

On Solow's Ignorance: the Sources of Economic Growth

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Abstract: In spite of the importance, strong empirical evidence has eluded the topic of the sources of economic growth.

This article contributes to the subject by considering countries as large organizations, whose competitiveness depends on the quality of their business administration areas: strategy, marketing, information systems, human resources policies and so on.

Under this perspective and for a sample of 33 countries during an homogeneous five year period, it is possible to explain 90% of the variance in income per capita.

Keywords: Economic growth sources, Economic growth causes, Economic development sources, Economic development causes.

JEL: F00 General; F43 Economic Growth of Open Economies; F63 Economic Development.

1. INTRODUCTION

That the causes of economic growth stand among the most important economic topics, led Robert Lucas to recognize, in a much quoted Marshall Lecture, that “once one starts to think about them, it is hard to think about anything else” (Lucas 1988).

It is thus not surprising the contributions the subject has received from many influential economists, including Nobel Prize winners; besides Lucas himself, Robert Solow (Solow 1956, 1957, 1963, 1970, 2001) and more recently Paul Romer (Romer 1983, 1986, 1990, 2008, 2019).

Efforts have not, however, been rewarded by satisfactory empirical evidence (Romer 1992; Gundlach 2005; Renelt 1991; Diebolt 2000; Gülmez 2018).¹

And although non-governmental entities and universities such as the World Economic Forum² and the Institute for

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Management Development³ have developed competitiveness indexes which correlate strongly with the countries GDP per capita (at 0,9 level with zero significance), they nevertheless suffer from two major limitations.

ationalized with the extent of secondary education, leaving outside higher education and professional training (as will be done in this article).

Then, Grier's analysis produced an 82% R² but with absolute GDP, not per capita, and using as an independent variable the population growth.

Still, Zhu's work explains 70% in the short term and 40% in the long run, variance, but again of absolute, not per capita, GDP.

Next, Barro's R² is 76%, but the theory behind the independent variables choice is not clear as it includes life expectancy, perhaps better suited to be a dependent variable, or if used as an independent variable it can both be argued to have a positive or negative contribution (higher level of pensioners).

And Kavoussi obtained a R² between 58% and 78% depending on the sample being larger (73 countries) or smaller (36), but regarding developing countries only, excluding OECD countries. This article will consider, both developed and developing countries.

There is finally the **fourth** category of studies which focus on the impact of a single cause on GDP per capita. That is the case of Raghutla (Raghutla 2020) which concluded that 1% increase in trade implies a 18,6% augment on the GDP growth rate and Benhabib et al (Benhabib 1994) that focusing on human capital obtained disappointing results as the parameters came negative in some instances and not significant in others.

In short and in overall all studies have **one or more of the following drawbacks:** not using GDP per capita of the total population as dependent variable; or/and low R²; or/and small samples; or/and unclear theory underneath the independent variables choice.

³ Global Competitiveness Report, World Economic Forum, Cologny (Switzerland).

³ World Competitiveness Yearbook, *Institute for Management Development, Lausanne* (Switzerland).

¹ Empirical research on the sources of economic growth can be divided into **four** categories.

First, Solow's ground breaking and Nobel winning work in 1963 (Solow 1963), which using as sample USA data of the years 1929-1957 and with capital and man-hours as independent variables, explained 37% of the GNP absolute (not per capita) variance.

Second, there is Paul Romer, another Nobel winner (Romer 1990), who under his endogenous theory explains a higher variance of GDP per capita: 58%. It includes as an independent variable 1960 GNP per capita for the sample countries, assuming decreasing marginal productivity of capital, what requires to focus on the quantity, not quality of capital.

A **third** category of empirical studies includes G. Mankiw et al (Mankiw 1992), K.B. Grier et al (Grier 1989), S. Zhu et al (Zhu 2017), R. Barro (Barro 1996) and R. Kavoussi (Kavoussi 1984).

