

Working Paper: The Effect of Tax Progressivity on Economic Growth

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## **I. Introduction**

The quintessential query of why it is necessary to study the effects of tax progressivity has a very obvious answer. Does it make sense, economically speaking, to have progressive tax systems? The answer from the welfare perspective is a resounding yes, as progressive tax schedules aim to reduce income inequality. If tax progressivity inhibits economic growth then we must consider whether it is practical to compromise economic growth to attempt to correct income inequality. Flat taxes are considered regressive because they do not take into account the absolute incomes of each household. Even though a flat taxation rate may seem to tax everyone the same relative amount, it does not take into account the relative value given to the last dollar. If the poor live off of the bare necessities the last ten percent of their income will provide them with much more relative value than the last ten percent of a rich person's income will provide them. For the poor that last ten percent may be the difference between being able to pay their mortgage whereas for the rich it might be the decision between being able to afford a home with a little less square footage.

The question then becomes, who contributes more to overall economic growth, the rich or the poor? As of 2008 the top 1% holds 34.6% of net worth and 42.7% of the financial wealth of the United States. The top 20% holds 85.1% of net worth and 93% of financial wealth. It seems that it would make more sense to tax the top 20% because they are not living at the margin, yet economically speaking does taxing the rich benefit economic growth if they contribute more to investment? Two issues are present here. The first is the basic question of the effects of tax progressivity on GDP growth. The second has deeper implications. Does income inequality ultimately hurt the economy? If so, progressive tax measures need to accommodate the phenomenon. It will be the aim of this study to study the first question.

The matter of tax progressivity measurement must also be tackled in order to conduct this study. There is a substantial amount of research that has been published in this field yet the method of tax progressivity measurement has remained relatively constant in the past few decades. These methods require extensive data on tax revenue that is not easily attainable. Newer methods have recently surfaced that aim to reduce the specificity of the data required to compute a progressivity index. This study will employ a new, distinct tax progressivity index to determine the effects of tax structure on economic growth.

This paper will first address the literature and seek out explanations of progressive tax mechanisms from past studies. Methods of analyzing tax progressivity will also be addressed. The theory behind the hypothesis that tax progressivity and other control variables are significant predictors of economic growth will be elucidated in the Theory section. Regression results will then be analyzed and a discussion will follow to expound the results and make suggestions for future research.

## **II. Literature Review**

### Tax Progressivity

Lee and Gordon (2005) studied the effects of corporate tax structure of GDP growth. They begin their discussion by analyzing positive externalities resulting from tax structures which are not accounted for in the neo-classical framework that may potentially affect economic growth. They find that corporate tax is negatively correlated with economic growth using cross section data from 70 countries from 1970 to 1997. Lee and Gordon's regression result predicts that a ten percent decrease in the corporate tax rate will lead to a 1.1% increase in GDP growth. Their result suggests to me that taxing corporations deters them from making more investment decisions that lead to greater economic growth.

Padovano and Galli (2007) examine the effects of tax rates on economic growth in 23 OECD countries from 1950 to 1990. They find that higher marginal tax rates and tax progressivity are negatively correlated with long-run economic growth. Padavano and Galli explain that these results contradict previous literature that tax structure and economic growth are not significantly correlated because their regression depended on marginal tax rates, not the previously erroneously used average tax rates. These results suggest that the effect of progressivity must be judged based on the socioeconomic specific effects of the tax schedule not just the total amount of revenue collected.

Lucas (1990) discusses the effects of tax structure using human capital accumulation as the engine for economic growth and finds that contrary to his original hypothesis, that tax changes may alter long-run growth rates and equilibrium levels, tax changes had trivial effects. He attributes these findings to labor taxation affecting “equally both the cost and the benefit side of the marginal condition governing the learning decision”. Stokey and Rebelo (1995) find that Lucas’s estimate of the effect of tax structure on human capital accumulation is robust. They emphasize though, that while the effects of tax structure on growth are modest, the effects on welfare are large.

Caucutt et. Al (2002) find that using a general equilibrium model of endogenous growth with heterogeneity in skill, income, and tax rates, “... a less progressive tax system, which is rarely perceived as an egalitarian measure, gives rise to increased growth, decreased inequality, and greater mobility for the poor in the long run...”. Caucutt et. Al also focus on human capital as the main “engine” for economic growth and relate hypothetical effects of tax progressivity to human capital accumulation at all times. Their model predicts that in the long run even the poor

benefit from decreased tax progressivity but when the transition to a higher growth, balanced growth path is considered only the presently rich prefer the flat rate system.

