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PRODUCTIVITY ATTRIBUTABLE TO OFFSHORING IN SELECTED COUNTRIES

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Abstract

The term offshoring refers to the process when firms decide to manufacture products abroad to reduce costs and to produce more efficiently. In the field of economics, offshoring is not a new topic, however, the rapid increase in offshoring induced by the incentive of creating a more efficient production, technological changes, and competition to reduce costs has been globally overlooked. Nonetheless, the rate of change in productivity is different among countries due to their uniqueness and resources, as well as between the different sectors of the economy. Although there are many published studies about inward Foreign Direct Investment (FDI), there are not many available studies that focus on the relationship between outward FDI and productivity, additionally, much less in sectors of the economy other than manufacturing and services. For this reason, in an effort to explain the phenomenon of the latter, a multiple linear regression was created to determine the outward FDI of the sectors of the economy that significantly influence productivity. To measure productivity attributable to offshoring, the model used data on outward FDI per sector of the economy and compared to each country's Gross Domestic Product (GDP) per hour worked. It was found that, in general, there is a distinctively higher productivity in the manufacturing and services sector than other sectors of the economy. This paper presents an alternative way to measure the productivity of offshoring.

Keywords: Offshoring, productivity, sectors of the economy, inward Foreign Direct Investment (FDI), outward Foreign Direct Investment (FDI)

JEL Classification: F00, F10, F69

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1. Introduction

Firms tend to find innovative ways to reduce production costs in an effort to make higher profits. The process of offshoring is the relocation of goods and services from companies to a foreign country in an effort to reduce production costs. The rapid increase in offshoring has been induced by the incentive of creating more efficient production, increased technological changes, while competition to reduce costs has been globally overlooked (Olsen, 2006, p. 6). Nonetheless, the rate of change in productivity is different among countries due to their uniqueness and resources hence, it also varies among the different sectors. Offshoring is a process that has increasingly grown over the last century and will continue to increase as it impacts the rate of productivity in each country. For this reason, it should not be overlooked, but studied into further detail. Therefore, this paper will examine the connection of offshoring to productivity in some selected countries, analyzing from a different perspective the correlation of outward FDI and productivity. Additionally, offshoring will be assessed among distinct sectors. The economic indicator known as outward foreign direct investment (FDI), which is defined as a business strategy in which a domestic firm expands its operations to a foreign country, will be used to measure offshoring. Additionally, this paper will evaluate the effect that the outward FDI has on productivity in the different sectors.

2. Methodology

To measure productivity attributable to offshoring in some selected countries, GDP per hour worked was used as an indicator of productivity (Dependent variable), while outward FDI's of all sectors of the economy in each country were considered as indicators of offshoring (Independent variables) as proposed by Olsen (2006).

Therefore**,** a database was built in the statistical software Statistica 8.0 using the reports of the Organization for Economic Co-operation and Development (OECD) on the data set of Foreign Direct Investment (FDI) flows by industry and GDP per hour worked. All countries that had reported any relevant information for Outward DFI for all major sectors of the economy between 2003 and 2012 were included in the analysis.

An exploratory statistical analysis, including the construction of box plots, was performed in order to identify errors and outliers. All outliers were then excluded, however, several countries such as Canada and United States, showed a high number of outliers and extreme values. Therefore, to identify if data was naturally formed by clusters, a Principal Components analysis was performed using this *original* database.

The Principal Components Analysis (PCA) identified 3 clusters, one of those clusters included the countries that showed high number of outliers and extreme values. Therefore, all countries whose data contained more than 25% of outliers or extreme values were totally excluded from the *original* database to be analyzed separately. The *main* database included, therefore, 22 countries.

A Multiple Regression Analysis was then performed on the *main* database using the GDP per hour worked (in millions of USD) as the dependent variable (Y), and the outward FDI (in millions of USD) of the sectors of the economy as independent variables. The proposed regression model is next:

$$\gamma = c + \beta_1\chi_1 + \beta_2\chi_2 + \beta_3\chi_3 + \beta_4\chi_4 + \beta_5\chi_5 + \beta_6\chi_6 + \beta_7\chi_7 + \varepsilon$$

… where…

Abbreviation	Variable	GDP & Sectors of the Economy
c	c	Constant of the model
□□□□□□	□□□□□□	Coefficients of the Independent variables
GDP	□	GDP per Hour Worked
AAF	χ_1	Outward FDI in the Agriculture and Fishing Sector
MAQ	χ_2	Outward FDI in the Mining and Quarrying Sector
MAN	χ_3	Outward FDI in the Manufacturing Sector
EAW	χ_4	Outward FDI in the Electricity and Water Sector
CON	χ_5	Outward FDI in the Construction Sector
TS	χ_6	Outward FDI in the Total Services Sector
UN	χ_7	Outward FDI in the Unallocated Sector
□	□	Statistical error of the model

All non-significant variables were excluded, and a new regression analysis was performed (Not shown). A Principal Component Analysis was developed with the *main* database.

