The Effects of Tax Rates, Technology, and Quality of Life on Standard of Living in Developed Countries

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Abstract:

This paper investigates the relationship between tax rates, technology, and the quality of life on the standard of living in developed countries over time. The study uses an econometric model to understand and quantify these relationships. Standard of living will be measured by PPP GDP in this study. The results show the most significant variables that impact the standard of living are life expectancy at birth, openness to trade, the domestic savings rate, and corruption.

JEL Classification: O10, F63, C33
Keywords: Standard of Living, Quality of Life, Panel Analysis.

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1.0 Introduction

One of the most important roles of government is to maximize the standard of living for its citizens, as well as provide them protection and security. Governments also create law, order, and justice in society. Different governments manage these tasks in different ways. Some governments prioritize defense, and spend the largest portion of their budget defending their borders and keeping the nation secure. Other governments spend much more money on healthcare costs for their citizens to ensure they live healthy and fruitful lives. Some may spend tons of money on technology by enforcing patent laws and sponsoring research.

One thing all these countries have in common is the need to generate money in order to fund these expenditures. The largest form of government income comes from taxes. Countries that spend more money must collect more in taxes in order to keep a healthy and balanced budget. Some countries, such as the Scandinavian countries tend to have higher tax rates, and higher government expenditures. Other nations, such as the United States, tend to have lower tax rates and less government expenditures compared to high tax countries.

Regardless of government expenditures, it is common knowledge that people do not like paying taxes, and will always prefer having a lower tax rate. Higher taxes reduces citizens' discretionary income, which typically does not make people happy. When taxes are high, the government decides where to spend some of the money that citizens make. However, the standard of living is relatively high in the Scandinavian countries, despite their higher than average tax rates.

This study aims to dig in to the determinants of the standard of living in developed nations from 1996 to 2014. In addition to the tax rate, this study will analyze the relationship between

the standard of living and technology, quality of life, corruption, savings rate, and trade openness variables.

The remainder of this paper is organized as follows: Section 2 discusses the various trends in the variables the study uses. Section 3 gives a review of previous literature done by other economists. Section 4 identifies the data the study used and outlines the empirical model. Finally, section 5 discusses the results found. This is followed with a conclusion in section 6.

2.0 Trend in PPP GDP and it's Determinants

Figure 1 shows the increase in average PPP GDP from all of the designated countries. PPP GDP is measured in constant 2011 international dollars. The figure shows PPP GDP consistently rising until 2007, when the US housing bubble crashed. This crash affected all global markets, and caused a global recession. PPP GDP dropped until 2009, when it started to increase again. It has been slowly increasing since 2009, but has not yet reached its pre-recession high. PPP GDP is used to indicate the standard of living.

