THE EFFECTS OF PRODUCTIVITY, INVESTMENT, AND TAXES ON LOW WAGE EARNERS ON INCOME DISTRIBUTION INEQUALITY

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ABSTRACT
This paper deals with effect of total investment, taxes on low wage earners, and GDP on income distribution inequality. The sample consists of five countries, Greece, Portugal, Ireland, Germany, and the UK, and ranges from 1997 to 2008. Panel analysis and granger causality effects are used in order to reach our findings. Results show that growth of GDP and total investment result in an increase of income distribution inequality, with Germany and the UK suffering more from this effect.
Keywords: income inequality, panel analysis, granger causality
JEL codes: E01, E22, D31, D63
Index of acronyms:
FDI: Foreign Direct Investment
IID: Income Inequality Distribution
GLS: Generalized Least Squares
SUR: Seemingly Unrelated Regressions

1. Introduction

The equilibrium of income distribution among different levels of income receivers is a rather vague phenomenon, which is expected to deteriorate in economies where their citizens are *credible taxpayers with high levels of social responsibility*. Of course, experience has taught us otherwise, since economically advanced countries such as France and the USA have shown an increased tendency to disproportionately distribute income. One can say that this is the price for liberalism in the markets, since monopolies and cartels tend to rule every single economic decision, from retail shops to heavy industry.

There is a rather popular measure for income inequality distribution, the Gini coefficient. For highly industrialized countries, such as France and the USA as prementioned, there is a high Gini effect, unlike countries like Bulgaria or even India. The Gini coefficient is a measure of the inequality of a distribution, a value of 0 expressing total equality and a value of 1 maximal inequality. Therefore it can range from 0 to 1; it is sometimes multiplied by 100 to range between 0 and 100. The importance and usefuleness of the Gini effect has been tested and the outcome was some prons and cons. A major advantage is that it satisfies four important principles in its measuring, namely, anonymity, independence of population, independence of scale, and the transfer principle[1].

The effects of income distribution inequality and its relationship with macroeconomic conditions have long attracted the attention of economists. The general methodology used in regressing income shares on aggregate macroeconomic performance indicators, such as the unemployment rate and inflation, assumes that income inequality is countercyclical in behavior, i.e., increases in unemployment worsen the relative position of low-income groups. Other researches involve the effect of the European's integration economic dimension on income inequality (Beckfield, 2006), and they suggest that due to the fact that the most deeply integrated economies have developed institutions that insulate labor from the pressures of international competition, the positive effect of economic integration on

[1] For more information see Ray, Debraj (1998) *Development Economics*, Princeton University Press, p. 188.

income inequality may be attenuated at high levels of integration.

Another factor affecting income inequality is the variation of income tax, that is, whether it is progressive or proportionate, whether it takes into account qualitative variables such as marital or employment status, and so on. Even if a tax-treatment is used to reduce income inequality, sometimes differences in tax treatment may operate against an overall inequality-reducing goal. For example, when people enjoying the tax concessions may be richer than those that do not. Or, to the contrary, when there is a richer class that is taxed more highly than the other, there is an overall inequality due to the change of people's positions in the tax-level framework.

The purpose of this paper is to investigate the hypothesis that income distribution inequality is seriously affected by tax rate on low wage earners, by the level of total productivity measured as GDP per capita, and by the level of total investment. More specifically, it is a test for the myth of *high total productivity-high income per capita*, which is established for decades in highly advanced economies. The data set focuses on the European economy and, therefore, includes representative countries from all of the levels of economic advancement, namely, Greece, Portugal, Ireland, Germany, and the UK. The rest of the article is as follows: part two analyses some of the most important past researches for income distribution inequality, part three refers to the methodology and the data used, part four discusses the empirical results, the fifth part draws the final conclusions, while the sixth depicts the appendix with the granger causality results for the countries used in the data set.