Using the variables that were initially excluded due to their high number of outliers, a *secondary* database was built, and a second exploratory statistical analysis, including the construction of box plots, was performed to identify outliers. All values in this database from United States were identified as outliers and the whole information from this country was excluded from further analysis. A Multiple Regression Analysis was then performed with this *secondary* data base.

In order to visually compare the analyzed countries, means for all variables were calculated per country using the *original* data. To be able to visually compare all countries, data was standardized among both, cases and variables. Then, Chernoff faces were plotted by assigning the values of the analyzed variables to face features. In this

way, relative values of variables selected for the graph were represented by variations of specific facial features.

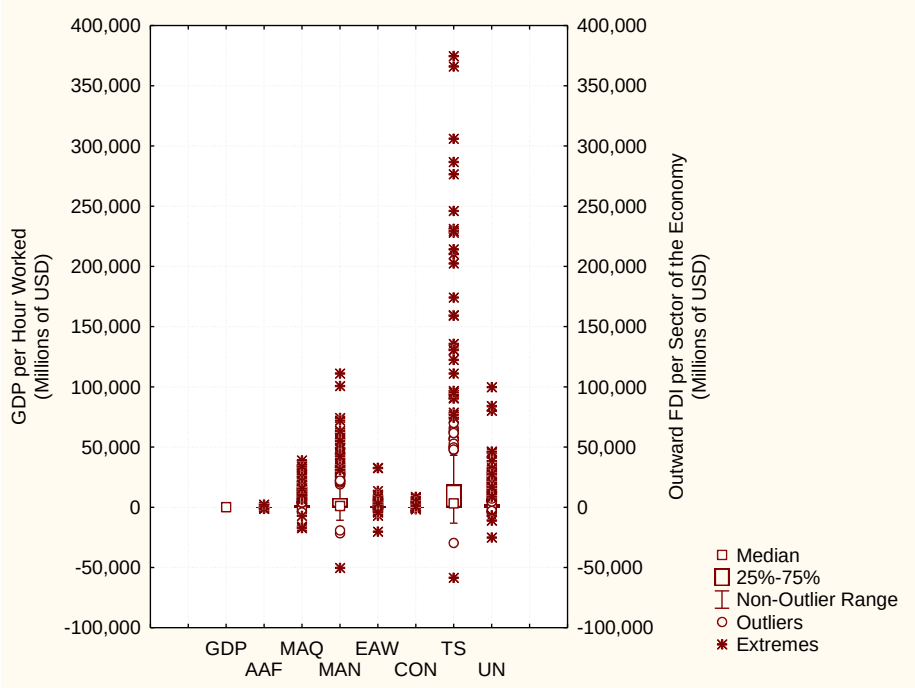
Similarly, to the Outward FDI, a database was built using the reports of the Organization for Economic Co-operation and Development (OECD) on the data set of Foreign Direct Investment (FDI) flows by industry and GDP per hour worked. All countries that had reported any relevant information for Inward DFI for all sectors of the economy between 2003 and 2012 were included.

An exploratory statistical analysis, including the construction of box plots, was again performed in to identify errors and outliers. All outliers were then excluded, and a Multiple Regression Analysis was performed using the GDP per hour worked (in millions of USD) as the dependent variable (Y), and the inward FDI (in millions of USD) of the sectors of the economy as independent variables. Finally, Chernoff faces were again plotted by assigning the means of the analyzed variables to face characteristics to visually compare the analyzed countries according to their Inward FDI variables. Inward-related data was also standardized among both, cases and variables before being plotted.

3. Results and Discussion

Figure 1 shows the box plot of the GDP per Hour Worked and the Outward FDI of the sectors of the economy. Outliers are shown as small circles, while extreme values are indicated with asterisks. Outliers are defined as those located between +/- 1.5 and 3 Standard Deviations beyond the second and fourth quartiles, while extreme values are beyond +/- 3 Standard Deviations of the second and fourth quartiles.

