TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 29, 2022

A new decade for social changes

ISSN 2668-7798

9 772668 779000

www.techniumscience.com

Technium Social Sciences Journal
Vol. 29, 271-284, March, 2022
ISSN: 2668-7798
www.techniumscience.com

Optimal Tax Rates for Maximal Revenue Generation

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Abstract. Tax revenue is a function of tax rate. As tax rate increases tax revenue increases, peaks, and then falls. This paper presents an empirically observed relationship between corporate income tax rates and tax revenues. Infrastructure plays a critical role in economic growth and development. Infrastructures such as public facilities that include endogenous capital stock of knowledge, machines, computers, recordings, etc. are commonly the result of government investments. Money for these investments is obtained from tax revenues. One such tax is corporate income tax. The tax rate that corresponds to maximum revenue from taxes is determined to be 32%. It is proposed that this is a false optimum as the preferred objective should be to maximize economic growth where the corresponding maximizing rate is 26%.

Keywords. Taxation; Economic growth; Economic development; Reinvestment capital; Innovation; Tax revenue

1. Introduction

Economic growth and development are a cooperation between citizens and business institutions in division of labor, trade and exchange for individual gain and the unintentional gain of others (see Smith, 1775). Taxation is not simply for the distribution of wealth that just exits somehow. Wealth must be created before it can be distributed, and said distribution is best accomplished by commercial trade. Taxation is a collaboration by citizens and business institutions of a nation for contributing to infrastructure that is necessary for the intentional shared goals and rewards of economic growth and development. See Tomasello (2001) for more on collaboration. Infrastructure must be provided by government when no one person or corporation is able or willing to provide it.

Taxation comprises direct and indirect taxes. Direct taxes comprise personal income, corporate income, and social security taxes. Indirect taxes comprise excise duty, sales, customs duty and property taxes. Previous researchers, including Laffer, Moore and Tanous (2008), Laffer and Moore (2010) and Laffer et. al. (2014) set as their objective the maximization of tax revenue. But they did not ascertain the optimal criterion in terms of a specific value. In any case, we argue that the maximization of tax revenue is the wrong objective. We propose that a better objective is maximization of real per capita gross domestic product (GDP) adjusted for purchasing power parity(GDPppp). GDPppp measures standard of living. Annual GDPppp,

Technium Social Sciences Journal
Vol. 29, 271-284, March, 2022
ISSN: 2668-7798
www.techniumscience.com

after depreciation and obsolescence, and consumption, is one year's contribution to wealth. In this paper we identify the tax rate that corresponds to maximum tax revenue (32%). Then we compare and reconcile it with the Ridley (2022) tax rate that corresponds to maximum GDPppp (26%). These rates are different, so it makes a difference which criterion we choose.

There are certain infrastructures that are necessary for economic growth and development. These include for example roads, bridges, airports, seaports, etc., and schools, hospitals, sanitation, clean water, clean air, national defense, public safety, domestic law enforcement, etc. The purpose of government is to act as an agent for minimally taxing and investing money in those infrastructures that the private sector cannot or will not invest in. For example, roads are required to take products to the market where they can be sold. Roads are also required to take consumers to the market where they can purchase said products. But no one company or individual consumer will build a road for all other companies or persons to use. This, despite how critical roads and their maintenance are for the conduct of commerce. Hence government is the chosen agent. Something worth bearing in mind is that government spending is a redirection of private spending. Any money obtained by government through taxes and spent by government is money that can no longer be spent privately by the entities from which the money was obtained. The net contribution to GDP is therefore zero. There might however be a small crowding out and therefore inflationary effect (see also Hayek, 1944 and Freidman, 2002). Welfare transfers also require taxes. Welfare recipients eventually spend the related money in the economy as consumption where they contribute to GDP. This is an apparent net zero contribution to GDP. However, welfare recipients become dead capital because they are not involved in work and exogenous idea contributions to the economy. Therefore, this is a net loss compared to what might otherwise have been.

The remainder of the paper is organized as follows. Section2 is a literature review. Section 3 is a listing of data, analysis, and comparison of results. Section 4 provides conclusions and suggestions for future research. The list of references is of direct research relevance. The bibliography is of peripheral interest.