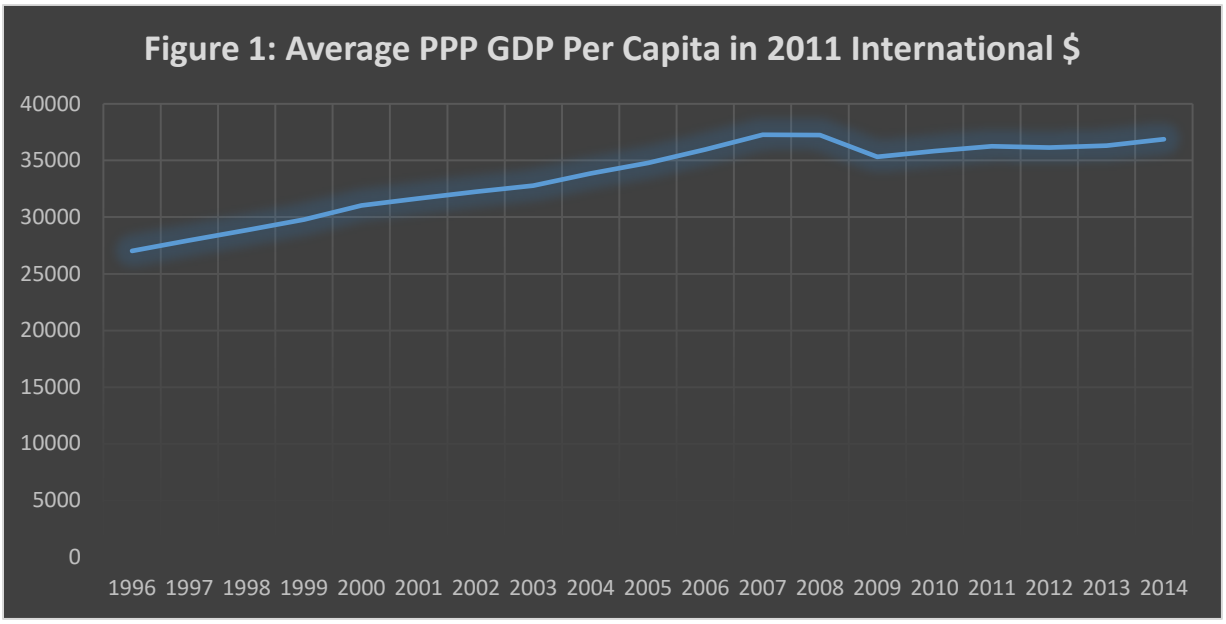

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Figure 2 shows the average tax revenue as a percent of GDP for all of the researched countries. The graph shows there was inconsistent growth in the tax rate until 2007, again when the US housing market crashed. It makes sense that this rate would decrease because it is tax revenue divided by GDP. Since Unemployment rates increased because of the global recession, income tax revenue dropped significantly. In addition, since many people were forced to default

on their mortgages, they were paying less property tax. The amount of tax revenue dropped more significantly than GDP did. It is interesting to note that both the PPP GDP and the tax rate peaked in 2007 before the recession and have not yet reached their pre-recession highs.

One would anticipate that as the tax rate increases, so will the standard of living. When the government is getting more money, they will be able to have more government expenditures. They can use this money on things that will directly affect standard of living such as defense and healthcare.

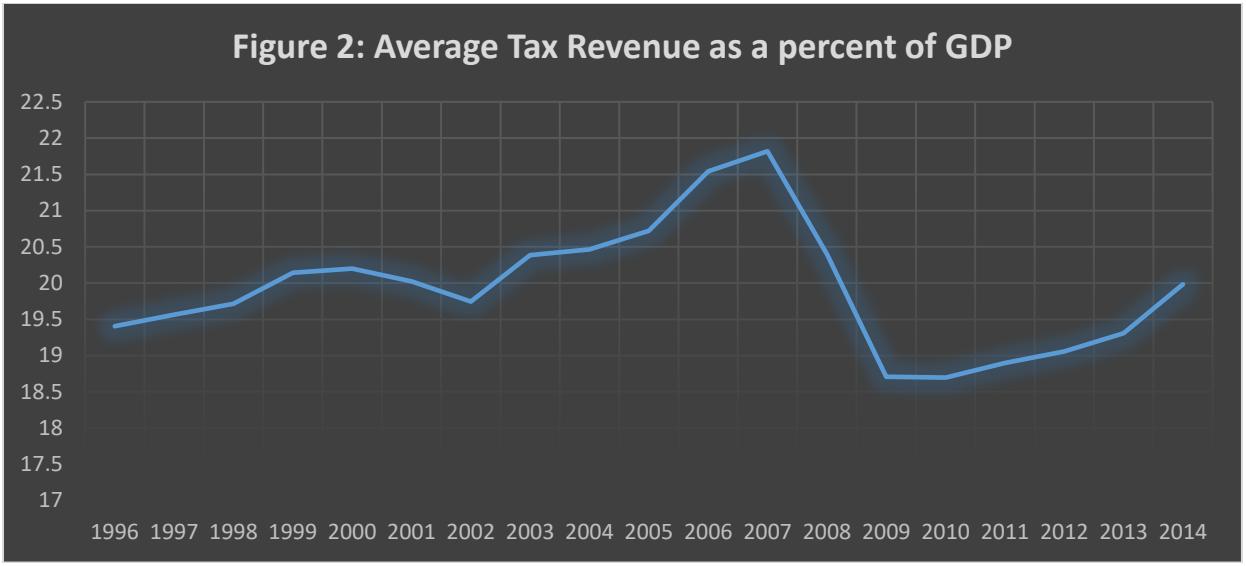

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Figure 3 represents research and development expenditures as a percent of GDP for all of the countries over time. R&D expenditures have been slowly rising since 1996. This should be a cause for increased technological progress in the future. It is expected that as R&D expenditures increases, so should the standard of living due to the increase in technology.

