IT TAKES GOLD TO COMPETE FOR GOLD : ECONOMY AND OLYMPIC GAMES

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ABSTRACT

During the Olympic Games in Rio, it costs Great Britain 4.1 million pounds to win a single Olympic gold medal. The idea of the current research was generated while thinking about the benefits country gets in case of earning medals during the Olympic Games. The possible benefit that was hypothesized is the physical activity of the citizens. In order to fully understand the connection the current study analyzes the relationship between economic development, the number of weighted medals gained during the Olympic Games and the insufficient physical activity of the citizens. The research is comprised of two separate models that use two different methodologies (panel data analysis and cross-sectional analysis). The first model determines the connection between economic development of a country in the form of part of GDP dedicated to sports (limited to the European country's data). The second model tries to determine the connection between the number of medals the country gain during the 2014 Olympic Games and the physical activity of citizens in 2016. The key finding is that there is a positive connection between economic development of a country and weighted medals per capita of European countries and that there is a positive relationship between insufficient physical activity and economic development of a country as well as the number of medals the country gained.

Keywords: Insufficient physical activity, Olympic games, Economic development, medals

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1. Introduction

Russell Andrew drew Mark, Olympic Champion Shooter once said: “The Olympic Games is the ultimate level of competition”. (Partland,2014) This ultimate competition first was staged in Olympia, Greece, and it took 1503 years for the Olympics to return. The first modern Olympics were held in Athens, Greece, in 1896. And from that time the Olympic Games is considered to be the pick of an athletic career. Olympic Solidarity program aims to ensure that athletes with talent have an equal chance of reaching the Games and succeeding in the Olympic arena. Mainly the committee is financing outstanding athletes to reach the Olympic “village” and to have the possibility to compete. But does the problem lie only in the transportation and accommodation of an athlete? It takes thousands of dollars and tens of years to reach the level of at least qualification to the Olympic Games. Many countries invest in the development of the sport with the hope to hear the country’s hymn from the arena of the Olympic Games. For sure the number of investments differs based on the economic development of a country. Current research firstly tried to understand whether the number of medals gained depends on the development of a country or no. For instance, during the Olympic Games in Rio, it costs Great Britain 4.1 million pounds to win a single Olympic gold medal. (Lawton, 2016) And then a question arises, why? What is the motivation of a country to invest “gold” for receiving gold?The second part of this research proposed that a possible benefit of investing in the Olympic Games could be the physical activity of citizens. The analysis is conducted to see whether insufficient physical activity depends on the performance in the Olympic Games, which is backed by the economic development of a country. Connecting the two above mentioned research questions, the aim of the whole research is generated. Current research aims to find possible evidence of the following

relationship: If a country is considered an economically developed country and invests in sports will it increase the number of medals gained by a country and consequently motivate citizens to be more physically active which is the main benefit for that specific country. According to the preliminary research, literature review and basic understanding, two hypotheses were generated. First, better economic development of a country might result in a better performance in Olympic Games and secondly, better performance in the Olympic Games might have a positive effect on the level of physical activity of citizens. Due to limitation in data the conclusion is not that direct, but still at least for European countries, one can state that investing in sports will increase the number of medals gained in the Olympic Games and consequently will have an impact on physical activity of citizens, which stands as an economic benefit for the whole economy.

2. Literature Review

The existing literature concerning the Olympic games and it's economic factors is rich with papers looking to the issue from diverse angles. The majority of papers tried to find possible economic consequences of hosting Olympic games in a certain country. (Pierleoni, 2017), (Edds 2012), (Malfas, Theodoraki 2004), (Fuller 2000). For instance, Pierleoni (2017) focuses on the benefits of hosting the summer Olympics, while Edds (2012) analyses three past Olympics and their consequences. Despite the huge investments from the host countries, the papers prove that there is a positive economic impact for the host countries. Some papers even analyze how Olympic games committee decides where to host the games and consequently how that decision promotes economic development in that particular country. (Blake, Thomas 2012). Some unique studies explore quantitatively the utility maximization of a country participating in Olympic games. (Tcha,2004). The uniting thing of the literature that is directly linked to the first part of