2. Literature review

Focus

The focus of this review is to distinguish how GDP and revenue are affected by government and taxes. Optimal tax theory calculates the optimal tax rates to gain knowledge of how tax rates vary with objectives and possibilities. It shows how tax rates depend on certain indices (elasticities of various kinds, for example), thus indicating what form of evidence would be most useful and what influence that would have on tax rates. The formulation of rules for optimal taxation which, even when not expressed in terms of tax rates, may serve to attract attention to better measurements of the effects of economic policy (Mirrlees 1976).

Tax defined

A tax is a mandatory financial charge, or some other type of levy imposed upon a taxpayer (an individual or other legal entity) by a governmental organization in order to fund various public expenditures. Taxation is a very important policy tool. Moreover, many aspects of taxation affect our lives. Therefore, research on taxation is very important and necessary (Lin & Jia 2019). Taxation and the economy are interactive (Ireland, 1994; Xing and Whalley, 2014). Conditions, growth rate, and structure of an economy affect the revenue, growth rate and structure of taxation. Taxation also plays a role in supporting economic growth, structural adjustment, and welfare improvement (Bruce and Turnovsky, 1999).

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Declining taxes

Corporate tax rates among industrialized nations have been declining steadily since the mid-1980s (Brill and Hassett, 2007). As the tax rates continue to decline, many theories of globalization, capital mobility, and tax competition have been proposed to some extent to explain such changes. The government plays a significant role when it comes to taxation and growth rates because they are in charge of issuing the tax laws. The impact of tax cuts on growth rates and government revenues is shown to vary based on the allocation of government budgets towards government consumption, transfers, and investment in public capital. In general, governments that allocate their revenues to public capital investment enjoy higher growth rates and larger revenue gains from tax cuts than governments that allocate to transfers or government consumption. (Stinespring, 2009).

Scientific approach

Although the creation of optimal tax policy is one of the most difficult problems in economics, it should be based on science and mathematics and the real world of business (Abuselidze, 2013). According to Mirress (1976) the necessary conditions for optimal taxation are derived when taxes are constrained to be linear, when the form of taxation is unconstrained, and when some commodities are subject to nonlinear taxation, the remainder to proportional taxation.

Tax evasion

Ivanyna, Mourmouras and Rangazas (2010) study the effect of corruption and tax evasion on the determination of fiscal policy in a general equilibrium growth model. They consider tax evasion with regard to optimal tax revenue. They found that corruption and tax evasion affect the determination of tax rates and the fraction of tax revenue that is invested in public capital rather than diverted for private use by public officials. The presence of corruption and evasion is shown to have large positive effects on tax rates and large negative effects on economic growth and tax revenue. Harris and MacKinnon (1979) propose a technique for computing optimal taxes in a full general equilibrium model that is based on a fixed-point algorithm of the type that is widely used to solve Walrasian general equilibrium models.

Models

There are a multitude of models that are created to optimize taxation, but the Laffer curve serves as the most efficient model. The Laffer curve is a theoretical concept coined by Arthur Laffer in the 1970's that shows a graphical representation of the relationship between tax rates and tax revenues (Kazman, 2014). According to Laffer, economic activities are a decreasing function of the taxation rate. As a consequence, total tax revenue increases with the taxation rate at its lower levels and decreases against it at its higher levels. Laffer believed the reason for this decrease lies in decreasing economic activities. van Oudheusden (2016) studied the dynamics of the Laffer curve and stated that a lower tax rate on capital income is the best candidate for obtaining a dynamic Laffer effect. van Oudheusden was able to show that when lower taxes on income are financed by higher taxes on consumption, there is a wide array of combining ways to improve both long run government budgets and lifetime welfare. Novales and Ruiz (2002) also studied the dynamics of the Laffer curve. In an endogenous growth model with human capital accumulation, they discuss the possibility of welfare improving changes on the fiscal policy stance in some actual economies. The Laffer curve was not only studied for the

US. It was also studied in Japan. In Japan studies were based on a neoclassical growth model. It was found that while the labor tax rate is smaller than that at the peak of the Laffer curve, the capital tax rate is either very close to, or larger than, that at the peak of the Laffer curve. This problem is more acute when the consumption tax rate is high. It is also found that to maximize total tax revenue, the government should increase the labor tax rate but decrease the capital tax rate (Nutahara, 2015).