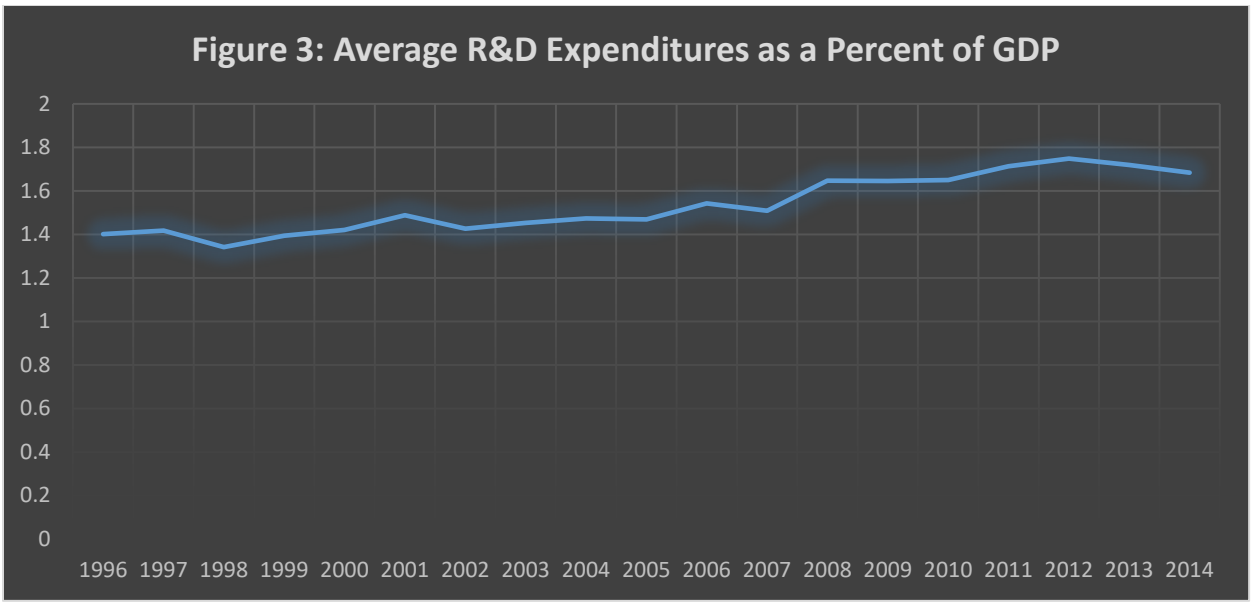

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Figure 4 indicates the average number of patent applications filed for in all of the countries. This figure is also rising over time. It makes sense that these numbers are increasing, because as seen in Figure 3, spending on research and development are increasing. Increases in R&D should cause an increase in patent applications as new products and technologies are being invented.