the current research is that the dependent variable, which measures the performance in the Olympic Games is the sum of medals. Àlthough some papers used the pure sum of the medals earned (Matros, Namoro 2004), (Vagenas, Vlachokyriakou 2011) the method of measuring medals for current research is taken from articles that assign weights to gold, silver and bronze models in order to differentiate them in calculations. (Maximenko, Novikov 1972), (Moosa, Smith 2004). Concerning the variables explaining the performance in Olympics all papers used population, GDP and some dummy variables like "host country", "communist country". It is worth emphasizing that Matros and Namoro (2004) included in their regression first marriage age of a country, explaining the choice by the inability to combine professional sports and marriage life. From first glance, it's not the best explanatory variable for the performance in Olympic games but according to the study, it was statistically significant. According to Vagenas and Vlachokyriakou (2011), the previous literature either use complex regressions that increase variances in the predictions or oversimplify the model that may cause omitted variable bias.They used the following variables to explain the success in Olympic games: land, population, GDP, the percentage of urban population and percentage of unemployment. Additionally, this literature review includes a paper about performance in a soccer game and the economic development of a country.(Hoffman, Ging, Ramasamy 2002).Although it does not analyze the Olympic games, the method and the structure is very close to the other papers. It used only the outcomes of one soccer game: World championship of 2002 and used cross-sectional analysis to find the connection with economic development. One of the big features that almost all papers in this topic have is the cross-sectional analysis of only one Olympic game. (Novikov, Maximenko 1972), (Vagenas, Vlachokyriakou 2011), (Kelly, Rubin 1974), (Moosa, Smith 2004), (Hoffman, Ging, Ramasamy 2002). However, the current research will conduct a study using many

observations from different Olympic games, which was done in the paper written by Namoro and Matros (2004). On the contrary, to the mentioned paper the study of this research will involve panel data analysis in order to better illustrate the possible prediction power of Olympic games performance. The paper that is closest to the current research is “Economic development and medals” conducted by Bernard and Busse (2000). The paper used panel analysis on the different Olympic games. The model was constructed using the Cobb-Douglas production function for Olympic medals in other words success. The function includes people money and organizational ability, which were measured as population, GDP per capita and constant respectively. The term “organizational” includes all possible reasons that countries may have high or low medal counts. (Bernard, Busse 2000). Additionally, earlier mentioned dummy variables were added. All the studies that included the dummy variable “host country” concluded that there is a positive upward trend for the host country in the number of medals that a country gained during that specific Olympics. Some papers define their results as “roughly reflecting the performance” (Moosa, Smith 2004) or that the model explained only 70 percent of the variance in the dependent variable (Kelly, Rubin 1974). On the contrary, some research reveals the main explanatory variable of success in Olympic games such as National income in a form of GDP (Bernard, Busse 2000) or Olympic team size of a certain country (Vagenas, Vlachokyriakou 2011). Interesting results such as “individuals participation and effort level in Olympics rise due to money invested in sports” were found by Matros and Namoro (2004) or that country’s wealth has a diminishing effect on sports (Hoffman, Ging, Ramasamy 2002). Although the study conducted by Hoffman, Ging, and Ramasamy (2002) observed the world cup of soccer the current research will also observe the investment in sports as an explanatory variable. More

precisely the investment in sports was represented as a number of sports complexes in a certain country.