The former achieved a R² of 78% but with as dependent variable GDP per capita of the active, not of the total population, and human capital was oper-

First, the risk of spurious relations in the absence of a strong and simple theory behind the selected variables which compose the competitiveness indexes.

And (second) the fact that both indexes contain over one hundred variables.

Thus the need for a theory, 1) conceptually strong, 2) simple and 3) that provides solid empirical results.

In business the answer to the question of what determines competitiveness is straightforward: the quality of the business administration areas. From strategy, to marketing, including all the others such as human resources policies and operations/production.

And given that many multinationals (Walmart, State Grid, Toyota, UnitedHealth, etc.) are larger than many countries, a question arises by analogy: what if a country's income per capita is dependent on the excellence of its business areas, that is, on the overall quality on them of its firms?

And that focusing on the country as a whole, not only on its private sector. Considering a country as, that is equivalent to, a company, what is its overall marketing quality? And human resources prowess? And strategy? And so on.

To evaluate such as hypothesis, four things are necessary: 1) a short list of the main business administration areas; 2) indicators to measure their quality at macro, country level; 3) a large sample of countries and years; and 4) a statistical analysis to evaluate the results.

2. THE RESEARCH

Figure one presents the business areas, their operationalization and the source of the data.

The business administration areas are nine: 1) strategy; 2) general management (organization through the organization chart, objectives setting, control and coordination mechanisms); 3) human resources management (and within it three aspects are considered here: hiring both personal – character – and work ethics, and training/instruction); 4) marketing; 5) operations/production; 6) R&D; 7) information systems management; 8) finance/accounting; and 9) the administrative area (hygiene, security and energy).

Then, the indicators for the quality of the business areas were obtained either from official sources statistics or non-governmental organizations indexes.

Strategy was operationalized by the percentage of trade (exports + imports) on each countries GDP.⁴

Indeed, when a country's internal market is completely closed, national goods do not need to be competitive (in price, quality or/and delivery) as nationals cannot opt-out. By opposition, the larger the openness, the greater the consumers freedom of choice and consequently the competitiveness requirement: local goods are sold internally or externally only to the extent that they have competitive advantage, which is precisely one of the pillars of strategy (Sá 1999; Sá 2005; Sharma 2020; Froning 2000; Gancia 2020).

General management was operationalized with a survey by Bloom at al (Bloom 2017) and within **human resources**, personal ethics by the corruption perception index of the NGO Transparency International⁵. Still within human resources work ethics was measured by the entrepreneurship index of the Global Entrepreneurship and Development Institute⁶ (which rates countries in terms of variables such as risk acceptance, networking and openness to opportunities) and the level of training was measured by the variables of quality and enrollment level of primary and higher education together with training (variables evaluated by the World Economic Forum)⁷.

The purpose of **marketing** is after analyzing clients needs (through marketing research) to serve them with the four Ps: product, price, placement and promotion. That is known as the marketing concept (McKitterick 1957; Kotler 1967) (by opposition to the production concept) and has at its core, adaptation.

Something the more necessary, the more with freedom of choice, the consumer rules in economic free markets (an index produced by the Heritage Foundation⁸) by opposition to low levels of competition in private sector (due to monopolies, oligopolies).⁹

Operations/production was operationalized by gross fixed capital formation relative to the GDP (a statistic directly supplied by the World Bank¹⁰). The quality of the **R&D** department by the global innovation index (created by a joint-venture among the Cornell and Insead universities and the World Intellectual Property Organization)¹¹.

Information systems management was measured by ICT adoption as evaluated by the World Economic Forum¹², **finance/accounting** was operationalized by World Economic Forum pillar 8 (financial market development) of the global competitiveness report¹³.