Externalities

Sandmo, 1975 & Goulder, 1995 found that the revenue raising and externality correcting tasks of the tax system are independent. One reason is that the externalities directly affect the production side of the economy. This implies that internalizing externalities does not yield any net tax revenues because positive and negative externalities balance exactly; the optimal tax system internalizing these externalities merely redistributes resources from the side of the labor market that imposes negative externalities.

Administration

The Diamond and Mirrlees(1971) production efficiency result suggests that labor-market tightness should not be distorted. Another concept that impacts the optimal tax revenue is the concept of the enforcement elasticity of tax revenue. That is the responsiveness of revenue collected to administrative interventions (one such elasticity, in principle, for each instrument of administration). At an optimum, the enforcement elasticity is equated to a straightforward variant of the usual cost-revenue ratio, a simple rule that also provides a clear role for a quantity that, with little theoretical rationale, has long been a center of attention in the traditional literature on (and practice of) tax administration (dating back at least to Sandford (1973)). Ivanyna, Mourmouras, Rangazas (2010) find that corruption and disruptive government impact the GDP and optimal tax return negatively. When the aversion to engage in illegal activity is high, evasion is not very responsive to tax rate increases and the government can set high tax rates without concerns that evasion will lower their tax base. When the culture of corruption effect is present, the level of tax evasion varies with corruption. When the culture of corruption effect is included, higher corruption leads to less tax revenue collected. Quantitatively, the presence of corruption and evasion increases the economy’s tax rate by more than 50 percent and causes a 22 percent drop in steady state worker productivity when compared to a baseline model without corruption and evasion. Evasion enhances limit taxation, but corruption creates the incentive to increase tax revenues which are diverted for private use. Tax evasion occurs when income is not reported to the government while tax avoidance occurs when an individual receives income in a form that gets favorable tax treatment. The administration and compliance policies of the government are additional factors that affect behavioral responses to tax rates because they shape the ability of people to evade or avoid taxes (Kazman, 2014).

Over taxation

There are many causes of a decrease in tax revenue. One of the most negative causes of decreased GDP and revenue is grand corruption. There are three main factors that describe how it negatively affects GDP. First, it lowers actual public investment by diverting a significant part of the investment budget for private use. Second, corruption directly raises tax evasion and lowers tax revenue through the culture of corruption effect. Finally, the higher tax rates associated with corruption reduce private investment and further encourage evasion, thereby limiting the positive effect of the tax rate on tax revenue (Ivanyna, Mourmouras and Rangazas, 2010). Any reduction in the probability of detection of tax evasion or in the penalty for evasion will raise the rate of evasion relative to that on avoidance activity (Waud, 1988). One of the main tools to determine the optimal tax rate is the Laffer Curve. The Laffer Curve illustrates the basic idea that changes in tax rates have two effects on tax revenues: the arithmetic effect and the economic effect. The arithmetic effect is simply that if tax rates are lowered, tax revenues (per dollar of tax base) will be lowered in proportion to the amount of the decrease in the rate. The reverse is true for an increase in tax rates. Raising tax rates has the opposite economic effect but penalizes participation in the taxed activities. The arithmetic effect always works in the opposite direction from the economic effect. Therefore, when the economic and the arithmetic effects of tax-rate change are combined, the consequences of the change in tax rates on total tax revenues are no longer quite so obvious (Laffer, 2014). People do not work, consume, or invest to pay taxes. They work and invest to earn after-tax income, and they consume to get the best buys after tax.