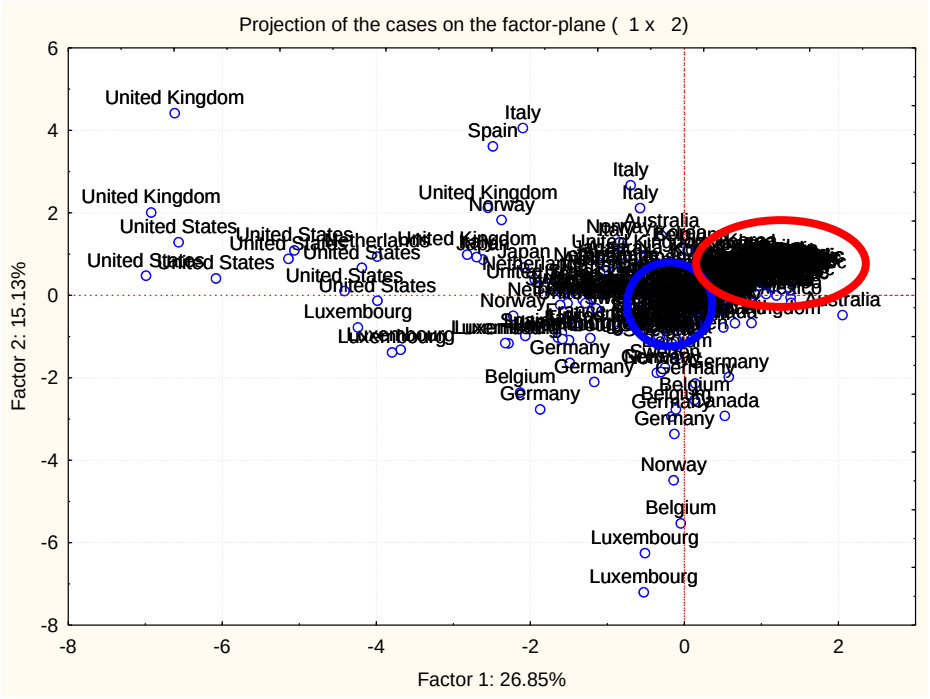
Figure 1. Box plot of the GDP per Hour Worked and the Outward FDI of the sectors of the economy.



As stated in the methodology, all outliers and extreme values were removed to perform the regression analysis, however, several countries such as Canada and United States, show a high number of outliers and extreme values. Therefore, to identify if the data was naturally formed by clusters, a Principal Components analysis was performed using this original data base.

The Principal Components Analysis is shown in Figure 2. Three basic clusters were identified and indicated in a red circle, in a blue circle, and the rest of cases that are not circled. The latter cluster included countries that showed high number of outliers and extreme values in the box plot. Therefore, all countries with more than 25% of outliers or extreme values were totally excluded from the *original* database to be analyzed separately. The *main* database included, therefore, 22 countries.

Figure 2. Principal Component analysis using the original database. Clusters are indicated inside a red circle, a blue circle and the rest that is not circled. Percentages that are shown besides each factor indicate the variance contribution of the variables that form that factor.



The included and excluded countries for the regression analysis are listed on Table No. 1. It is clear that the excluded countries correspond to open economies that have high GDP levels where offshoring might not be that significant when compared to the size of their economies. According to Cheung, Rossiter and Zheng (2008), benefits of offshoring differ from country to country.

Table 1. Included and excluded countries in the Regression Analysis

Included Countries in the Regression Analysis (The *main* database included information from these countries only)		**Excluded Countries**
Austria	Israel	Australia
Belgium	Korea	Canada
Chile	Luxembourg	France
Czech Republic	Mexico	Germany
Denmark	New Zealand	Italy
Estonia	Poland	Japan
Finland	Portugal	Netherlands
Greece	Slovak Republic	Norway
Hungary	Slovenia	Spain
Iceland	Sweden	Switzerland
Ireland	Turkey	United Kingdom
		United Stated

The Regression Analysis of the main database revealed four significant variables ($p<0.05$) besides the intercept. Non-significant variables were excluded, and the regression analysis was run again. Table 2 shows the regression analysis for the significant variables. Although the R^2 was significant, its value shows a relatively weak association between the significant variables and the GDP per Hour Worked, this might indicate that, although there is a relationship between Offshoring and the Productivity of a country, Offshoring is not really a factor that strongly affects the productivity of a country. However, according to Agnese and Ricart (2009), there is either a net or positive effect from offshoring in the long run, even when those effects are directly produced or as a spillover effect.