2. Literature Review

Beckfield J. (2006), on an attempt to extend sociological approaches to income inequality and to develop new hypotheses as far as regional political and economic integration on income inequality is concerned, he used panel data (1973-1997) on 12 western European countries. Not only did he find out that regional integration is associated with income inequality, but also that globalization weakens labor by creating an international labor pool. As far as the level of integration is concerned, '…An initial exploratory analysis of the relationship between economic integration and national income inequality produce evidence of a positive effect of economic integration that weakened or even reversed at the highest levels of economic integration'. (2006: p.967). Apart from his sociological approach, which consists of data on political integration, welfare state, and income inequality, he included controls for year, social security transfers, real GDP per capita, and outflow of foreign direct investment per worker. The FDI outflow results suggest however that globalization may not matter for income inequality. Beckfield reaches his argument 'that the positive effect of economic integration on income inequality may be attenuated at high levels of integration because the most deeply integrated economies have developed institutions that insulate labor from the pressures of international competition' (2006: p. 976). Concluding, his results showed that economic integration has a positive effect that downsizes at high levels of integration, while political integration has a linear positive effect.

Gagliani G. (1987) begins his research on the relationship between income inequality and economic development by emphasizing (based on previous researchers) that inheritance taxes may increase the inequality of wealth. Especially in developed countries, differences in pay are the main cause. He agrees with others when he states that '…an increasing weight of the urban (relative to the rural) population "means an increasing share for the more unequal of the two component distributions" (1987: p. 315). He also notes that changes in traditional or modern sector increase income inequality, which has a pattern of growth affected by: a) structural characteristics, b) private behavior,

concerning population growth, and c) the government's growth strategy and intervention. Other than that, he criticizes the methods employed in collecting data made from past researchers, while he points out that '…One should then correct for household size and composition by finding an appropriate weight based, for instance, on an equivalence scale which will tell us how many *equivalent* units there are in each type of household' (1987: p. 322). Finally, he reaches the conclusion that increasing income inequality and development can coexist, emphasizing on the tight labor market regimes, the educational expansion and democracy applied by most developed countries. His conclusions can be at least characterized as fallacious, since he assumes that the real economic world is divided in sectors, where development can be enjoyed by few, while income inequality by the rest.

The relationship between income inequality and variability in aggregate consumption growth is thoroughly examined by Iygun M. F. and Owen A. L. (2004). Using mean GDP, inflation, and growth as variables and with a panel set of 14 countries and a data set ranging from 1969 to 1992, they find that *poor* countries (i.e. when their per capita income is low) with high levels of income inequality show a lower variation in consumption and output growth. On the other hand, the effect of income inequality in richer countries is associated with greater variation in the growth of real consumption and output. By dividing their panel in two sections, their research sample actually almost doubled to 27 countries. In order to capture the effects of financial development on income inequality, they used three different measures of it, and reached the conclusion that they seem to explain macroeconomic fluctuations better than the rest of the variables. Generally speaking, the link between income inequality and consumption volatility seems to be relatively strong.

3 Methodology and Data

3.1 Methodology

The methodology used in this research is the panel data analysis because it allows studying the *dynamics of changes* in the data. The fact that we use time series of different cross section variables provides us with more freedom as far as the degrees of freedom is concerned.

The model that we used to estimate the panel analysis approach can be written as:

$y_{it} = \alpha_{it} + \chi'_{it}\beta_i + \varepsilon_{it}$ (1) where y_{it} is the dependant variable, and χ'_{it} and β_i are vectors of non-constant regressors, while the parameters are i=1,2,…n cross-sectional units.

More specifically, the variables of the panel analysis are described in the following section, 5.2.

