



Relações entre as variáveis macroeconômicas, o Índice de Complexidade Econômica e os investimentos em Ciência, Tecnologia e Inovação

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Resumo: Muitos países ao redor do mundo têm investido em Ciência, Tecnologia e Inovação (CT&I) para conseguir aumentar o setor exportador. Aliás, alguns deles têm a percepção de que o dinheiro repassado para CT&I pode aumentar a complexidade da economia. Para demonstrar tais percepções de países foram coletados dados de um ranking dos 15 países que mais investem em CT&I no mundo. O objetivo deste trabalho é analisar a relação entre as variáveis macroeconômicas e o Índice de Complexidade Econômica (ICE) e nos investimentos em CT&I. Assim, foram encontradas evidências de que não há relação entre a complexidade econômica e os investimentos em CT&I por parte do governo.

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Palavras-chave: Complexidade Econômica. PIB.
Análise de regressão.

Relations between the macroeconomics variables, the Economic Complexity Index and the investments in Science, Technology and Innovation

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Abstract: Many countries around the world have invest at the Science, Technology and Innovation (ST&I) in order to succeed to incrementing the exportation sector. By the way, some of them has a perception that the money transferred to ST&I may rise the complexity of the economy. In order to demonstrate such perceptions of countries were collected dates from a rank of 15 countries that more investments in ST&I in the world. The objectives of this work is to analyze the relationship between macroeconomics variables and the Economics Complexity index (ECI), and in investments in ST&I. So, it was found some evidence about there are not relationships between economic complexity and investments in ST&I by the government.

Keywords: Economic Complexity. GDP. Regression Analysis.

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Relaciones entre las variables macroeconómicas, el Índice de Complejidad Económica y las inversiones en Ciencia, Tecnología e Innovación

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Resumen: Muchos países alrededor del mundo han invertido en Ciencia, Tecnología e Innovación (CT&I) para lograr incrementar el sector exportador. Por cierto, algunos de ellos tienen la percepción de que el dinero transferido a ST&I puede aumentar la complejidad de la economía. Para demostrar tales percepciones de los países se recogieron datos de un ranking de los 15 países que más invierten en CT&I en el mundo. El objetivo de este trabajo es analizar las relaciones entre las variables macroeconómicas y el Índice de Complejidad Económica (ECI), y las inversiones en CT&I. Así, se encontró evidencia de que no existen relaciones entre la complejidad económica y las inversiones en CT&I por parte del gobierno.

Palabras clave: Complejidad Económica. PIB. Análisis de regresión.

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1. Introduction

The innovation contributes to the connection between economy and development in the countries. Therefore, many countries around the world invest in Science, Technology, and Innovation (ST&I) an important amount of their Gross Domestic Product (GDP) in order to succeed to incrementing the exportation sector. In the 1960s, the country was a great importer of food like chicken meat for example. Since Brazil start to invest in science and research, the country provided enormous growth in productivity. In this way, investments in ST&I are also associated with agribusiness.

In the past the results of such investments were the creations of governmental institutions as the Embrapa (in Portuguese – Empresa Brasileira de Pesquisas Agropecuárias), Ceplac (in Portuguese – Comissão Executiva do Plano da Lavoura Cacaueira), Cati (in Portuguese – Coordenadoria de Assistência Técnica Integral) among others and educations institutions as the universities. In order to maintain the agricultural production, it was necessary to continue investments in the science and technology.

The reducing of investments in research, production innovations will make the agriculture loses its competitiveness in the medium and long term (GONÇALVES, 2019). So that, the reducing of production could impact on the food security. These investments are essential for the country to advance and for this way its industry could be more competitive in the international scenario. In view of scenario, it is necessary to describe the various present in this work.

According to the Haussmann (2013), the Economic Complexity Indicator (ECI) measures both the diversity and complexity of a country's economy. It is calculated as the average of the complexity of products in which the country produces and export. For this way, the more a country advances in productive

knowledge, the more diversified the economy becomes. Furthermore, each product made in a country reveals the complexity of all the sectors involved. Thus, the product complexity is part of process. It is related to a Product Complexity Index (PCI). It is based on diversity and ubiquity. Diversity refers to the number of products that the country exports with a comparative advantage and ubiquity is the number of regions that export a given product with comparative advantage. So, diversity refers to numbers of product and ubiquity refers to number of countries.

The PCI is based on the idea that more complex products are produced, and exported, by a smaller number of countries. So, they require more productive knowledge to be manufactured. Moreover, the more complex products are those produced by few (HAUSMANN et al., 2013). The Human Development Index (HDI) is a measure related to the average of the human development of a country. It splits into three parts: health (life expectancy), education (level of knowledge of the population) and Income (Gross Domestic Product *per capita*) (UNITED NATIONS, 2022).

The objective of this work is to demonstrate a relationship among variables those are bonded to the economics growing of 15 countries as well development. So, this work hereby looks for an answer about two assumptions

- First: there is a relationship between the Economic Complexity Index (ECI) of the countries and the group of variables composed by Gross Domestic Product (GDP), Human Development Index (HDI), exportations and importations.
- Second: there is a relationship between the investments in Science, Technology and Innovations (ST&I) and the group of variables composed by Gross Domestic Product (GDP), Human Development Index (HDI),

exportations and importations.

The relationship among the variables will be demonstrate by the statistic multivariable regression method and using the Microsoft Excel software. For this way, in brief the investments in ST&I are also associated with agribusiness.