Table 2. Regression Summary for Dependent Variable: GDP (Outward DFI)

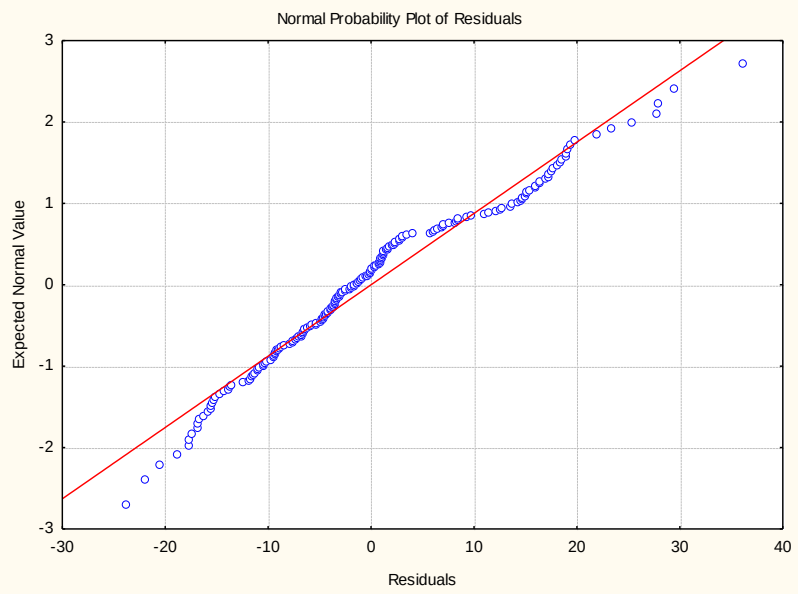
R= .61308510 R²= .37587333 Adjusted R²= .36307074 F(4,195)=29.359 p<0.05

	Beta	**Std.Err. – of Beta**	**B**	**Std.Err. – of B**	**t(195)**	**p-level**
Intercept			33.42708	0.943890	35.41418	0.000000
MAQ	-0.169530	0.060513	-0.00335	0.001197	-2.80156	0.005598
MAN	0.328823	0.060996	0.00152	0.000282	5.39093	0.000000
TS	0.370873	0.056900	0.00054	0.000083	6.51795	0.000000
UN	0.343966	0.057139	0.00041	0.000068	6.01976	0.000000

The analysis of residuals showed an almost normal distribution, which indicates that original variables did not need any transformation. Figure 3 shows the residuals distribution.

Using the variables of countries that were initially excluded due to their high number of outliers (*secondary* database), a Multiple Regression Analysis was also performed. All values in this database from United States were excluded due to being outliers. No variable was significant for the regression. All of these countries are too different in their economies, that trying to find a significant regression was not possible. It is important to say that countries that finance offshoring are usually develop countries, while host countries, are usually developing countries or countries with emerging economies, therefore, every develop country possibly has diverse products and services to offshore that might be different among them. In addition, offshoring countries may choose different host countries depending on the different elements that each host country can offer. Some of the characteristics a country may depend on include location factors, business and labor environment, talent availability as well as cost structure (Scasso, Ruiz and Kwacz, 2013).

Figure 3. Residuals Analysis: Normal Probability plot of Residuals.



The Principal Component Analysis was again performed on the *main* database (no outliers or extremes). Figure 4 shows the projection of the selected countries (cases) on the factor plane (1x2). The plot shows two main areas, one that includes some dispersed cases on the left, and a second one with a highly dense cases zone on the right.

A zoom close to the origin (0,0 intercept) is shown in Figure 5. Countries towards the negative x-axis correspond to developed countries with relatively strong economies of Western Europe (except for those countries with stronger economies that were excluded since the beginning) plus Korea that is slightly towards the negative y-axis. The cluster on the right is still very dense and difficult to see at this zoom level.