This model does not state that a tax cut will raise or lower revenues, but the tax rate change will depend on the tax system in place, the time period being considered, the ease of movement into underground activities, the level of tax rates already in place, the prevalence of legal and accounting-driven tax loopholes, and the proclivities of the productive factors (Laffer, 2014). The Laffer Curve does demonstrate that if the tax rate is in the upward-sloping (normal) range, tax revenue will increase when the tax rate is raised. When tax rates are reduced in the downward-sloping (prohibitive) range, labor supply may increase, and income and the tax base may go up (Hsing, 1996). Laffer assumes that when the tax rate becomes too high, economic agents become inactive (Laffer, 2014) and concludes that a disproportionately high taxation rate leads to a high wedge between gross and net pay, low production, low incomes and, consequently, to low tax revenue. Laffer and others seem to suggest that the optimal tax rate is lower than the actual tax rate (Heijman & Ophem, 2005). A reduction in tax rates can cause greater investment and work effort leading to positive and permanent impacts on the growth rate of the economy. The higher growth rate may even increase the tax base such that the present value of future tax revenues actually increases (Stinespring, 2004).

3. Taxation and tax revenue

Table 1 shows Income tax revenues (R) and Corporate income tax rates (T) for year 2020 for 79 countries. These are the countries for which there is a complete set of data. Other countries do not report data or have populations of less than one million. The analysis to follow makes use of the discovery by Ridley (2020) that GDPppp for all countries lie on a single capitalism, democracy, rule of law (CDR) straight line (given in the appendix). The straight line tells us that GDPppp is determined solely by the policy variables C, D, and R for all countries, together with small, fixed effects of non-policy natural resources and geography. The fixed effects are independent of capital. The marginal return of fixed natural resources and geography on capital is zero. This allows us to apply data from all over the world with theoretically identical tax rate consequences. In this sense the world really is flat. The CDR model is the path to widespread and accelerated entrepreneurship. The corporate tax rates range from 2% to 39%. Clearly there is no understanding or consensus that there is an optimal tax rate and what it is. Hence the potential for this paper to make a significant contribution.

Technium Social Sciences Journal
Vol. 29, 271-284, March, 2022
ISSN: 2668-7798
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Table 1. Corporate tax revenues and Corporate income tax rates by country (2020).

Country	Real percapita GDPppp	Tax revenue as a percentage of GDPppp	Income tax revenue (R)	Corporate Income tax rate (T)	Country	Real percapita GDPppp	Tax revenue as a percentage of GDPppp	Income tax revenue (R)	Corporate Income tax rate (T)
Argentina	20,751	30.30	6,288	35.00	Latvia	31,509	30.40	9,579	15.00
Armenia	13,261	20.80	2,758	20.00	Lebanon	11,564	15.30	1,769	15.00
Australia	51,680	27.80	14,367	30.00	Lithuania	38,824	29.80	11,570	15.00
Austria	55,218	41.80	23,081	25.00	Macedonia	14,900	25.00	3,725	2.00
Bangladesh	5,307	9.10	483	27.50	Malawi	993	17.30	172	30.00
Belgium	51,096	44.60	22,789	33.99	Malaysia	27,402	13.60	3,727	25.00
Bolivia	8,344	23.90	1,994	25.00	Mauritius	20,292	20.00	4,058	15.00
Botswana	16,893	14.00	2,365	22.00	Mexico	19,130	16.20	3,099	30.00
Brazil	14,916	32.30	4,818	34.00	Mongolia	11,825	23.20	2,743	25.00
Bulgaria	23,817	27.70	6,597	10.00	Morocco	7,620	21.80	1,661	30.00
Canada	48,720	32.20	15,688	26.20	Namibia	9,397	30.10	2,828	33.00
Chile	23,366	20.20	4,720	21.00	Netherlands	57,534	38.80	22,323	25.00
China	17,192	17.50	3,009	25.00	Nigeria	5,187	3.60	187	30.00
Colombia	14,324	18.80	2,693	25.00	Norway	65,800	38.20	25,136	27.00
Cote d'Ivoire	5,365	17.40	934	25.00	Oman	30,178	4.20	1,267	12.00
Croatia	27,717	38.60	10,699	20.00	Panama	27,003	14.70	3,969	25.00
Denmark	58,933	46.00	27,109	24.50	Peru	11,871	15.30	1,816	30.00
Dominican Republic	18,608	13.90	2,587	28.00	Philippines	8,452	14.20	1,200	30.00
Egypt	12,790	15.20	1,944	25.00	Poland	34,103	33.90	11,561	19.00
El Salvador	8,422	20.40	1,718	30.00	Portugal	34,103	34.70	11,834	31.50
Estonia	37,745	33.00	12,456	21.00	Romania	30,526	24.70	7,540	16.00
Finland	49,853	43.30	21,586	20.00	Russia	27,903	24.20	6,753	20.00
France	46,062	46.20	21,281	37.99	Saudi Arabia	46,811	3.40	1,592	20.00
Germany	54,076	37.50	20,279	30.18	Serbia	19,146	36.10	6,912	15.00