With the help of Eviews one can estimate a feasible GLS specification correcting for both cross-section heteroskedasticity and contemporaneous correlation. More specifically, this class of covariance structures allows for conditional correlation between the contemporaneous residuals for cross-section *i* and *j*, but restricts residuals in different periods to be uncorrelated. More specifically, it is assumed that:

$E(\varepsilon_{it}\varepsilon_{jt} \mid X_t^*) = \sigma_{ij}$ (2) $E(\varepsilon_{is}\varepsilon_{jt} \mid X_t^*) = 0$

for all *i*, *j*, and *t* with $s \neq t$. Note that the contemporaneous covariances do not vary over *t*.The term 'Cross-section SUR specification' is used since it involves covariances across cross-sections as in a seemingly unrelated regressions type framework (where each equation corresponds to a cross-section). For this particular dataset, Cross-section SUR weighted least is simply the feasible GLS estimator for systems where the residualsare both cross-sectionally heteroskedastic and ontemporaneously correlated[2]

[2] It is worth noting that an attractive alternative to the SUR methodology estimates the model without a GLS correction, then corrects the coefficient estimate covariances to account for the contemporaneous correlation.

3.2 Data

The data set ranges from 1997 to 2008. The dependent variable is *inequality of income distribution* (IID), and can be described as the ratio of total income received by the 20% of the population with the highest income (top quintile) to that received by the 20% of the population with the lowest income (lowest quintile). Generally speaking, *income* must be understood as equivalised disposable income. More specifically, the total disposable income of a household is calculated by adding together the personal income received by all of household members plus income received at household level. Missing income information in individual questionnaires is imputed. Disposable household income includes:

- all income from work (employee wages and self-employment earnings)
- private income from investment and property
- transfers between households
- all social transfers received in cash including old-age pensions

The independent variables are:

Tax rate on low wage earners by marginal effective tax rates on employment incomes (TLW)

It is calculated data based on single persons without children. This structural indicator covers single persons without children earning, when in work, 67% of the average earnings. This sub-sample is used because the unemployment trap measures the percentage of gross earnings which is "taxed away" through higher tax and social security contributions and the withdrawal of unemployment and other benefits when an unemployed person returns to employment. Information on net earnings and related tax-benefit rates complements gross-earnings data with respect to disposable earnings.

Total investment - % of GDP (TI)

This indicator is defined as total gross fixed capital formation (GFCF) expressed as a percentage of GDP, for the public and private sectors. GFCF consists of resident producers acquisitions, less disposals of fixed assets plus certain additions to the value of nonproduced (usually natural) assets realized by productive activity. It also includes certain additions to the value of non-produced assets realized by productive activity, such as improvements to land. The ratio gives the share of GDP that is used by the public and private sector for investment (rather than being used for e.g. consumption or exports).

GDP per capita in PPS - GDP per capita in Purchasing Power Standards (PPS) (GDP)

Gross domestic product is a measure for the economic activity. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The volume index of GDP per capita in Purchasing Power Standards is expressed in relation to the European Union's 27 countries' average set to equal 100.

4. Empirical results and Granger causality

The results are the product of EViews 5.0, using the pooled EGLS method, as shown below, with variables GR, POR, IR, GER, UK, standing for Greece, Portugal, Ireland, Germany, and the UK respectively:

4.1 Empirical results

Table 4.1.a Results of the pooled GLS

Dependent Variable: IID?
Method: Pooled EGLS (Cross-section weights)
Sample (adjusted): 2001 2008
Included observations: 5 after adjustments
Cross-sections included: 5
Total pool (balanced) observations: 25
Linear estimation after one-step weighting matrix
Cross-section SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
_GR--TLW_GR	-0.011944	0.029659	-0.402713	0.6956
_POR--TLW_POR	-0.178584	0.179567	-0.994525	0.3434
_IR--TLW_IR	0.057707	0.057127	1.010139	0.3362
_GER--TLW_GER	-0.321696	0.600962	-0.535302	0.6041
_UK--TLW_UK	-0.175628	0.140335	-1.251489	0.2392
_GR--TI_GR	0.082559	0.029447	2.803645	0.0187
_POR--TI_POR	-0.116988	0.117280	-0.997510	0.3420
_IR--TI_IR	0.146478	0.117992	1.241422	0.2428
_GER--TI_GER	0.015097	0.433893	0.034795	0.9729
_UK--TI_UK	0.298769	0.238900	1.250599	0.2396
_GR--GDP_GR	0.053106	0.020325	2.612821	0.0259
_POR--GDP_POR	0.311403	0.217271	1.433250	0.1823
_IR—GDP_IR	-0.021726	0.049189	-0.441674	0.6681
_GER--GDP_GER	0.241381	0.409279	0.589772	0.5684
_UK--GDP_UK	0.103316	0.054380	1.899911	0.0866