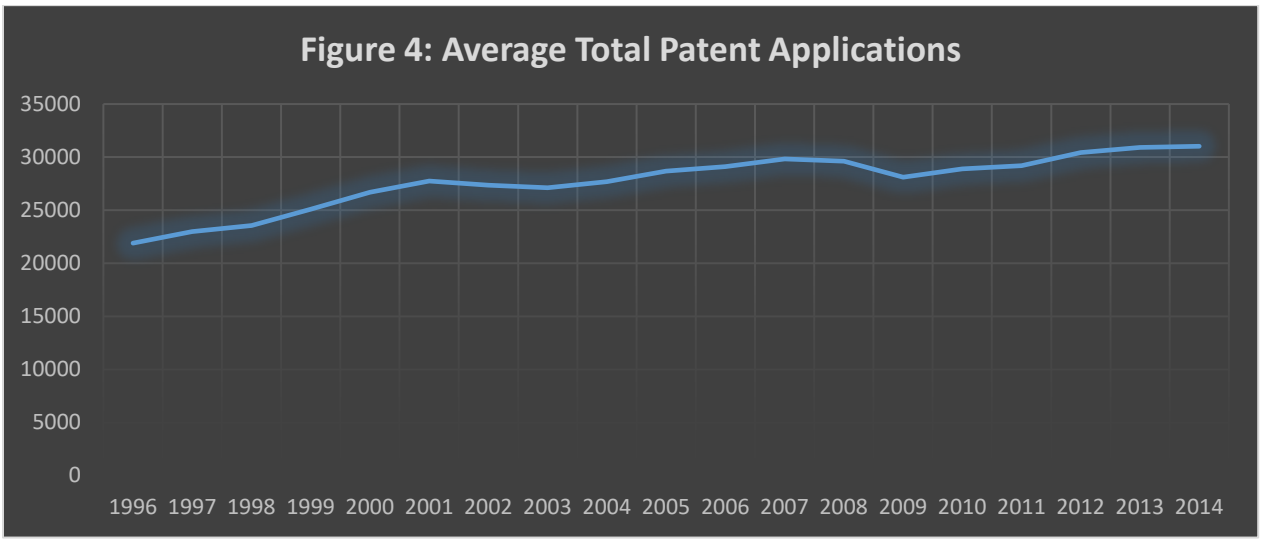

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Figure 5 shows the average life expectancy at birth between all of the countries. This figure rises very consistently from 1996-2014. This could be due to the increase in patent applications and R&D spending, or it could be due to an increase in healthcare costs. It is expected that while the average life expectancy at birth increases, so will the standard of living. Living longer is generally a good thing.

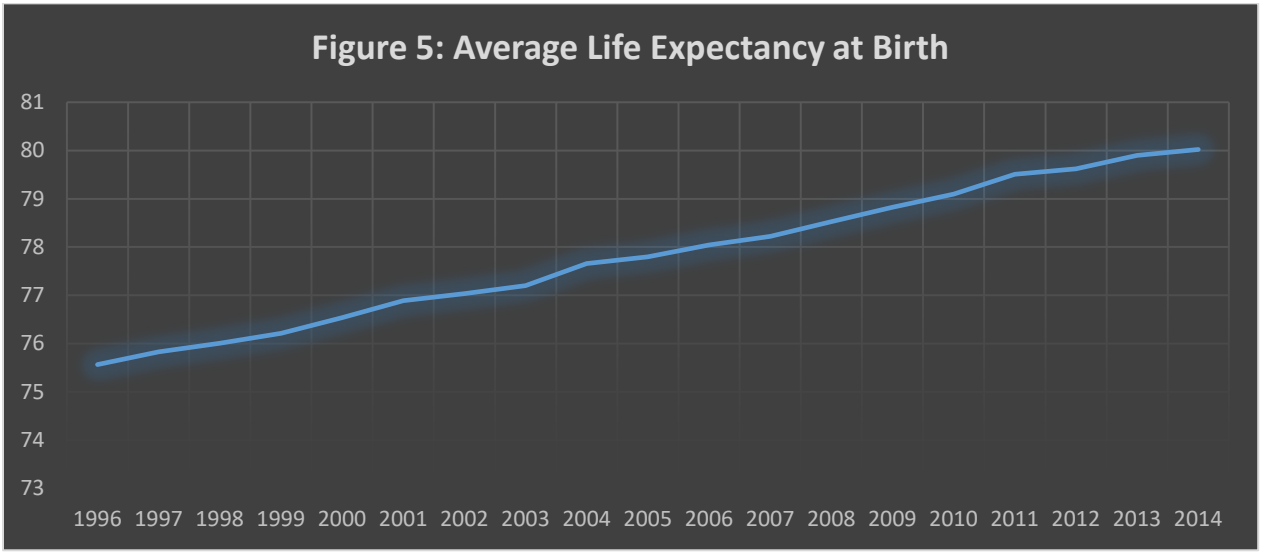

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Figure 6 indicates the change in the gross domestic savings as a percent of GDP. This rate seems to be fairly steady until the recession in 2007. People lost their jobs and could not afford to save as much money during that time. It has since increased up to approximately the same level that it was pre-recession. It is expected that as people save more, the standard of living will increase. The savings rate equals the investment rate, and when more money is being invested, economies should do better due to an increase in business activity, as well as other things.