Current research does not only focus on the relationship between economic development and performance in Olympic games but also whether the positive relationship in the mentioned variables will result in an increase in physical activity and sports engagement of a certain nation. The mentioned connection was not observed in any research work, however separately the connection between economic/social indicators and sports activity was observed. (Graton, Kokolakakis 2012), (Haase, Steptoe 2004), (Rashad 2007), (Lechner 2009), (Norris, Wet 2004). All of the mentioned papers found out the positive correlation between economic development of a country and the physical activity/sports engagement of the citizens. All the studies were conducted for a certain country: United Kingdom (Graton, Kokolakakis 2012), United States (Rashad 2007), Germany (Lechner 2009), South Africa (Norris, Wet 2004) except for the study done by Haase and Steptoe (2004) that tries to find out connection between physical activity and socio-economic factors in a sample of 23 countries. All of the studies included GDP to describe the economic development of a country. The difficult part was to find a source that measures physical activity. In case of individual countries, the survey-data sources were used for that specific country (GSOEP-Germany, National Survey of Pedestrian and Bicyclist Attitudes and Behaviors -United States) or primary data was collected through questionnaires (Norris, Wet 2004). Additionally APS database was used (Graton, Kokolakakis 2012) and Health and Behaviour Survey of students (Haase, Steptoe 2004) for data of more countries. The second model of the research will try to explain the physical activity of citizens by using the same variables used in the first model. The major drawback of both parts of literature (Olympic games and physical activity) is that the results were subjective and based on a certain observation. More

precisely, the papers exploring the connection between Olympic games and economic development observe only one Olympic game and all the analysis are conducted on that specific observation. Similarly, the majority of papers that did research to find out a possible connection between physical activity and economic/social factors observe the data of only one certain country. On the contrary current research will both analyze outcomes of different Olympic games and explore the data of different countries, which is simultaneously one of the contributions to the current literature. However, the core contribution of this research paper to the existing literature is the linking of two possible connections and consequently finding a cross connection between investing in Sports and physical activity of the citizens of a certain country..

3. Data Description

In order to answer two research questions mentioned above the data of this research is comprised of two parts. The detailed list of the variables can be found in Appendix Table 1.1 and Table 1.2. The first part of the data consists of yearly observations (2013-2018) for 93 European countries. The performance in Olympic games is measured by weighted medals per capita using New York Times classification method (Gold=4, Silver=2, Bronze=1). The full data was retrieved from the medals per capita website. The variables that try to explain the fluctuations in weighted medals per capita are the Gross Domestic Product per capita (a measure of a country's economic output that accounts for its number of people), population and the part of GDP that is dedicated to sports (total expenditure in dollars on sporting services). The data on GDP and population is retrieved from Worldbank. The part of GDP dedicated to sports is measured by Eurostat, using the spending of GDP on recreational activities and sports. It is important to emphasize that there is a high correlation (0.81) between GDP per capita and GDP dedicated to sports, thus only one of these variables should be included in the model to eliminate the possibility of multicollinearity.

(Correlation matrix is depicted in Appendix Table 2). The data on sport expenditure from GDP is available only for 2013-2016. The possibility to measure some post effect of investing in sports in the previous year and gaining medals in the current year limits the observations of medals per capita to 2014,2016,2018 years only. Additionally, there is a positive correlation between GDP dedicated to the sport and weighted medals per capita (0.15), which at least does not reject research's preliminary hypothesis. The second part of data consists of economic variables like Urbanization (the percentage of population living in urban areas) , Unemployment (the share of the labor force that is without work but available for and seeking employment), School enrollment (Gross enrollment ratio is the ratio of total enrollment in primary education, to the population of the age group that officially corresponds to the level of primary education), Human Development Index (the measure of the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living), GDP per capita and Population that try to describe the insufficient physical activity of citizens. Insufficient physical activity was measured by the World Health Organization. It measures the percentage of the population that is insufficiently physically active. Insufficient physically active is defined in the following way: If people who are more than 18 years old are doing less than 150 minutes of moderate intensity physical activity per week and if school going adolescents aged 11–17 years are doing less than 60 minutes of moderate- to vigorous-intensity physical activity daily. These data is available only for 2016, which limits the current model to a cross-sectional analysis. Additionally, all the economic variables listed are taken from the World Bank.Weighted medals per capita of 2014 are used to describe the physical activity of citizens. More precisely the model will try to estimate whether a medal won in 2014 has any effect on the physical activity of citizens in 2016. In fact, there is a negative correlation

between the weighted medals per capita of 2014 and the insufficient physical activity of 2016 (-0.06), which at least does not reject the preliminary hypothesis of this research. (Correlation matrix is depicted in Appendix Table 2.1 and Table 2.2). Also, there is multicollinearity between GDP and HDI (correlation coefficient 0.74, VIF greater than 15), thus HDI is eliminated from the final model.