Yamarik (1999) studied the effects of nonlinear tax structure on long run economic growth, specifically on the “distortionary not the redistributive effects of taxation on economic growth”. The study found two results. The first being that the addition of a nonlinear tax structure into the  $Ak$  growth model makes the convergence behavior of the neoclassical growth model apparent. Secondly, more relevant to this study, he finds that more progressive tax structure “through time will lower the transitional growth rate and raise the speed of convergence”. He reasons that capital accumulation causes endogenous increases in tax rates along with declining after tax averages and marginal products of capital. The end result is low transitional growth rates of consumption, capital and output. He acknowledges that these results may suggest that tax progressivity through time may be another basis of variation in per capita growth rates.

### Progressivity Measurement

The most pressing issue that needs to be addressed before commencing this study is that of measuring tax progressivity. Measurement of economic growth is easy enough as GDP figures are readily available. If traditional methods are utilized a very time consuming process of gathering microeconomic data and compiling time series for many different nations over a span of decades is involved. Fortunately, as I will show later on in this section, there are newer, more feasible ways of calculating tax progressivity that require only macroeconomic data.

Suits (1977) presents a method for judging tax progressivity using the Gini ratio. He points out that a useful property of his method is that the index of progressivity of the tax system with two or more taxes is a weighted average of their individual indexes. Suits utilizes the

Lorenz curve as the basis of his index. The Lorenz curve illustrates the relationship between accumulated percent of total income and accumulated percent of families. The Gini ratio takes a value between 0 and 1, with 1 being the value given to the total income being concentrated in a single family. Suit extrapolates his index from the Gini ratio and gives his index extreme values of -1 and +1. A value of -1 given to an extreme regressive tax with the lowest tax bracket bearing the entire tax burden and a +1 being an extreme progressive tax structure with the entire tax burden placed on the highest income bracket. A value of 0 is given to a proportional tax in which each tax bracket bears a percent of the tax burden proportional to its contribution to total income. For example, if the poorest tax payers earned 2% of all family income, they would be expected to contribute 2% of total income tax revenue. Suits finds that in 1970 the corporate tax was progressive at a +0.32 level but sales and excise taxes were slightly regressive at a -0.15 level. Overall the American tax system in 1970 was deemed to be very slightly progressive at a +0.070 level.

Duclos and Tabi (1996) highlight Suits' and Kakwani's approach to tax progressivity measurement and classify their approach as a share based approach. In contrast tax progressivity measured by Suits' index is simply related to the percentage of the tax burden paid by each of the tax payers of each income bracket. Duclos and Tabi then present a second approach to measuring tax progressivity that has more to do with redistribution of wealth and welfare. They proceed to describe what the purpose of progressive taxation by citing Vickrey (1947) that "progressive taxation may be defined as taxation which tends to promote economic equality". Duclos and Tabi state that, "According to that second approach, therefore, for a fixed distribution of gross incomes, the greater the progressivity of the tax system, the more equal the distribution of net incomes". They proceed to establish their own system of measuring tax progressivity in which

the greater the progressivity of tax system, the more equal the associated net income distribution. Using this method would cause confusion because the effect of tax progressivity and inequality on economic growth would be combined. In order to isolate the consequences of tax structure a more specific method will need to be employed.

In an effort to simplify the calculation of tax progressivity Kakinaka and Pereira (2006) devise a new method of tax progressivity measurement. They strive to distance themselves from the Gini coefficients and Lorenz curves that Kakwani and Suit advocated. Kakinaka and Pereira's new method involves the proportional standard deviation of tax revenue; consequently the proportional standard deviation of income. The premise of the system is that if a tax structure is progressive, during an upswing of the business cycle tax revenue should outpace economic growth as the higher classes will see greater monetary gain than lower classes. A recessionary period will display converse consequences. The more volatile tax revenue is compared to GDP the more progressive the tax schedule is. The benefit of this new system is that it can be derived completely from macroeconomic data, which is readily available.

The Kakinaka and Pereira method does not take into account the distribution of income and the equality of the tax burden. As I have mentioned earlier it is not the goal of this study to analyze welfare changes caused by differences in tax structure. The tax volatility method provides a simple way of calculating tax progressivity for different nations with relative ease as GDP and tax revenue data are readily available from the OECD database.