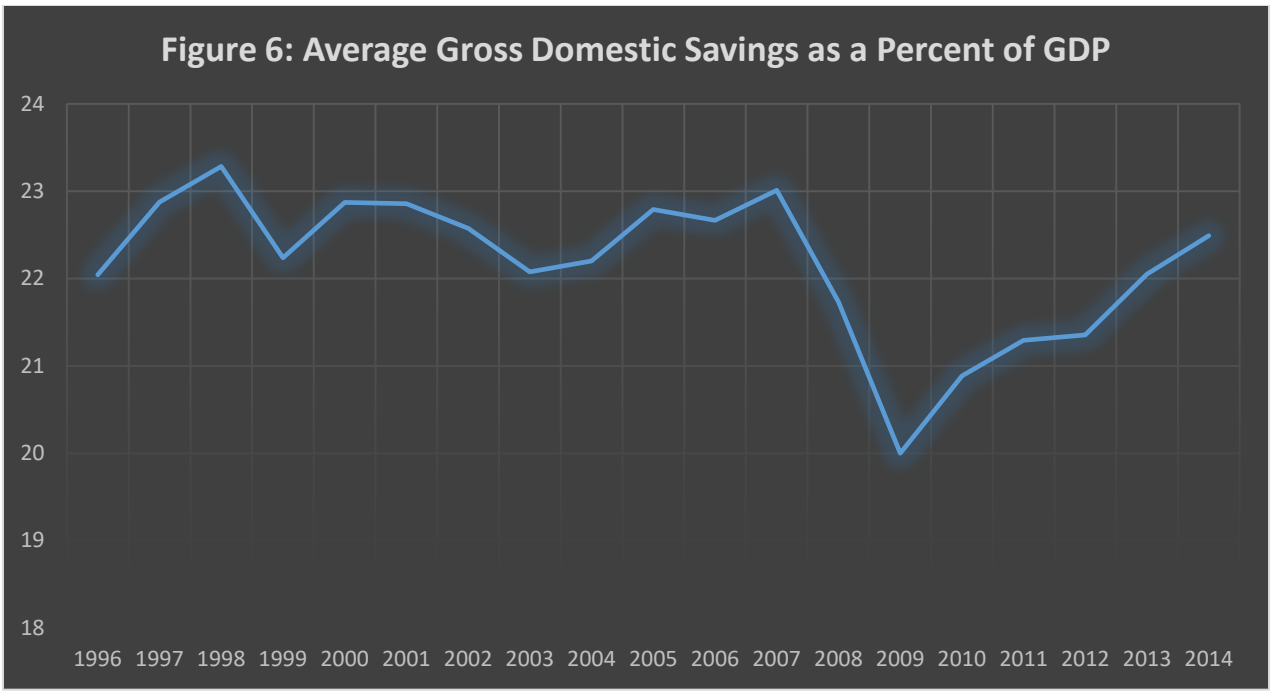

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Figure 7 shows the average corruption index rating for all of the countries. When the corruption index is lower, the country is more corrupt. This graph does not show a definitive trend, as it is fairly volatile. It is expected that when corruption increases, so when the index decreases, the standard of living will decrease.