The highly-dense cluster of countries on previous graphs is again zoomed in Figure 6. Countries in this zone correspond to developed economies, including Eastern European Countries, Greece, Portugal, Israel, New Zealand as well as countries with developing and emerging economies such as Mexico, Chile and Turkey. Although some of these countries are considered developed economies, it is clear that most of them (if not all) have suffered from hyperinflation, high debt levels causing financial bailout, high poverty measures and/or income inequality. While countries with emerging and developing economies have similar concerns, they also face corruption, political uncertainty, high unemployment, shrinking GDP growth and high tariffs.

Figure 4. Projection of countries (cases) on the factor plane (1x2). Percentages that are shown besides each factor indicate the variance contribution of the variables that form that factor.

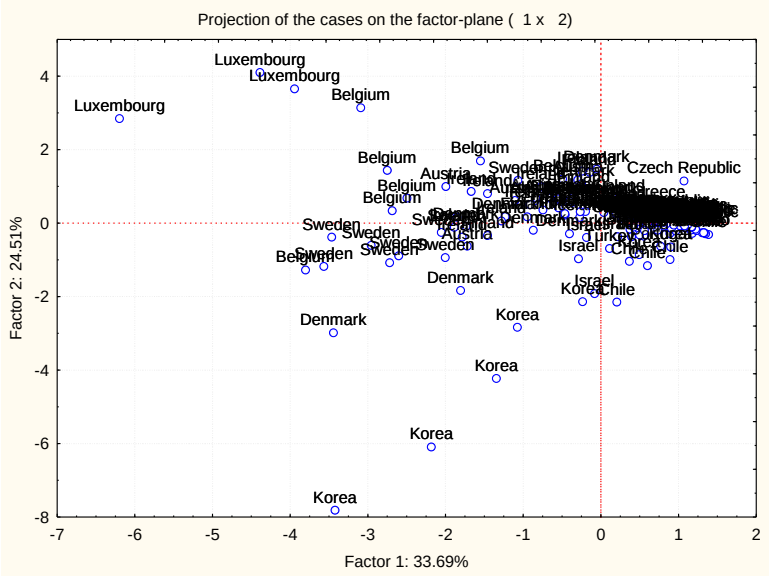


Figure 5. Zoom close to the origin (0,0 intercept) of the Projection of countries (cases) on the factor plane (1x2). Percentages that are shown besides each factor indicate the variance contribution of the variables that form that factor.

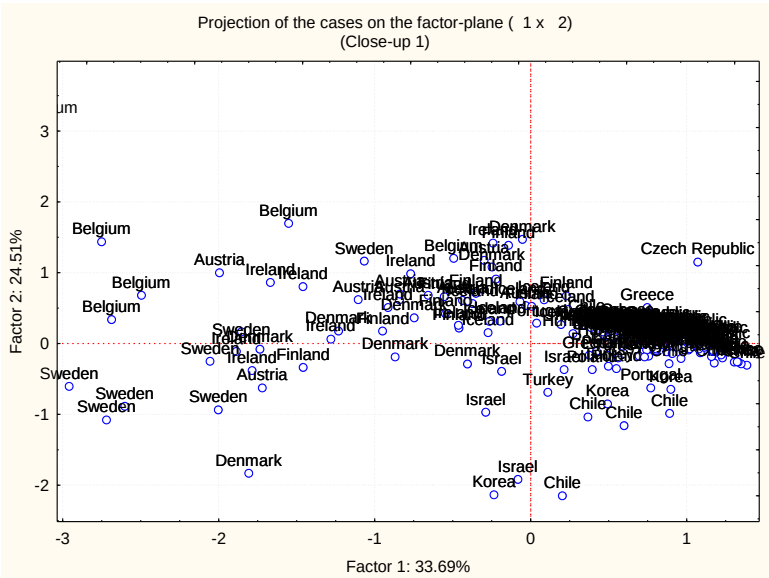
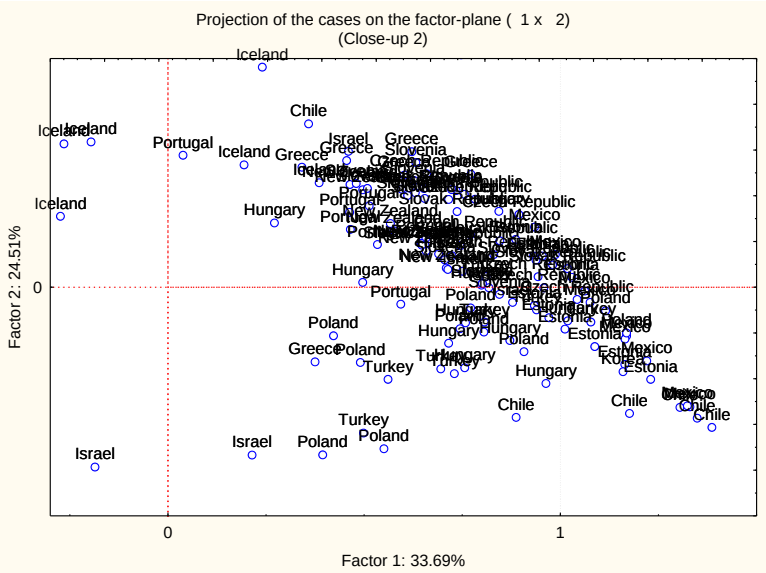