4. Estimation and Hypothesis Testing

H_0 :Better economic development of a country might result in a better performance in Olympic Games.

For the goal of testing the first hypothesis of this research panel data analysis were conducted. The below model was used as the final model.

$$\text{Log(perfOl)}= \beta 0+ \beta 1\ \text{Log(pop)}t+\beta 2\ \text{Log(spGDP)}t+ ut$$

where:

perfOl-Performance in Olympic Games measured by weighted medals per capita

pop-The population of a country

spGDP- The amount of GDP dedicated to sports

The analysis was conducted on European countries only (due to data limitation). The preliminary model included GDP as one of the explanatory variables but as there is a possibility of multicollinearity problem the only spGDP remained in the final model. According to the finding that you can see in Table 3 all the explanatory variables are highly significant at 1 percent significance level (N=92, R squared=0.28). Population variable has a positive coefficient of

0.392, which means that if the size of the population increased by one percent than the weighted medals per capita will increase by 0.4 percent. Additionally if part of GDP dedicated to sports increase by one percent than the weighted medals per capita will increase by 0.6 percent.

Table 3: Regression results of panel data analysis Dependent variable: Weighted medals per capita/Logarithmic form			
	1	2	3
GDP	0.0002*		
	[.000135]		
Population	4.32E-07***		
	[1.13e-07]		
SportGDPpercapita	-0.0001		
	[0.0002]		
LogGDP		0.658	
		[.4557475]	
Logpopulation		0.418***	0.392***
		[.1325362]	[.1327363]
Logsportgdpperc		0.097	0.525***
		[.349913]	[.1866296]
Number of observations	92	92	92

R squared	0.23	0.31	0.28
Notes: Standard errors in brackets, * significant at 10%,**significant at 5%,***Significant at 1%			

In order to test Heteroskedasticity (non-constant errors) of the variable, the likelihood ratio test was implemented. According to the results, the p-value is 1, meaning that we fail to reject the Null hypothesis which was that the panels are homoskedastic. To conclude this research does not have any problem with heteroskedasticity, which could have lead to the biases of standard errors as well as to the larger disturbances of some observations.

H0: Better performance in Olympic Games might have a positive effect on the level of physical activity of citizens.

In order to test the second hypothesis of this research cross-sectional analysis was conducted. The two models were used as the final models.

1. $insuffphys = \beta0 + \beta1\ Log(pop) + \beta2\ Log(GDP) + \beta3\ Log(wmedpc14) + \beta4\ Log(unem) + \beta2\ Log(urb) + u$

2. $insuffphys = \beta0 + \beta1\ Log(pop) + \beta2\ Log(GDP) + \beta3\ OG + \beta4\ Log(unem) + \beta2\ Log(urb) + u$

where:

insuffphys- The percentage of the population that is insufficiently active

Pop- The population of a country

GDP- GDP per capita

wmedpc14- Weighted medals per capita (2014 OG)

unem-Unemployment rate

urb-Urbanization

OG-Dummy variable (1=participated in Olympic Games)