Weighted Statistics

R-squared	0.999149	Mean dependent var	13.39447
Adjusted R-squared	0.997958	S.D. dependent var	9.173996
S.E. of regression	0.414589	Sum squared resid	1.718844
F-statistic	838.6759	Durbin-Watson stat	2.740487
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.909914	Mean dependent var	5.400000
Sum squared resid	1.718844	Durbin-Watson stat	1.263971

Note: SUR method estimates a feasible GLS specification correcting for both cross-section heteroscedasticity and contemporaneous correlation. This specification is known as 'the Parks estimator'.

By substituting the results of the pooled GLS in an equation form, we get:

- IID_GR = -0.01194395485*TLW_GR + 0.08255949847*TI_GR 0.05310557809*GDP_GR
- IID_POR = -0.1785840746*TLW_POR - 0.1169880317*TI_POR + 0.3114030945*GDP_POR
- IID_IR = 0.05770661211*TLW_IR + 0.1464783584*TI_IR - 0.02172550298*GDP_IR
- IID_GER = -0.3216961597*TLW_GER + 0.01509714369*TI_GER + 0.241381145*GDP_GER
- IID_UK = -0.1756279876*TLW_UK + 0.2987686716*TI_UK + 0.1033164008*GDP_UK

Our results clearly show that in the cases of Greece, Portugal, Germany, and the UK, there is a negative relationship between income inequality distribution (IID) and tax rate on low wage earners. As discussed earlier, variations of income tax are considered to be a just method of income-inequality reduction. Especially, according to our findings, in Germany an increase of 1% of the particular tax can reduce IID by 32.17%. The corresponding reductions for the rest of the countries are 1.2% in Greece, 17.86% in Portugal, and 17.56% in the UK. As far as the total investment (TI) is concerned, there is a positive relationship with the rise of IID in all of the countries, except in Portugal. In Greece, a 1% rise in TI will lead to a 8.25% rise in IID, while for the rest of the countries the effects are 14.65% in Ireland, 1.51% in Germany, and 29.87% in the UK. Results for the GDP-IID relationship are as expected. A 1% rise in GDP in Greece will result in a 5.31% rise in IID, in Portugal in a 31.14% rise in IID, in Ireland in a 2.17% fall in IID, in Germany in a 24.13% rise in IID, and in the UK in a 10.33% rise in IID. Special attention should be given to the Irish economy. An increase of TLW seems to positively affect IID, while the opposite holds for the relationship between GDP and IID. The first outcome can be interpreted as a sign of sound and just tax regime, since taxation revenues can be re-circulated in the public-private sector relationship in order to reduce remaining tax anomalies. Focusing now on the second outcome, the negative GDP-IID relationship, an increase in GDP per capita seems to reduce income inequalities, in a way that personal production and earnings from production throughout the year act as a means of equally redistributing income in the economy, that otherwise would be unequally distributed.

4.2 Granger causality

The Granger approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. Note that two-way causation is frequently the case; x Granger causes y and y Granger causes x. It is important to note that the statement "x Granger causes y" does not imply that y is the effect or the result of x. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

Table 4.2.a: F statistic values

		Levels of significance			
df Numerator	**df Denominator (n-k)**	25%	10%	5%	1%
1	3	2.02	5.54	10.1	34.1
1	4	1.81	4.54	7.71	21.2
1	5	1.69	4.06	6.61	16.3
1	6	1.62	3.78	5.99	13.7
1	7	1.57	3.59	5.59	12.2
1	8	1.54	3.46	5.32	11.3
1	9	1.51	3.36	5.12	10.6