The **administrative area** includes: *hygiene* which was operationalized by the expectancy of healthy life (quantified by

⁴ Trade (% of GDP), World Bank, Washington D.C. (USA)

⁵ Corruption Perception Index, *Transparency International*, Berlin (Germany)

⁶ Global Entrepreneurship Index, The Global Entrepreneurship and Development Institute, Washington D.C. (USA)

⁷ Global Competitiveness Report, Pillars 4.09, 4.10 and 5, *World Economic Forum*, Cologne (Switzerland)

⁸ Index of Economic Freedom, *The Heritage Foundation*, Washington D.C. (USA)

⁹ Indeed the economic freedom index measures three things: 1) the level of taxation; 2) the extent to which the state is present in the economy; and 3) the degree of competitiveness in private markets (absence of monopolies, oligopolies and dominant positions by firms). The first two are related unless systematic and unsustainable in the long run public deficits prevail and both together with the latter define the level of consumer freedom of choice and the need for firms to implement sound marketing policies. Contrary to a strong presence of state-owned firms which rarely allow for competition.

¹⁰ Gross fixed capital formation (% of GDP), World Bank, Washington D.C. (USA)

¹¹ Global Innovation Index, *Cornell University, INSEAD, and World Intellectual Property Organization*, Geneva (Switzerland)

¹² Global Competitiveness Report, Pillars 2.08, 2.09 and 9, *World Economic Forum*, Cologne (Switzerland)

¹³ Global Competitiveness Report, Pillar 8, *World Economic Forum*, Cologne (Switzerland)

Figure One

The Nine Business Administration Areas, their Operationalization and Sources.

Business Administration Areas				
Areas (and subareas)		Indicator / operationalization		Source
1. Strategy		% exports + imports (trade) on GDP		World Bank
2. General management		World management survey		Bloom et al survey
3. Human resources	Training/instruction		Instruction quality	World Economic Forum
	Selecti-on	Personal ethics	Corruption perception index	Transparency International
		Work ethics	Global entrepreneurship index	Global entrepreneurship and development institute
4. Marketing		Economic freedom index		Heritage Foundation
5. Operations/production		% gross fixed capital formation on GDP		World Bank
6. Research & Development		Global innovation index		Cornell University + Insead + World Intellectual Property Organization
7. Information systems		ICT adoption		World Economic Forum
8. Finance/accounting		Financial System		World Economic Forum
9. Administrative area	Hygiene		Healthy life expectancy	World Health Organization
	Security		Global Peace Index	Institute for Economics and Peace
	Energy		Electricity access and quality	World Economic Forum

the World Health Organization)¹⁴; *energy* by the World Economic Forum¹⁵; and *security* by the global peace index of the NGO Institute for Economics and Peace¹⁶.

Figure one summarizes the business variables, the indicators used and the respective sources.

The sample selection followed six criteria.

First both cross section and time series. Second the countries sample should include developed (OECD members) and less developed ones. Third, availability of data. Fourth and fifth, the time (series) period should be homogeneous to increase the difficulty and thus significance to obtain results and immune to external shocks such as the subprime or Covid crisis. And finally, the sample should be as large as possible.

In the end one settled on the 35 countries used in a study of Bloom et al. to evaluate the quality of general management with the exclusion of Northern Ireland and Myanmar because of the inexistence of other data (figure two). And the period was the years in between the subprime and Covid crisis producing a total of (33x5) 165 observation points.

To reinforce causality, the independent variables preceded by one year the dependent one (national income per capita

obtained from World Bank), and thus the former respect the years from 2014-2018 and the latter 2015-2019.

3. THE STATISTICAL ANALYSIS

First of all a Lasso analysis (Hastie 2015; Chatterjee 2012; Provost 2013; Taddy 2019) was performed on the data to deal with the high levels of multicollinearity among the independent variables.¹⁷

As a consequence of the Lasso analysis the following variables were excluded:

- Gross fixed capital formation in % of GDP (operations/production);
- Financial system (finance/accounting);
- Healthy life expectancy (hygiene within the administrative area);
- Global peace index (security in the administrative area); and
- Electric access and quality (energy also belonging to the administrative area).