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Ghana	5,693	17.60	1,002	25.00	Singapore	97,057	14.10	13,685	17.00
Greece	28,748	39.40	11,327	26.00	Slovakia	32,710	32.90	10,762	22.00
Hungary	33,030	37.70	12,452	19.00	Slovenia	38,807	36.00	13,971	17.00
India	6,461	10.08	651	33.99	South Africa	12,032	28.60	3,441	28.00
Indonesia	12,222	11.50	1,406	25.00	Spain	38,392	33.70	12,938	30.00
Iran	13,073	7.30	954	25.00	Sweden	54,146	44.00	23,824	22.00
Ireland	94,392	22.80	21,521	12.50	Switzerland	72,874	28.50	20,769	21.15
Israel	40,547	32.70	13,259	26.50	Thailand	18,236	17.60	3,210	20.00
Italy	40,861	42.40	17,325	31.29	Trinidad and Tobago	25,031	22.20	5,557	25.00
Jamaica	9,975	27.30	2,723	25.00	Turkey	30,253	24.90	7,533	20.00
Japan	42,248	30.60	12,928	36.99	Uganda	2,574	13.10	337	30.00
Jordan	10,306	15.00	1,546	20.00	Ukraine	13,110	34.20	4,484	18.00
Kazakstan	26,565	16.40	4,357	20.00	United Kingdom	44,117	33.30	14,691	21.00
Kenya	4,926	18.10	892	30.00	United States	63,416	27.10	17,186	39.08
South Korea	44,621	26.90	12,003	29.08	Vietnam	10,869	18.60	2,022	22.00
Kyrgyzstan	5,036	19.80	997	10.00					

Data sources

Real percapita GDPppp	Countries by GDP (PPP) per capita 2020 - StatisticsTimes.com*R*
Tax revenue as a percentage of GDPppp	List of countries by tax revenue to GDP ratio - Wikipedia
Corporate Income tax rate (T)	https://taxfoundation.org/corporate-tax-rates-by-country-2021/

GDPppp for Macedonia is not available for year 2020 and is estimated by the year 2017 value.

A chart of the corporate tax rates by country is shown in Figure 1.

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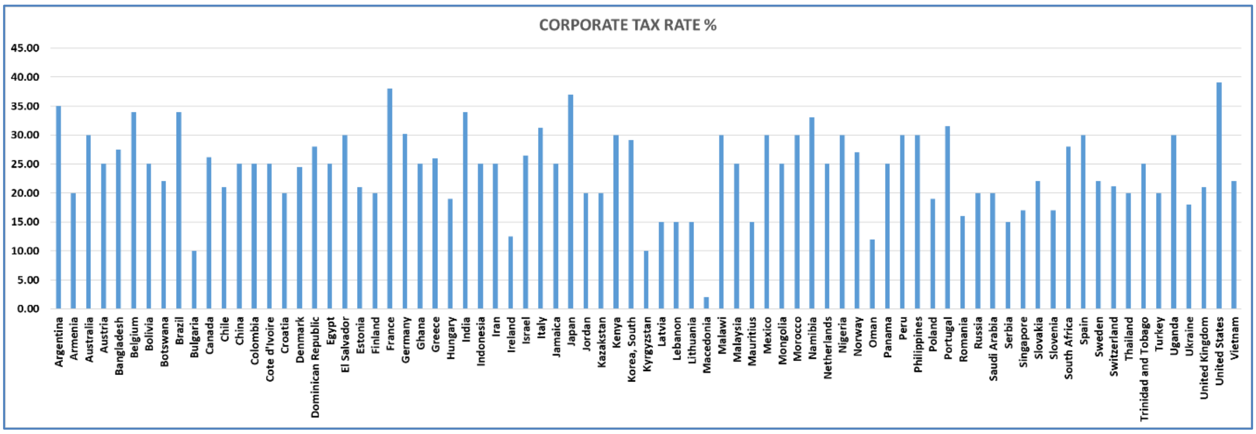

Figure 1. Year 2020 Corporate tax rate for 79 countries ranging from 2% to 39%.