Note: df for the numerator is the number of lagged values of the X parameter (in the X→Y model) included in the regression. n is the number of observations, while k denotes the parameters in the unrestricted regression of the test, which are 2. That is, if n=6, then df for the denominator=6-2

Tables 4.2.b of the Appendix include all of the granger causality results. It is not surprising that in every case there is at least three granger causalities among the variables. In the case of Greece, past values of total investment affect future income inequality distribution levels. There seems to be a time lag between investment application and its effects on the real economy. Apart from that, past values of income inequality distribution seem to affect GDP values. This can be explained from a socio-economic point of view, since more and more consumers tend to have less disposable income, while fewer and fewer tend have increased benefits, this acts as *counter motive* for consumption, which in turn negatively affects levels of production and investment.

In the case of Portugal, taxes on low wage earners also affect future income inequality distribution levels. But the interesting feature is that there is bilateral granger causality between total investment and income inequality distribution. This means that past values of both variables affect one another. Clearly, investment decisions should be more thoroughly examined regarding their costs and benefits, not only for the business parts involved, but for the country's economy as a whole.

In the case of Ireland, there is bilateral granger causality between total investment and income inequality distribution and between total investment and taxes on low wage earners. Investment seems to play a crucial role in the country's economy, and should be considered with more precaution, since Ireland needs investment not only from the UK, but also form the rest of the EU.

In the case of the UK, bilateral granger causality is found only between GDP and taxation on low wage earners. On the other hand, unidirectional granger causality is found between total investment and income inequality distribution, total investment and taxation on low wage earners, and total investment and GDP.

More specifically speaking, in the examined cases where only unidirectional granger causality is found, we have to raise the question of *exogeneity*. By this term, it is meant the equivalent of the X variables in a single-equation regression model. In other words, is it safe to use granger causality from the obtained results in order to forecast or suggest any policy-making opinions? As an answer, it can be stated that when we have unidirectional granger causality, for example in the case of Greece's total investment and income inequality distribution, or of Portugal's taxation on low wage earners and income inequality distribution, this *weak exogeneity* can only be useful for testing and estimating. In case we had *stronger* signs of exogeineity, i.e. if the dependent

variables' *current and lagged values* did not explain independent variables' current values, then our results could be used for forecasting and even for policy analysis.

5. Conclusions

Our analysis tries to prove the fact that income inequality distribution is affected by specific variables, namely taxes on low wage earners, total investment, and GDP as a measure of development. Our sample includes two highly industrialized countries (Germany and the UK), and developed and less developed countries, in order to be able to compare our results among different economic states. As shown above in table 4.1.a, there is a clear positive relationship between total investment and IID, and GDP and IID. For the first result we can safely say that investment benefits, both of the public and the private sector, are mostly in the interest of companies' stakeholders and those involved in the investment process, and not justly allocated to the local economic society as a whole. The UK seems to be more sensitive to this kind of relationship, since our findings denote a 29.87% increase of IID to a 1% increase of TI, while for Ireland or Greece this percentage is smaller. Not only TI, but also GDP seems to negatively affect income distribution, with Germany and the UK suffering more in terms of our analysis, as we can see in section 4.1.

The fact that our granger causality analysis shows many bilateral effects should provide an incentive for further analysis of those variables' relationship. Different lag-levels could be attempted, and this could result in findings that can help forecasting or even policy analysis. Apart from that, the level of *real causality* instead of granger causality could be investigated.