Figure 6. Double zoom of the highly-dense zone of the Projection of countries (cases) on the factor plane (1x2). Percentages that are shown besides each factor indicate the variance contribution of the variables that form that factor.



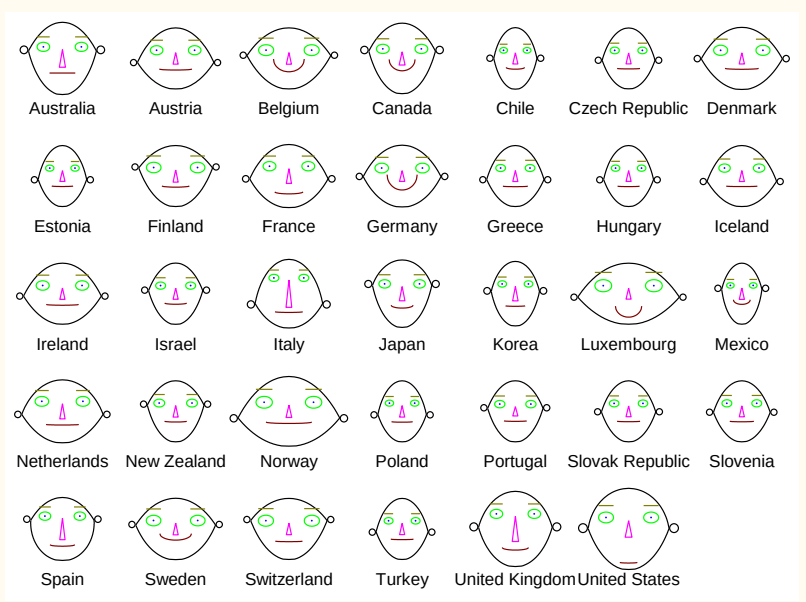
Chernoff faces for the GDP per Hour Worked and Outward DFI per sectors of the Economy variables are shown in Figure 7. Similar faces indicate similar mean values of the analyzed variables per country. For instance, Chernoff faces for Australia and Denmark are similar, which indicate similar mean values of their corresponding analyzed variables. As a whole, these Chernoff faces revealed four groups:

a. Western European countries with developed economies according to the International Monetary Fund (IMF) (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Netherlands, Sweden and Switzerland).
b. Non-European countries with developed economies (Australia, Canada and Japan)
c. Eastern European countries (Czech Republic, Estonia, Hungary[1], Poland[1], Slovak Republic and Slovenia), Western European countries with that face economic problems (Greece, Iceland and Portugal), countries that are developing and emerging economies (Chile, Mexico and Turkey), as well as Israel, Korea and New Zealand.
d. Countries that do not look similar to any other (Italy, Luxembourg, Norway, Spain, United Kingdom and the United States)

[1]Hungry and Poland are also considered as emerging economies.

Most countries in groups No. 1 and No. 3 were members of the main database that was used to carried out the regression analysis. Groups No. 2 and No. 4 were those countries that showed most outliers and extreme values. The case of the United States is particularly different from the rest of the countries. This effect is perhaps due to its especially strong economy. According to the International Monetary Fund (IMF), the United States has the largest economy of the world with $21.48 trillion of USD in 2019. Countries such as Japan, Germany France, United Kingdom, Italy, Canada, Spain and Australia with a range of $5.22 to $1.46 trillion of USD in 2019.

Figure 7. Chernoff faces. All means of the GDP per Hour Worked and Outward DFI per sectors of the Economy variables per country were calculated and assigned to face characteristics. Cases are visualized by schematic faces such that relative values of variables selected for the graph are represented by variations of specific facial features.