To study the relationship between income tax revenue (R) and corporate tax rate (T), we fit a curve to the data as follows.

$$R=\beta_0 + \beta_1 T + \beta_2 T^2 + \varepsilon,$$

Where the intercept β_0 is set to zero when the tax rate is zero. If the tax rate is zero, then the tax revenue will be zero. β_1 is the coefficient of tax rate, β_2 is the coefficient of the square of tax rate and $\varepsilon \sim \mathbb{N}(0, \sigma^2)$ is a normally distributed random error with a mean of 0 and constant variance σ^2. The first attempt to find a relationship was based on $R=\beta_0 + \beta_1$ Tax rate + ε, but this equation yielded statistically insignificant values for the coefficient of multiple determination adjusted for the number of variables R^2adj and β_1 . The least squares curve fit is as follows.

$$\text{Fitted } R= 568.746\, T -8.97387\, \beta_2\, T^2,$$

$$t= (3.47) \qquad (-1.54) \qquad\qquad R^2adj=0.52$$

The adjusted coefficient of multiple determination R^2adj=0.52 indicates that tax rate explains 52 percent of the variation in revenue. We can test the significance of this relationship as follows. Our regression computation gives us an estimate for β_1, b_1=568.746 with standard error of estimate s_{b_1}=164.0092. Since $t=b_1/s_{b_1}$=568.746/164.0092=3.47> $t_{\alpha=0.01,\upsilon=79-2}$=2.64, where υ is the number of degrees of freedom, we conclude with a level of significance α=1% that there is a statistically significant relationship between tax revenue and tax rate. There is only a 1% chance that this conclusion is reached erroneously. The coefficient for T^2 is evaluated similarly and found to be statistically significant at approximately the 10% level. This model was re-estimated for years 1995 to 2019 with similar results.

A graph of the fitted function is shown in Figure 2. As we can see tax revenue rises and falls as the corporate tax rate increases. When the rate is zero revenue is zero. As the tax rate increases, taxes yield increasing revenues. The revenue peaks at a corporate tax rate of about 32%. As tax rate continues to increase the disincentive of taxation reduces investment and tax revenue.

The optimal tax rate can be calculated directly from calculus. Differentiating the fitted revenue function 568.746 T - 8.97387 T^2 with respect to the tax rate and setting the result to zero, we have 568.746-2x8.97387 T =0. Fom which we obtain T=32%. Maximizing tax revenues may on the surface appear to be a good strategy. However, this strategy does not maximize economic growth.

Ridley (2022) showed that GDPppp is maximized at a lower tax rate. Figure 3 shows a graph of GDPppp versus corporate tax rate. GDPppp is maximized when corporate rate is 26%. The explanation for this is that 32% generates two much revenue. Too much revenue crowds out private investment. Private investors competing with government for money must pay higher interest rates for loans than they otherwise would. The result is a net reduction in economic growth.

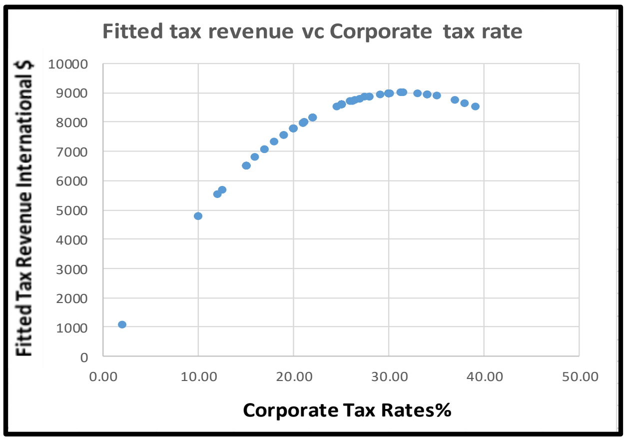

Figure 2. Year 2020 Fitted tax revenue is maximized at a corporate tax rate of 32%