6. Appendix

Table set 4.2.b: Granger causality results (**bold** implies the presence of granger causality)[3]

Pairwise Granger Causality Tests
Sample: 1997 2008
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
TI_GR does not Granger Cause IID_GR	**6**	**6.89000**	**0.07867**
IID_GR does not Granger Cause TI_GR		0.01951	0.89776
TLW_GR does not Granger Cause IID_GR	5	0.07396	0.81116
IID_GR does not Granger Cause TLW_GR		0.05262	0.83989
GDP_GR does not Granger Cause IID_GR	9	0.02853	0.87143
IID_GR does not Granger Cause GDP_GR		**1.64811**	**0.24656**
TLW_GR does not Granger Cause TI_GR	7	0.87916	0.40152
TI_GR does not Granger Cause TLW_GR		0.00812	0.93253
GDP_GR does not Granger Cause TI_GR	8	1.71555	0.24721
TI_GR does not Granger Cause GDP_GR		0.01960	0.89412

[3] Due to the fact that Germany's data had many gaps between the observed years, it is omitted form the granger causality test.

GDP_GR does not Granger Cause TLW_GR	**7**	**0.18292**	**0.69090**
TLW_GR does not Granger Cause GDP_GR		3.37832	0.13992

Pairwise Granger Causality Tests
Sample: 1997 2008
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
TLW_POR does not Granger Cause IID_POR	**7**	**2.96718**	**0.16007**
IID_POR does not Granger Cause TLW_POR		0.02825	0.87468
TI_POR does not Granger Cause IID_POR	**8**	**5.37566**	**0.06818**
IID_POR does not Granger Cause TI_POR		**2.38149**	**0.18343**
GDP_POR does not Granger Cause IID_POR	11	0.50493	0.49753
IID_POR does not Granger Cause GDP_POR		**2.96576**	**0.12335**
TI_POR does not Granger Cause TLW_POR	**7**	**9.50074**	**0.03685**
TLW_POR does not Granger Cause TI_POR		0.27254	0.62921
GDP_POR does not Granger Cause TLW_POR	7	0.41345	0.55523
TLW_POR does not Granger Cause GDP_POR		0.05283	0.82949
GDP_POR does not Granger Cause TI_POR	8	0.03903	0.85117
TI_POR does not Granger Cause GDP_POR		**4.74756**	**0.08123**

Pairwise Granger Causality Tests
Sample: 1997 2008
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
TLW_IR does not Granger Cause IID_IR	5	8.7E-15	1.00000
IID_IR does not Granger Cause TLW_IR		0.00741	0.93925
TI_IR does not Granger Cause IID_IR	**6**	**2.44182**	**0.21608**
IID_IR does not Granger Cause TI_IR		**6.75958**	**0.08038**
GDP_IR does not Granger Cause IID_IR	9	0.17353	0.69149
IID_IR does not Granger Cause GDP_IR		0.84182	0.39426
TI_IR does not Granger Cause TLW_IR	**7**	**10.5415**	**0.03147**
TLW_IR does not Granger Cause TI_IR		**4.40494**	**0.10379**
GDP_IR does not Granger Cause TLW_IR	7	0.37120	0.57526
TLW_IR does not Granger Cause GDP_IR		1.30259	0.31743
GDP_IR does not Granger Cause TI_IR	8	0.05148	0.82949
TI_IR does not Granger Cause GDP_IR		0.03259	0.86382

Pairwise Granger Causality Tests
Sample: 1997 2008
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
TLW_UK does not Granger Cause IID_UK	5	NA	NA
IID_UK does not Granger Cause TLW_UK		NA	NA
TI_UK does not Granger Cause IID_UK	**6**	**3.51908**	**0.15733**
IID_UK does not Granger Cause TI_UK		0.00973	0.92764
GDP_UK does not Granger Cause IID_UK	9	0.41247	0.54446
IID_UK does not Granger Cause GDP_UK		0.00537	0.94395
TI_UK does not Granger Cause TLW_UK	**7**	**17.9726**	**0.01327**
TLW_UK does not Granger Cause TI_UK		0.04994	0.83412
GDP_UK does not Granger Cause TLW_UK	**7**	**4.51846**	**0.10070**
TLW_UK does not Granger Cause GDP_UK		**2.09259**	**0.22156**
GDP_UK does not Granger Cause TI_UK	8	0.26305	0.62988
TI_UK does not Granger Cause GDP_UK		**6.64907**	**0.04952**

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