perspective our results have clear implications. According to our estimates, increasing the size of the public sector (i.e. a larger budget) improves the distribution of income at the expense of economic growth. This said, increasing public investment would be less detrimental for growth than increasing current consumption. On the revenue side, indirect taxation is best for growth but worse for inequality.

Despite and maybe because of the practical relevance of our results it is prudent to conclude with several cautionary notes. First, in this paper we consider only the effects of non-systematic fiscal policies, i.e. policy shocks. The effects of systematic policies could be rather different. Second, we are considering exclusively the effects on output and inequality. It would be important to consider also the effects on other macroeconomic indicators, such as inflation or interest rates. Third, we are implicitly assuming that fiscal policy shocks do not have effects before they are implemented. Finally, we also suppose that non-linear effects of fiscal policies are not relevant. However, this would be problematic in the context of credibility or solvency issues.

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