### III. Theory

So how exactly does progressivity impact economic growth? Following the rationale proposed by Caucatt et. Al (2002) progressive taxation makes the human capital investment decision less appealing. Barro (1992) and Bassanini and Scarpetta (2001) both find that human capital positively impacts economic growth in the long run. Less human capital attainment will thus lead to slower growth. Human capital accumulation has the potential to increase the earning power of those who invest in it. From an investment perspective progressive taxation decreases the marginal benefit received from human capital accumulation (Heckman et. Al 1998). It makes the investment decision less appealing and can thus deter students from pursuing higher education. Caucatt et Al (2002) find that greater tax progressivity has the potential to decrease human capital and growth in the long run while increasing the “skill premium”. In light of past studies it is hypothesized that the coefficient to the tax progressivity variable should be negative and possibly correlated to human capital attainment.

#### Model

In order to isolate the effects of tax progressivity on economic growth other variables that have been proven to significantly affect economic growth were included in the model. The prime rate, inflation rate, human capital, health capital and terms of trade were controlled for in the initial model. Time was included to observe any trends that may arise in the data due to events and conditions that may have occurred and were not captured in the variables. Dummy variables for each nation being tested were also included as cultural and policy differences that may affect economic growth were not quantifiable.

Inflation has been implicated by Barro (1997) and Andrés and Hernando (1999) as being significantly negatively correlated with economic growth. The study by Andrés and Hernando is



of particular interest as they specifically studied the effects of inflation on economic growth in OECD countries. They found that even when controlling for country dummies inflation remains significantly negatively correlated with economic growth. Andrés and Hernando explain that inflation not only reduces investment but also “the efficiency with which productive factors are used”.

Basannini and Scarpetta (2001) as well as Barro (1997) confirm the link between human capital and economic growth. Basannini and Scarpetta studied the effects of human capital accumulation on the economic growth of OECD countries from 1971-1998. Human capital accumulation was measured by the average years of education of the working class population obtained from Barro and Lee’s (2000) database. The same database was used in this study. It was found that human capital accumulation has a significant positive effect on the per capita GDP growth rate. Barro (1997) also finds that terms of trade and health capital, measured by the life expectancy, has positive effects on economic growth.

#### **IV. Data and Methods**

The data was obtained primarily from the World Bank database and the OECD StatExtracts. Life expectancy, inflation, GDP, GDP per capita growth rate, terms of trade and lending interest rate data were obtained from the World Bank database. Tax revenue data was obtained from the OECD statistics library. Human capital data was interpolated from a dataset on global education attainment compiled by Barro and Lee (2000).

The lending interest rate in this study was defined as the lending interest rate charged by banks on loans to prime customers. The inflation rate was an annual measure based off of the GDP implicit deflator. The terms of trade were measured by a net barter terms of trade index

using the year 2000 as the base year. The index was calculated as the percentage ratio of the export unit value indexes to the import value indexes. Health capital was quantified by life expectancy following Barro's model. Finally GDP per capita growth rate was an annual measure based on the GDP growth of the local currency divided by the midyear population.

The tax progressivity measure was constructed using tax revenue and GDP data. Tax revenue for each of the eleven countries was measured as the total revenue collected in United States dollars. The GDP data that was used was in constant year 2000 dollars. The index itself was calculated as a moving average using data from eleven year periods. The calculated index was used as an explanatory variable for the middle, or sixth year of the eleven year period.

The new tax progressivity index is a ratio of the proportional standard deviation of tax revenue to the proportional standard deviation of GDP over the designated time period. The proportional standard deviation is defined as the standard deviation divided by the mean. The index effectively quantifies the volatility of tax revenue in comparison to the volatility of GDP. It is assumed that during periods of growth higher income individuals will see a greater rise in income than lower income individuals. Thus the proportionate rise in tax revenues should outpace the proportionate rise of GDP under a progressive tax structure. If the volatility of tax revenue is equal to that of GDP a flat tax schedule is present. A regressive tax schedule will yield an index with a value less than one as tax revenues will be less volatile than GDP. A progressive tax schedule will be denoted by an index with a value greater than one as tax revenues would be more than volatile GDP.