Similarly, to the Outward FDI, an exploratory statistical analysis, including the construction of box plots, was performed for the Inward-related variables. All outliers were excluded, and a Multiple Regression Analysis was then performed using the GDP per hour worked (in millions of USD) as the dependent variable (Y), and the inward FDI (in millions of USD) of the sectors of the economy as independent variables (See Table 3). The intercept and the variable Inward FDI in the Electricity and Water Sector were significant in the regression only. It is not surprising that the electricity and water sector has a significant effect since it is common that countries with relatively weak economies get foreign investments for this sector of the economy. However, the R^2 was too low to try to use it as predictor.

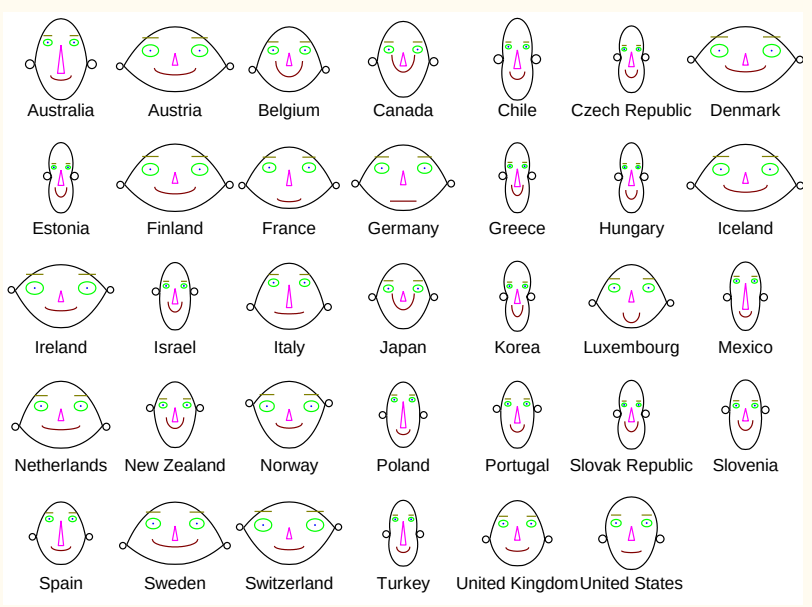
Table 3. Regression Summary for Dependent Variable: GDP (Inward DFI)

R= .12516722 R²= .01566683 Adjusted R²= .01199395 F(1,268)=4.2655
p <.03985 Std.Error of estimate: 15.727

	Beta	Std.Err. - of Beta	B	Std.Err. - of B	t(268)	p-level
Intercept			44.53702	1.108265	40.18625	0.000000
EAW	-0.125167	0.060604	-0.00908	0.004396	-2.06532	0.039854

Finally, Chernoff faces were again plotted by assigning the means of the analyzed variables to face characteristics to visually compare the analyzed countries according to their Inward FDI variables. Inward-related data was also standardized among both, cases and variables. Once again, similar groups of countries were identified when compared to the Outward DFI variables.

Figure 8. Chernoff faces. All means of the GDP per Hour Worked and Inward DFI per sectors of the Economy variables per country were calculated and assigned to face characteristics. Cases are visualized by schematic faces such that relative values of variables selected for the graph are represented by variations of specific facial features



4. Conclusion

Every country is unique in what it specialized and what their firms can offer as offshoring. This paper explored the relationship between productivity and offshoring in some selected countries. Although a significant regression coefficient was found, the relationship was relatively weak. The model revealed that the sectors of the economy that may be related to Productivity (GDP per hour worked), were the mining and quarrying sector, the manufacturing sector, the service sector and the unallocated sector. It is important to highlight that the Principal Component Analysis revealed that there are strong differences in productivity attributable to offshoring depending on how developed a country is. It was clear that the strongest economies that included the well-known G7 countries, besides Spain, Luxembourg and Australia, were significantly different from those Western European economies that also were significantly different to the Easter Europeans, some troubled Western European economies and emerging economies. It was particularly interesting the outstanding difference between the United States and the rest of countries. It seems that more studies should be performed by separating the different levels of the economy, as well as identifying those countries that practice offshoring and those that host it. Findings of this study confirm that offshoring does not strongly relate to productivity in a short-term period, and that offshoring tends to affect more the productivity of hosting countries (developing and emerging economies) than what it affects those countries that finance the offshoring (developed economies).

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