The analysis was conducted for 2016, due to data limitation. On contrast to the panel data analysis, these models used the data of 147 countries. All the inputs were available for all the countries except the weighted medals per capita. The reason for missing values is that not all the countries participated in the Olympic Games, thus the first three models were analyzed using only 68 observations. Even in this limited scenario 4 out of 5 variables are highly significant. While GDP, Unemployment, and Population have positive coefficients. These connections could be explained in the following way: 1. In order to reach higher GDP, people should work and spend their time on the activities that will increase the wealth (here could arise the problem of reverse causality which will be examined later). 2. If the Unemployment rate increases, the people's income will decrease and the spending will decrease as well. Mainly unemployed people will spend money on first need goods and services, rather than just for attending the gym. 3. It is interesting to observe the positive coefficient of population, meaning that if the population increase by one percent than the insufficient physical activity will increase by 0.01 percent. The change is not drastic but still, it is positive. Additionally, weighted medals per capita of 2014 and Urbanization rate have negative coefficients. Meaning that an increase of the variables by one

percent will lead in 0.0005 % and 0.004 % increase in insufficient physical activity rate. In further analysis interaction term between medals and population and the squared form of medals were included in the model. Due to the insignificance of coefficients, no important connection was observed. As mentioned earlier cross-sectional analysis resulted in two final models. The second one is generated for the purpose of not losing the data. As not all countries participated in Olympic games and gained medals OG variable was included in the model instead of weighted medals per capita. OG shows whether a country participated in 2014 Olympic Games or no (1 meaning that a country participated in the Games). Although the number of observations increased to 147, the main finding was similar to the first model. The OG has a highly significant negative coefficient, which shows that insufficient physical activity of 2016 is lower by 5.05 percent for the countries that participated in the Olympic Games of 2014. Additionally, in this model, all of the variables were at least significant at the ten percent significance level.

Table 4: Regression results of cross-sectional analysis Dependent variable: Insufficient physical activity per capita (2016)

	1	2	3	4
LogGDP	4.25***	4.36***	4.28***	3.81***
	[1.19]	[1.2]	[1.21]	[0.75]
LogPopulation	1.19**	0.330	1.14**	0.86*
	[0.55]	[1.04]	[0.6]	[0.42]
LogMedalspc14	-0.05***	0.090	-0.33	

	[0.01]	[0.15]	[1.22]	
Unemployment	2.67**	2.54*	2.6*	1.43*
	[1.38]	[1.4]	[1.4]	[0.84]
Urbanization	-0.490	-0.53	-0.520	4.96**
	[4.03]	[4.03]	[4.06]	[2.14]
Medpop		-0.008		
		[0.009]		
Medalssquared			-0.001	
			[0 .007]	
OG				-5.05***
				[1.71]
Number of observations	68	68	68	147
R squared	0.37	0.38	0.37	0.39
Notes: Standard errors in brackets, *significant at 10%,**significant at 5%,***Significant at 1%				

In order to test Heteroskedasticity (non-constant errors) of the variable, Breusch Pagan test was implemented. According to the results, the p-value is 0.36, meaning that we fail to reject the Null hypothesis which was “constant variance”. To conclude this research does not have any problem with heteroskedasticity, which could have lead to the biases of standard errors as well as to the larger disturbances of some observations.

Additionally, Ramsey specification test was used to test for omitted variable bias.OVB occurs when a statistical model leaves out one or more relevant variables, causing bias results. The Null hypothesis of the is that there is no omitted variable bias. The p-value of the test is 0.1, meaning that we fail to reject the null hypothesis of the test stating that there is no omitted variable bias in the model.

5. Reverse Causality

According to Table 4, the GDP per capita has a positive relationship with insufficient physical activity, meaning that a one percent increase in GDP will lead in 0.0425 percent increase in insufficient physical activity. The connection is not obvious from the first glance but this research assumes that there might be a reverse causality problem. Examination of the connection from the other angle leads to the following logic; the increase in insufficient physical activity most probably is compensated with an activity that generates wealth for a country more specifically work. For instance, people that are working overtime or even at several jobs most probably will not have enough time to ensure the presence of needed time of physical activity. For the purpose of testing the above-mentioned assumption, instrument variable regressions were implemented. According to the Table 5, two main instrument variables were used: Natural resources of the country (in dollars) and the export, which is the export of goods, services and