2. Methodological procedures

This work is a quantitative analysis with continuous variable that are presents at table 1. It is a regression multivariate. It ranks 15 countries by the investments in Science, Technology and Innovations (ST&I). The dates of investments in ST&I are from de 2018. The Gross Domestic Product (GDP) is the whole production of services and goods for a period of time in a country. Its measurement is given in billions of dollars. Human Development Index (HDI) is a measure of average in three important dimensions of human development. First, the life expectation of people, second the years of schooling in relation to education, finally the Gross Domestic Product income *per capita*. These dates were collected in de United Nations Development Program (UNDP) (UNITED NATIONS, 2022).

Both exportation and importation of goods and services are measure in billions of dollars in international trade. Finally, the variable Economic Complexity. It is system of tools which is connected to economic geography, international development, and innovation studies (HIDALGO, 2021). Thus, it is possible to present a framework in which the mains products and services of a country are exported. Moreover, it views the percentages and the importing countries.

The dates and informations about the Economic Complexity are in the site <<https://oec.world/>>. It means The Observatory of Economic Complexity. All the dates were copied to the spreadsheet on the MS Excel, worked on and prepared for regression analyses. Then, the regression analyzes are performed

on the data in the spreadsheet. The results are presents in the section 4. The confidence interval in regression analysis applied is 95%.

3. Results and discussions

The table 1 below presents the data collected from books, sites, reports and several sources of information for the 15 countries.

Table 1 – Countries and respective Economics Variables

#	Country	ECI	*GDP	HDI	**Pro- duct Export	**Serv ice Ex- port	**Inves tment in ST&I
1	United States	1,56	22.996.100	0,91	1340	746	476,5
2	China	0,96	17.734.062	0,761	2654	209	370,6
3	Japan	2,19	4.937.421	0,919	623	205	170,5
4	Germany	1,88	4.223.116	0,947	133	236	109,8
5	Republic Korea	1,88	1.798.533	0,916	531	96	73,2
6	France	1,34	2.937.472	0,901	472	146	60,8
7	India	0,56	2.571.622	0,645	284	205	48,1
8	United Kingdom	1,42	3.186.859	0,932	371	38	44,2
9	Brazil	0,44	1.608.981	0,765	214	338	42,1
10	Russia	0,5	1.775.799	0,824	33	577	39,1
11	Italy	1,3	2.099.880	0,892	481	139	29,6
12	Canada	0,93	1.990.761	0,929	371	103	27,6
13	Australia	-0,31	1.542.659	0,944	25	46	23,1
14	Spain	0,76	1.425.276	0,904	298	138	19,3
15	Netherlands	1,13	1.018.007	0,944	511	144	16,5

Source: World Bank (2022), UNDP (2022), OEC (2021). *Trillion US\$. **Billions US\$.

The regression analysis run for twice in order to find the relationship between ECI and investments in ST&I and others variable, as Gross Domestic Product (GDP), Human

Development Index (HDI), exportations and importations. Both variables ECI and investmens in ST&I were run at the regression analysis in MS Excel Software.

Table 2 – Variables and p-value of Regression

Variables / p – value	1st run	2nd run
Interseccion	0,344955	0,561379
GDP (Trillions US\$)	0,944440	0,00016
HCI	0,164893	0,568754
Products Exports (Billions US\$)	0,629095	0,554755
Service Exports (Billions US\$)	0,833885	0,522729
R2 adjusted	-6,100000	0,960000

Source: Research data.

The variables impacted ECI and investments in ST&I could be or not be impacted by other variables. Thus, the regression was performed at the MS Excel software for the first time and involved all the rest of variables, except investments in ST&I. The results found for the first assumptions in relation to adjusted R2 is -6,1. The signal is negative. It means that R2 value is insignificant for this regression analysis.

It implies that the variable ECI is not explained by the other variables. Moreover, another variables Gross Domestic Product (GDP), Human Development Index (HDI), exportation and importations presents a p-value more than 5%. So, for the second time, the variable investments in ST&I it was run at the Excel. Thus, the regression software run for the second time and involved all the rest of variables, except ECI.

The results found for the first assumption in relation to adjusted R2 is 96%. Therefore, it means that R2 value is significant for this regression analysis. It implies that the variable investments in ST&I is explained by the follows variables Gross Domestic Product (GDP), Human Development Index (HDI), exportations and importations. In addition, the variable Gross

Domestic Product (GDP) is about 0%. This implies that the impact on the investments in ST&I by the GDP are significant, considering 95% of confidence interval.

4. Conclusions

Hassmann et al. (2005) explains that the support to an environment that includes entrepreneurship and investment in new activities would be the basis to economic convergence. So, the results shows both variables described ECI and investments in ST&I could be impacted by other variables. In this case, the ECI isn't affected by any of the variables analyzed. In addition, the adjusted R2 is negative, so insignificant. So, for these results the complex economic is not the enough to attract government investments. In addition, the ECI has no impact by the GDP, exports, imports and HDI. On the other hand, the investments in ST&I could be explained by adjusted R2 in 96%. In this case, the variable more adjusted is the GDP. Therefore, the investments in ST&I could be impacted by the variable GDP. So, some questions could be done. The financial resources that are transferred to the ST&I could come from the entrepreneurs and companies. These results are important once that "The ability of the ECI to predict future economic growth suggests that countries tend to move towards an income level that is compatible with their overall level of productive knowledge" (HAUSMANN et al. 2013, p. 29). For that reason, the investments in ST&I could have impact on the agrobusiness.

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