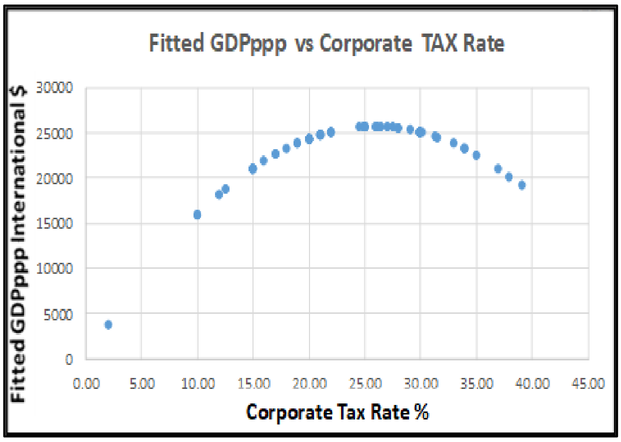

Figure 3. Year 2014 Fitted GDPppp is maximized at a corporate tax rate of 26%.

4. Conclusions

The current corporates tax rates across the world range from 2% to 39%. Obviously, there is no consensus that there is an optimal rate much less what its values is. Therefore, the findings of this paper are revealing and important. The corporate tax rates that correspond to maximum tax revenue and maximum economic growth were compared. The rates were found to be 32% and 26% respectively. The better objective is to maximize economic growth. Therefore, it is recommended that all countries set their corporate tax rates to 26%. Furthermore, we repeat the commendation by Ridley (2022) that the overall tax rate (from all sources) be arranged so as to be a weighted average equal to 21%.

Appendix

From Ridley (2020a) and Ridley (2018a) the ordinary least squares (OLS) model is $g_i = \beta_0 + \beta_c C_i + \beta_d D_i + \beta_r R_i + \beta_{cdr} C_i \cdot D_i \cdot R_i + \beta_n N_i + \varepsilon_i$, where i represents the ith country, the coefficients and variables are dimensionless, and the errors ε_i are random and normally distributed with zero mean and constant standard deviation. We regress g on C, D, R, and N to obtain the ith country estimated g as follows.

Year 2014: $g_i = 1.53C_i + 0.14D_i + 0.23R_i - 1.21C_i \cdot D_i \cdot R_i + 0.38N_i$

Where to determine the relative contributions of *C*, *D*, *R* and natural resources (*N*), we standardize the variables to guarantee upper and lower bounds of $0 \leq g, C, D, R, C \cdot D \cdot R, N \leq 1$ as follows:

g = (*G* -lowest *G*)/(highest *G* -lowest *G*), *G* represents GDPppp

C (Capitalism) = (per capita capitalization-lowest per capita capitalization)/(highest per capita capitalization - lowest per capita capitalization)

D (Democracy) = (lowest democracy rank-democracy rank)/(lowest democracy rank- highest democracy rank)

R (Rule of law) = (lowest corruption rank-corruption rank)/(lowest corruption rank- highest corruption rank)

N (Natural resources) = (per capita total natural resource rents-lowest per capita total natural resource rents)/(highest per capita total natural resource rents- lowest per capita total natural resource rents).

Democracy and corruption are rank ordered, where the highest = 1 and the lowest = the number of countries. These transformations are all one hundred percent reversible: *G* = g(highest *G*-lowest *G*) + lowest *G*, highest *G*=$83,066 and lowest *G*=$1,112.

The CDR model is depicted in the vexillological chart in Figure 4. The CDR model flattens the world and creates a path to widespread and accelerated entrepreneurship.