primary income (measured in current US$). First two regressions used each of the instrumental variables individually and the last one is the final model of instrument variable regression of this estimation. The third model both included natural resources and export as instrument variables while keeping GDP per capita as the endogenous variable. The third instrumental variable regression differs from the first two because continuously updated estimator was used. The continuously updated estimator is considered to be more efficient compared to two stepped GMM (Baum, 2003). All three regressions have estimated significant coefficients, meaning that the connection is direct and there is no reverse causality problem. However to check the validity and reliability of the model several tests were implemented. According to the IV heteroskedasticity test, the p-value is 0.515 meaning that we fail to reject the Null hypothesis of the test which was "the disturbance is homoskedastic". As there is no heteroskedasticity problem Sargan test can be implemented, which is mainly used to test overidentifying restrictions in a statistical model. According to the test, the p-value is 0.1, meaning that we fail to reject the null hypothesis and concluding that overidentifying restrictions are valid. This should mean that the instruments of the IV regression are not correlated with the error of the main regression and therefore are valid. In addition, Stock and Yogo test was implemented, that was testing whether the estimators are weekly identified or no. According to the results at the smallest possible bias level the estimators of instrumental variable regression are strongly identified. Further analysis includes underidentification which test whether the matrix is rank deficient and the equation is underidentified. According to Kleibergen and Paap test, we reject the null hypothesis, which implies full rank and identification. Additionally, the test suggests that in the case of overidentification via the order condition the instruments are adequate to identify the equation. Last but not least weak instruments problem may arise when the correlations between the

endogenous regressors and the excluded instruments are nonzero but small. To test the possibility of the above-mentioned problem Anderson-Rubin and Stock-Wright tests are implemented. According to the tests we reject the null hypothesis stating that endogenous regressors are relevant.

Overall the conclusion is that there is no reverse causality in the third instrumental variable regression, thus there is a direct connection between GDP per capita and insufficient physical activity of the citizens.

Table 5: Instrumental variable regression 1
Dependant variable:Insufficient physical activity, Instrumental variable:export(1)/natural resources(2)/export and natural resources(3)
Endogenous variable:GDP

	1	2	3
Log GDP	3.25**	6.72***	3.38***
	[1.35]	[2.25]	[1.31]
Log Population	1.27**	2.04***	1.52***
	[0.57]	[0.67]	[0.58]
Log medals14pc	0.78*	1.07***	0.76***
	[0.29]	[0.35]	[0.3]
Urbanization	1.530	-8.1000	0.22
	[4.34]	[6.44]	[4.31]
Unemployment	2.93**	3.19**	3.25**
	[1.35]	[1.37]	[1.33]
Number of observations	65	66	64
R squared	0.37	0.34	0.38

Notes: Standard errors in brackets, * significant at 10%,**significant at 5%,***Significant at 1%

6. Discussion

Although the connection between weighted medals per capita and economic development was analyzed only using European country data, still it is possible to make a conclusion by connecting the findings of the first model and the second one. At least for European countries we can state that investing in sport first increases the chances of getting more models during Olympic games and additionally will in the next period increase the physical activity of citizens. Actually, this logical chain can be developed further in terms of that physical activity is increasing the health status of the citizens which can lead to increased economic development (Bloom, Canning 2004),(Akram, Khan 2008). These relationships prove that investing in sports and the Olympic Games will not only create a prestigious image of a country because of gaining medals but also will bring economic benefits.

7. Conclusion

The current study analyzes the relationship between economic development, the number of weighted medals gained during the Olympic Games and the insufficient physical activity of the citizens. The aim of the current research is to find possible evidence of the following relationship: If a country is considered an economically developed country and invests in sports will it increase the number of medals gained by a country and consequently motivate citizens to be more physically active which is the main benefit for that specific country. Due to the limitation in data the first part of the research was conducted using only European countries and the second one was for only 2016. However, still, we can state that the relationship holds. According to the preliminary research, literature review and basic understanding hypothesis were generated. First, better economic development of a country might result in a better performance