## V. Results

A basic linear regression was executed first to see if the progressivity index was initially significant. It was found that progressivity was not significant yet the controls of time, lending rate, inflation and the Korea dummy were (Table 1). A Breush-Pagan/Cook-Weisberg test for heteroskedasticity yielded a chi-squared value of 0.16 and a p-value of 0.6928, failing to reject the alternative hypothesis that the data is heteroskedastic. Nonetheless a robust linear regression, to control for any deviations in variances, yielded the same results. Collinearity would have adversely influenced results so a correlation test was performed (Table 2). No two variables demonstrated significant collinearity. Interestingly, the highest correlation occurred between inflation and time.

Further testing was carried out by regressing the data using a stepwise regression with an entrance significance level of 0.1. Again, progressivity was nowhere to be found in the regression results. In order to further validate these results the regression was carried out under robust conditions. Intriguingly tax progressivity appeared first in the regression results (Table 4). The other variables that appeared in the stepwise regression were Korea, lending rate, Norway, time and inflation. Despite the fact that the progressivity index was the first variable to be listed the t-statistic associated with it did not demonstrate significance. This was a puzzling find and requires further investigation. It was noted that the Korea dummy was consistently significant in every regression and had a rather high coefficient.

Korea has seen spectacular growth in the past two decades whose causes may not be captured by the variables included in the model. It was hypothesized that the Korea data could be skewing the results because growth in Korea was on an extreme level as compared to the other

nations in the regression. In order to test for this phenomenon, the data for Korea was removed from the data set and a robust regression was conducted (Table 3). The regression results supported the hypothesis as the tax progressivity coefficient ( $-0.1878 \pm 0.1013$ ) became significant at the ten percent level ( $P=0.065$ ). Other significant dependent variables were time, lending rate and inflation, all of which demonstrated negative relationships with per capita GDP growth. A robust stepwise regression was performed on the dataset sans Korea data. Contrary to previous results, progressivity did not appear at all in the output model.

## **VI. Discussion**

The initial regression, which included the Korean data, showed that the tax progressivity index was not a significant predictor of per capita GDP growth. Even running a robust regression did not bring significance to the tax progressivity variable. The question still remains then, why in the stepwise regression did the progressivity index appear first as the primary independent variable explaining per capita GDP growth when Korea data was included but did not even show up when Korea data was excluded? It is thought that this behavior might be due to interactions within the data, but further testing is required to form a conclusive analysis.

The Korea data was obviously a source of variance not captured by the dependent variables. Due to lack of controls for culture, technological skill and other growth determining factors, the true cause of Korea's dramatically high per capita GDP growth rate could not be captured. This was reflected by the high Korea dummy coefficient and the fact that the removal of Korea data from the regression made the progressivity index significant. The significance of the tax progressivity variable and its negative correlation with per capita GDP growth coincide with the results of past studies. The negative sign of the tax progressivity variable conveys the

adverse effect of progressive taxation on GDP per capita growth. According to the regression performed in this study, an increase in the progressivity index of one unit will lead to a -.1878% decrease in GDP per capita growth.

The original hypothesis, that human capital attainment is the engine driving economic growth that is affected by tax progressivity, seems to be refuted by the data. Human capital attainment, measured by the average years of schooling of the population over the age of 25, showed no significant correlation with GDP growth per capita. A collinearity argument does not seem to hold water as the human capital variable showed no signs of correlation with the tax progressivity index or any of the other control variables.

## **VII. Conclusion**

This study performed two main functions. The first was using of a new measure of tax progressivity and the second was measuring the effect of tax progressivity of GDP growth. The first objective of the study has important implications for future research concerning tax structure and economic growth. Because the index of tax progressivity is simple to calculate due to its macroeconomic data composition, fewer economists will be deterred from studying tax structure due to the arduous nature of tax data collection. The major downside of this type of index is that the specific characteristics of the tax system, such as corporate luxury tax levels, cannot be isolated. The index judges the progressivity/regressivity of the entire tax schedule disregarding the marginal effects of specific policies.

This study has provided further evidence that tax progressivity negatively impacts economic growth. Even while controlling for other factors influencing economic growth such as the prime rate, health capital, human capital, terms of trade and inflation, tax progressivity

emerges as a significant predictor for economic growth. It does not seem that human capital attainment is the engine driving growth. It was not significant in any of the regression analyses and did not exhibit collinearity with any of the control variables.

The implications for fiscal policy seem obvious but are not. The effect of income inequality on economic growth must also be studied in order to make a conclusive argument for or against progressive taxation. If the effect of income inequality on economic growth is greater than that of progressive taxation and progressive taxation does indeed reduce income inequality significantly, progressive taxation may be a sound fiscal policy.