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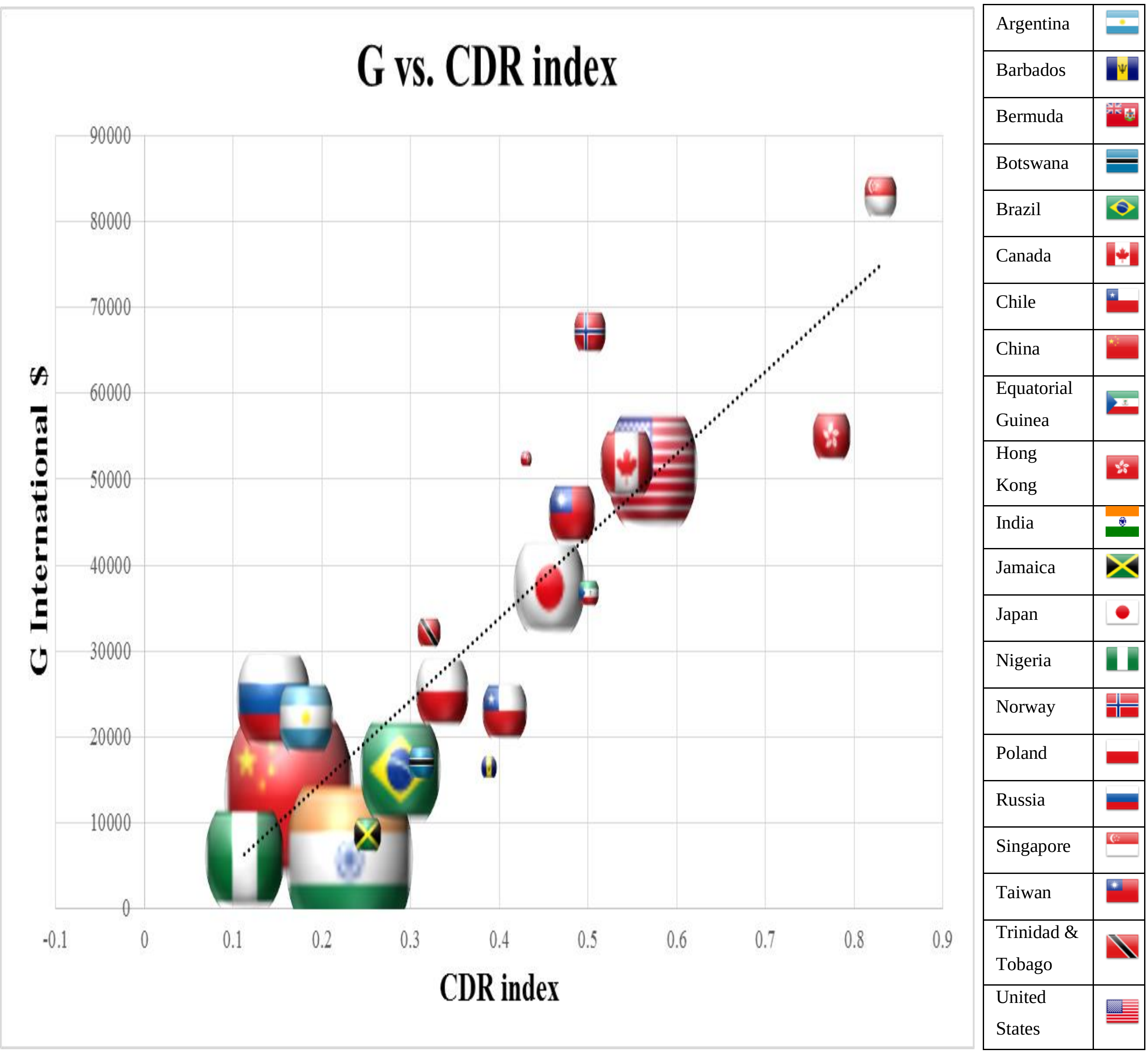

Fig 4. Year 2014 *G* vs CDR Index for 79 countries (line). Bubble size (21 countries) is the square root of population.

To correct for biased due to the endogenous capital stock component of capital, a two stage least squares (2SLS) estimate is conducted as follows.
The estimated 1st stage least squares model is

$$\hat{C}_i = 0.04 - 0.07L_i - 0.16D_i + 0.22R_i + 1.11C_i \cdot D_i \cdot R_i - 0.02N_i.$$

where $\hat{C}$ is the exogenous entrepreneurship component of capital and the instrumental variable (IV) is exogenous geographic latitude (L_i).
The estimated 2nd stage least squares unbiased model for estimating g from entrepreneurship capital ($\hat{C}_i$) is

$$\hat{g}_i = 1.30\hat{C}_i + 0.12D_i + 0.28R_i - 0.98\hat{C}_i \cdot D_i \cdot R_i + 0.39N_i.$$

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