in the Olympic Games and secondly, better performance in Olympic Games might have a positive effect on the level of physical activity of citizens. The analysis of panel data and cross-sectional data proves the above-mentioned hypothesis for Europe and the whole world. Due to the limitation in data the conclusion is not that direct, but still at least for European countries one can state that investing in sports will increase the number of medals gained in the Olympic Games and consequently will have an impact on physical activity of citizens, which stands as an economic benefit for the whole economy. Future research should focus on data quality and a number of observations. The main problem was the limitation in data of GDP dedicated to sports and insufficient physical activity of citizens. Improved data with a bigger number of observations first will help to conduct analysis for the whole world and for a bigger period of time and additionally will help to make more direct conclusions. Apparently, even if such a database is initiated now, it would take a long time before it could be used for any empirical analysis. Until then, it is hoped that this paper provides valuable information about the investment in the Olympic Games and the physical activities of citizens.

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9. Appendixes

Table 1.1 Data description of panel data analysis

Name of the Variable	***Time period***	***Number of observations*****	***Source***
Weighted medals per capita*	2014/2016/2018	93	Medalspercapita.com
GDP per capita	2014-2018	186	Worldbank

GDP dedicated to sports per capita	2013-2016	150	Eurostat
Population	2013-2018	186	Worldbank

Table 1.2 Data description of cross-sectional analysis

Name of the Variable	***Time period***	***Number of observations***	***Source***
Insufficient physical activity	2016	157	WHO
GDP per capita	2016	157	Worldbank
Population	2016	157	Worldbank
Education(school enrollment)	2016	99	Worldbank
HDI	2016	155	Worldbank
Weighted Medals per capita	2014	71	Medalspercapita.com
Urbanization	2016	157	Worldbank
Unemployment	2016	157	Worldbank

Table 2 Correlation matrix of first model's data

	Weighted medals	***GDP***	***Population***	***SportGDP***
Weighted medals	1			
GDP	0.1526	1		
Population	0.565	0.0258	1	
SportGDP	0.127	0.8124	0.164	1

Table 2.1 Correlation matrix of second model's data

	Insufficient physical activity	***Weighted Medals 2014***	***Population***	***GDP***
Insufficient physical activity	1			
Weighted Medals 2014	-0.0691	1		
Population	-0.0767	-0.1136	1	

GDP	0.1547	0.3957	-0.1464	1

Table 2.2 Correlation matrix of second model's data cont.

	Insufficient physical activity	***Weighted Medals 2014***	***Population***	***GDP***	***Unemployment***	***Urbanization***	***Education***	***HDI***
Unemployment	0.1891	-0.1363	-0.1778	-0.1177	1			
Urbanization	0.3515	0.0869	-0.2269	0.5111	0.0662	1		
Education	0.202	0.2204	-0.1796	0.2953	0.3278	0.5679	1	
HDI	0.3563	0.3551	-0.2426	0.7405	0.0975	0.6891	0.6496	1

Table 6 Panel Data analysis Tests

Panel Data Analysis			
Test name	Null hypothesis	p value	Conclusion
LM Heteroskedasticity	The panels are homoskedastic	1	Fail to reject Null hypothesis

Table 6.1 Cross Sectional Analysis Tests

Cross Sectional Analysis			
Test name	Null hypothesis	p value	Conclusion
Breusch Pagan	Constant variance	0.36	Fail to reject Null hypothesis
Ramsey specification test	No omitted variable bias	0.1	Fail to reject Null hypothesis

Table 6.2 Instrumental variable regression Tests

Instrumental Variable Regression		
Test name	Null hypothesis	Conclusion
IV heteroskedasticity test	The disturbance is homoskedastic	Fail to reject Null hypothesis
Sargan test	The over-identifying restrictions are valid	Fail to reject Null hypothesis
Stock and Yogo test	The estimator is weakly identified	Reject Null hypothesis
Kleibergen and Paap test	Underidentification	Reject Null hypothesis
Anderson-Rubin and Stock Wright tests	Endogenous regressors are not relevant	Reject Null hypothesis