## VIII. Appendix

Table 1

Independent Variable	Linear Regression		Robust Linear Regression	
N	245		245	
Constant	282.9384 (3.86)	73.23203	282.9384 (3.3)	85.76219
Time	<b>-0.11894*</b> <b>(-3)</b>	.0396387	<b>-.1189379*</b> <b>(-2.89)</b>	.0411594
Tax progressivity	-0.0903 (-0.75)	.1210359	-.0902969 (-0.82)	.1096274
Years of Schooling	-0.2930687 (-0.98)	.2990129	-.2930687 (-0.78)	.3767924
Inflation	<b>-0.1745481*</b> <b>(-3.74)</b>	.0467091	<b>-.1745481*</b> <b>(-2.83)</b>	.0617647
Terms of Trade	0.1380602 (1.35)	.1024203	.1380602 (1.15)	.1203571
Log(life expectancy)	-25.57902 (-1.13)	22.66144	-25.57902 (-0.99)	25.81262
Lending Rate	<b>-0.272876*</b> <b>(-5.36)</b>	.050953	<b>-.272876*</b> <b>(-3.55)</b>	.0767663
Australia	0.4536 (0.56)	.8156568	0.4536 (0.51)	.8822616
Canada	-0.59583 (-0.87)	.6858519	-0.59583 (-0.79)	.751892
Denmark	0.155539 (0.17)	.9057615	0.155539 (0.16)	.9519142
Germany	-0.81511 (-0.66)	1.241473	-0.81511 (-0.59)	1.375428
Korea	<b>3.094306*</b> <b>(2.52)</b>	1.228966	<b>3.094306**</b> <b>(1.72)</b>	1.794802
Netherlands	-0.8595 (-0.72)	1.188031	-0.8595 (-0.65)	1.324035
New Zealand	0.530186 (0.79)	.6672447	0.530186 (0.77)	.692767
Norway	1.192802 (1.04)	1.147352	1.192802 (0.98)	1.220204
Sweden	0.356953 (0.44)	.8121629	0.356953 (0.42)	.844031
United Kingdom	-0.32019 (-0.28)	1.157401	-0.32019 (-0.24)	1.339391
United States	-		-	
R <sup>2</sup>	0.3380		0.3842	
F	8.33		8.50	

\* Significant at the 0.05 level

\*\* Significant at the 0.1 level

-Values in parenthesis are t-statistics

-Dependent Variable = per capita GDP Growth Rate

Table 2

	Time	Lending rate	Years of schooling	Inflation	Terms of trade	Log(life expectancy)	Tax progressivity	Australia	Canada	Denmark	Germany
Time	1	-	-	-	-	-	-	-	-	-	-
Lending rate	0.6491	1	-	-	-	-	-	-	-	-	-
Years of schooling	0.3604	-0.2099	1	-	-	-	-	-	-	-	-
Inflation	0.6137	0.4858	-0.2098	1	-	-	-	-	-	-	-
Terms of trade	0.0226	-0.0431	-0.2268	0.104	1	-	-	-	-	-	-
Log(life expectancy)	0.029	-0.053	-0.2229	0.0863	0.9893	1	-	-	-	-	-
Tax progressivity	0.2934	0.293	-0.1353	0.2854	-0.0879	-0.0548	1	-	-	-	-
Australia	0.0153	0.1746	0.0453	0.0444	0.139	0.1399	-0.1506	1	-	-	-
Canada	0.0153	-0.0861	0.1873	-0.076	0.054	0.0701	-0.1415	-0.1036	1	-	-
Denmark	0.0153	0.1027	-0.0695	-0.0481	-0.0415	-0.0192	0.164	-0.1036	-0.1036	1	-
Germany	0.0753	-0.0327	-0.3351	-0.1874	0.1079	0.1146	0.0237	-0.0933	-0.0933	-0.0933	1
Korea	0.0153	-0.0049	-0.2385	0.2377	0.5289	0.4516	-0.2127	-0.1036	-0.1036	-0.1036	-0.0933
Netherland	0.0753	-0.2068	-0.2856	-0.1795	-0.0703	-0.0473	-0.142	-0.0933	-0.0933	-0.0933	-0.0841
New Zealand	0.0153	0.0426	0.3333	0.1252	-0.1431	-0.1209	0.2282	-0.1036	-0.1036	-0.1036	-0.0933
Norway	0.0153	0.0999	0.0894	0.0318	-0.6497	-0.7128	-0.0899	-0.1036	-0.1036	-0.1036	-0.0933
Sweden	0.0153	0.111	0.0438	0.0528	0.0276	0.0418	0.1093	-0.1036	-0.1036	-0.1036	-0.0933
United Kingdom	0.0153	-0.1243	-0.3191	0.0601	0.0246	0.0438	0.2929	-0.1036	-0.1036	-0.1036	-0.0933
United States	0.0153	-0.096	0.4972	-0.0915	0.0259	0.0441	-0.0912	-0.1036	-0.1036	-0.1036	-0.0933