Figure Two

¹⁴ Healthy life expectancy, *World Health Organization*, Geneva (Switzerland)

¹⁵ Global Competitiveness Report, Pillars 2.09 and 2.10, *World Economic Forum*, Cologny (Switzerland)

¹⁶ Global Peace Index, *Institute for Economics and Peace*, Sydney (Australia)

¹⁷ Multicollinearity was expected to occur since being high quality in most, if not all, business administration areas necessary for competitiveness, the best performing organizations excel in various of those areas (strategy, marketing, operation, and so forth). Therefore the same is expected to happen when countries are considered to be large organizations as in the present research.

The Thirty Three Countries Analyzed in the Study

Country	OECD MEMBER
Argentina	No
Australia	Yes
Brazil	No
Canada	Yes
Chile	Yes
China	No
Colombia	Yes
Ethiopia	No
France	Yes
Germany	Yes
Ghana	No
Greece	Yes
India	No
Ireland	Yes
Italy	Yes
Japan	Yes
Kenya	No
Mexico	Yes
Mozambique	No
New Zealand	Yes
Nicaragua	No
Nigeria	No
Poland	Yes
Portugal	Yes
Singapore	No
Spain	Yes
Sweden	Yes
Tanzania	No
Turkey	Yes
United Kingdom	Yes
United States	Yes
Vietnam	No
Zambia	No

Leaving as independent variables for further analysis: 1) strategy; 2) general management; 3) within human resources

management, character (personal ethics), work ethics and training; 4) marketing; 5) information systems management; and 6) the R&D.

A linear regression was then performed on the data since four assumptions hold:

1. Linearity and additivity of the relation between dependent and independent variables as the expected value of the dependent variable is a straight-line function of each independent variable, holding the other variables constant; the slope of that line is independent on the values of the other variables; and the effects of different independent variables on the expected values of the dependent variable are additive;

2. The issue of statistical independency of the errors does not apply as most of the sample is cross section (33 countries) and not time series (5 years).

Furthermore, the absence of residuals autocorrelation was supported by diagrams enabling the visualization of the errors;

3. The same applies regarding whether the error distribution is normal and as the objective is to minimize the mean squared errors; and

4. The model is homoscedastic as the P test assumes the value 0,17 (greater than 0,05), thus rejecting the heteroscedasticity hypothesis.

Figure three presents the regression results: parameters, t test and their significance level: as expected all eight parameters come positive, being five out of eight statistically significant at least at 5% level (indicating a very low probability that the parameters are due to chance).

4. RESULTS

The quality of nine business administration areas in a sample of 33 countries, both developed and developing, explains ninety percent of the variance of their income per capita during the five years in between the two recent crisis of sub-prime and Covid.

Thus the overall predictability of the model is strong and significant at zero level, and under a solid and simple theory which looks at countries as large diversified organizations composed by many individual units (their firms).

This article consequently represents a first step in what seems to be a promising new venue of research by providing empirical evidence to what has been previously said, namely that there are no underdeveloped countries, only undermanaged ones. (Drucker 1973)

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Figure Three

The Regression Results: Parameters, t Test and Significance.

Dependent Variable	Gross national Income Per Capita at Purchasing Power Parities	Model	R ² = 0,9043	
			F test	Value = 184,33
				Significance = 0,0000

Independent variables	Indicator	Parameter	T test	Significance level	
Strategy	% exports + imports (trade) on GDP	88,50	8,32	0,000	
General management	World management survey	8.468,39	2,38	0,018	
Human Resources	Personal Ethics	Corruption Perception Index	37,167	0,47	0,642
	Work Ethics	Global Entrepreneurship Index	150,71	2,14	0,034
	Training/Instruction	Instruction quality	164,615	1,41	0,161
Marketing	Economic Freedom index	162,78	1,49	0,138	
Information systems	ICT adoption	345,92	3,32	0,001	
Research & Development (R&D)	Global innovation index	278,85	2,23	0,027	

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