	Korea	Netherland	New Zealand	Norway	Sweden	United Kindom	United States
Korea	1	-	-	-	-	-	-
Netherland	-0.0933	1	-	-	-	-	-
New Zealand	-0.1036	-0.0933	1	-	-	-	-
Norway	-0.1036	-0.0933	-0.1036	1	-	-	-
Sweden	-0.1036	-0.0933	-0.1036	-0.1036	1	-	-
United Kingdom	-0.1036	-0.0933	-0.1036	-0.1036	-0.1036	1	-
United States	-0.1036	-0.0933	-0.1036	-0.1036	-0.1036	-0.1036	1



Table 3

Independent Variable	Linear Regression without Korea Data		Robust Linear Regression without Korea Data	
N	222		222	
Constant	131.7764 (1.76)	74.74663	131.7764 (2.04 )	64.5245
Time	<b>-.0784357*</b> <b>(-2.09)</b>	.0374961	<b>-.0784357*</b> <b>(-2.34)</b>	.0334552
Tax progressivity	-.1878406 (-1.70)	.1106527	<b>-.1878406**</b> <b>(-1.85)</b>	.1013413
Years of Schooling	-.1916308 (-0.61)	.314688	-.1916308 (-0.68)	.2821237
Inflation	<b>-.1229416*</b> <b>(-2.61)</b>	.0471061	<b>-.1229416*</b> <b>(-2.44)</b>	.0503512
Terms of Trade	-.1052098 (-0.79)	.1326062	-.1052098 (-0.86)	.1229525
Log(life expectancy)	20.87413 (0.76)	27.3999	20.87413 (0.83)	25.13903
Lending Rate	<b>-.1807739*</b> <b>(-3.72)</b>	.0486285	<b>-.1807739*</b> <b>(-3.79)</b>	.0477577
Australia	.5236547 (0.65)	.8043493	.5236547 (0.71)	.7365803
Canada	-.4614325 ( -0.71)	.6493734	-.4614325 (-0.68)	.6790284
Denmark	.1346782 (0.15)	.8774113	.1346782 (0.17 )	.7822868
Germany	-.2866825 (-0.23)	1.257575	-.2866825 (-0.27)	1.065252
Netherlands	-.6187371 (-0.52)	1.188463	-.6187371 (-0.63)	.9861492
New Zealand	.2130151 (0.35)	.6133962	.2130151 (0.33)	.6554083
Norway	1.0318 (0.95)	1.091503	1.0318 (1.08)	.951976
Sweden	.3476989 (0.44)	.7832548	.3476989 (0.48)	.7199192
United Kingdom	.0852246 (0.07)	1.165549	.0852246 (0.09)	.9877079
United States				
R <sup>2</sup>	0.1028		0.1677	
F statistic	2.58		2.97	
Breusch-Pagan	$\chi^2=0.16$			

\* Significant at the 0.05 level

\*\* Significant at the 0.1 level

-Values in parenthesis are t-statistics

-Dependent Variable = per capita GDP Growth Rate

Table 4

Independent Variable	Stepwise with Korea	Robust Stepwise with Korea	Stepwise without Korea	Robust stepwise without Korea
Entrance Level = 0.10				
N	245	245	222	222
Constant	257.8538 (4.45)	244.0151 (3.48)	151.0515 (2.73)	151.0515 (3.18)
Time	3) -.1269233* (-4.38)	5) -.1199693* (-3.43)	4) -.0737918* (-2.67)	4) -.0737918* (-3.11)
Tax progressivity		<b>1) -.0656155 (-0.66)</b>		
Years of Schooling				
Inflation	4) -.1656516* (-3.85)	6) -.1558775* (-2.87)	3) -.1211825* (-2.90)	3) -.1211825* (-3.04)
Terms of Trade				
Log(life expectancy)				
Lending Rate	2) -.249377* (-5.33)	3) -.2273843* (-3.49)	1) -.1628562* (-3.86)	1) -.1628562* (-3.88)
Australia	6) .7893547* (1.76)			
Canada				
Denmark				
Germany				
Korea	1) 4.507946* (9.87)	2) 4.318388* (6.23)		
Netherlands				
New Zealand				
Norway	5) 1.162675* (2.64)	4) 1.004716* (2.83)	2) 0.9479545* (2.43)	2) .9479545* (2.69)
Sweden				
United Kingdom				
United States				
F	22.23	21.28	8.03	8.71
R <sup>2</sup>	0.3591	0.3518	0.1289	0.1289

\* Significant at the 0.05 level

-Values in parenthesis are t-statistics

\*\* Significant at the 0.1 level

-Dependent Variable = per capita GDP Growth Rate

The numbers preceding the coefficient values indicate the order they appeared in the stepwise regression.

## IX. References

- Andrés, Javier and Hernando, Ignacio. 1999. "Does Inflation Harm Economic Growth? Evidence from the OECD." In Feldstein, Martin *The Costs and Benefits of Price Stability*. Univ. of Chicago Press., pp. 315-348.
- Baumol, B., S.C. Gwynne and L. Myers. 1991. "Taxes: Tempest in a Yacht." *Time*.
- Barro, Robert J. 1992. "Human Capital and Economic Growth." In: Federal Reserve Bank of Kansas City, *Policies for Long-Run Economic Growth*. pp. 199-216.
- Barro, Robert J. *Determinants of Economic Growth a Cross-Country Study*. MIT Press, 1997
- Barro, Robert J. and Lee, Jong-Wha. 2000. "International Data on Educational Attainment Updates and Implications." *Oxford Economics Papers*, 53(3), 541-563.
- Bassanini, Andrea and Scarpetta, Stefano. 2001. "Does Human Capital Matter for Growth in OECD Countries? Evidence from Pooled Mean-Group Estimates." *OECD Working Paper Series*, 33, 9-56
- Caucatt, E., S. Imrohorglu, and K. Kumar. 2003. "Growth and Welfare Analysis of Tax Progressivity in a Heterogeneous-Agent Model." *Review of Economic Dynamics*, 6, 546-577.
- Deininger, K. and L. Squire. 1997. "Economic Growth and Income Inequality: Reexamining the Links." *Finance and Development*, 38-41.
- Duclos, J. and M. Tabi. 1996. "The Measurement of Progressivity, with an Application to Canada." *The Canadian Journal of Economics*, 29, S165 – S170.

- Duncan, D. and K.S.Peter. 2008. "Tax Progressivity and Income Inequality." *W.J.Usery Workplace Research Group Paper Series*," 6-5.
- Heckman, James J., Lochner, Lance, and Taber, Christopher. 1998. "Tax Policy and Human-Capital Formation." *The American Economic Review*, 88(2), 293-297.
- Kakinaka, M. and R. Pereira. 2006. "A New Measurement of Tax Progressivity." *Economic Development and Policy Series*, 06-7.
- Kakwani, N.. 1977. "Measurement of Tax Progressivity: An International Comparison." *The Economic Journal*, 87, 71-80.
- Lee, Y. and R. Gordon. 2005. "Tax Structure and Economic Growth." *Journal of Public Economics*, 89, 1027-1043.
- Lucas, Robert E. Jr. 1990. "Supply-Side Economics: An Analytical Review." *Oxford Economic Papers*, 42(2), 293-316.
- Padavano, F. and E. Galli. 2007. "Tax Rate and Economic Growth in the OECD Countries," *Economic Inquiry*, 39, 44-57
- Suits, D. 1977. "Measurement of Tax Progressivity." *The American Economic Review*, 67, 747-752.
- Samanta, S. and A. Heyse. 2006. "Income Inequality and Economic Growth in Developing Countries: an Empirical Analysis." 5, 243-254.
- Stokey, Nancy L and Rebelo Sergio. 1995. "Growth Effects of Flat-rate Taxes." *The Journal of Political Economy*, 103(3), 519-550.

Vickrey, W.S., 1947, *Agenda for Progressive Taxation* (Ronald Press, NY).

Yamarik, S. 2001. "Nonlinear Tax Structures and Endogenous Growth." *The Manchester School*,  
69(1), 16-30.