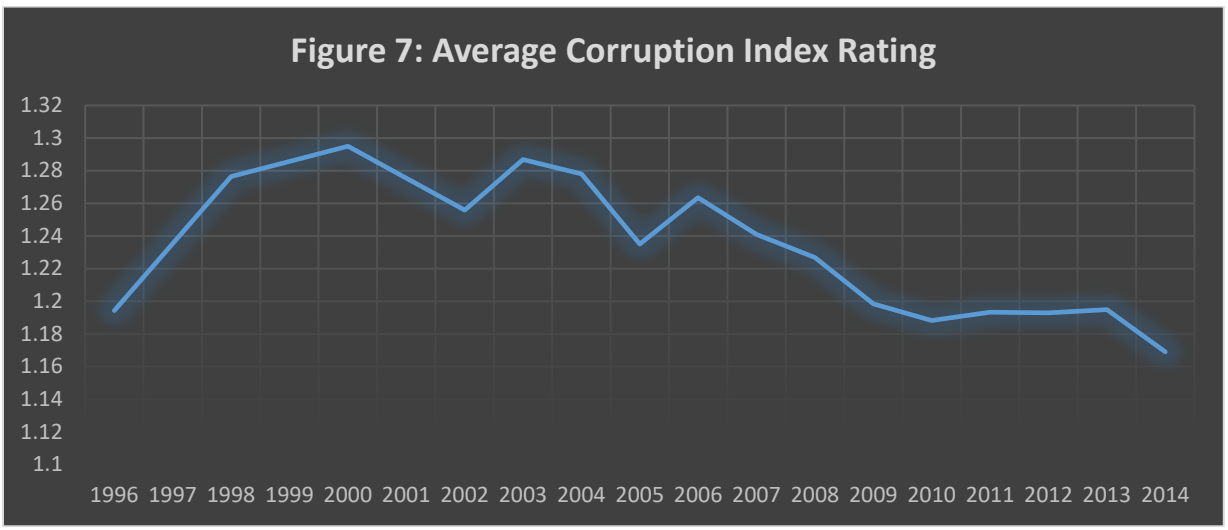

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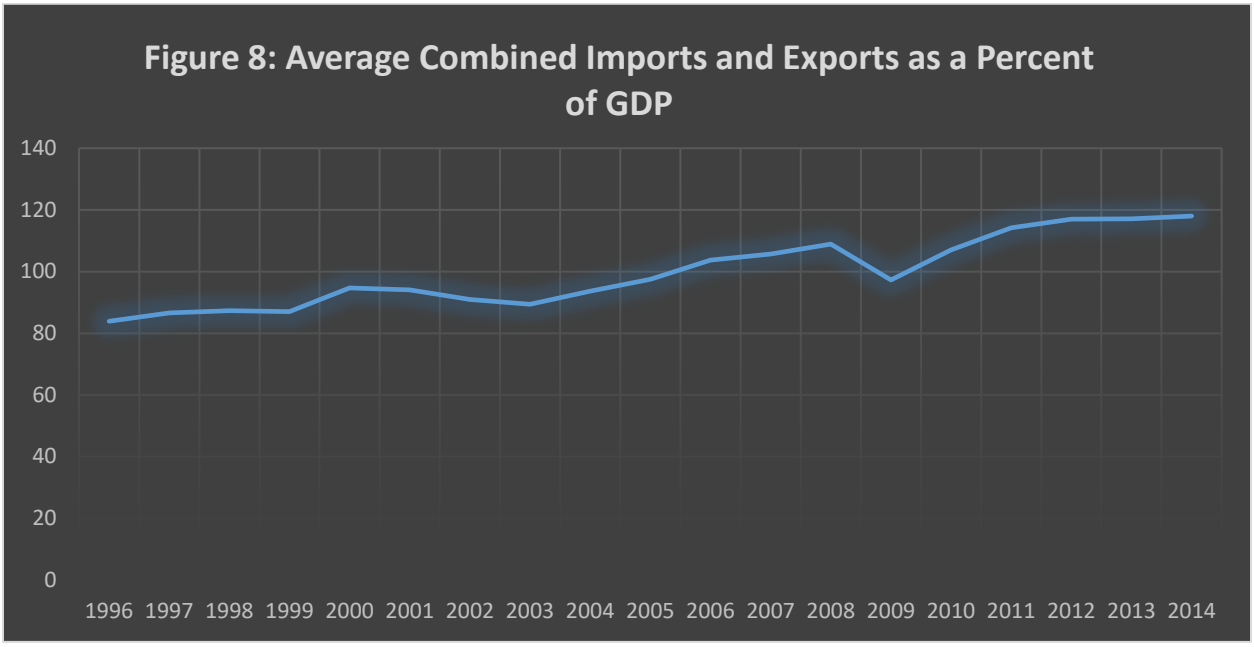
Figure 8 shows the combined imports and exports as a percent of GDP as an average of all countries. This is a measurement for openness to trade, and shows how much countries are willing to trade internationally. When trade openness increases, the standard of living should also increase. This is due to countries being able to specialize and trade based on competitive advantage.



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3.0 Literature Review

Standard of living is often used to measure the well-being of a nation. PPP GDP is often used to measure standard of living because it keeps the price level of goods even across different countries. Traditional reasons for why countries have different levels of standard of living include healthcare, technology, trade openness, and rule of law. Binder and Georgiadis (2011) found that investment in physical capital, government consumption stimuli, and the quality of institutions all effect the standard of living. They measured standard of living using both GDP and HDI and found that changes in the independent variables effect GDP much faster than they effect HDI. However, both dependent variables are effected, which shows no matter how you choose to measure standard of living, these independent variables play a role in determining how well a country is doing.

Research and development expenditures also play a role in determining standard of living, although only in very developed nations (Balcerzak and Pietrzak, 2015a). They ran two different regressions, one using very developed nations, and the other using nations that have more recently been considered developed, or are still developing. They only found a statistical significance of the effect of research and development spending on quality of life in the group of countries that are very developed. They came to the conclusion that it can also not be stated that research and development has no effect on developing nations. That was not the purpose of their study. They claim that research and development spending does not automatically influence welfare, but in this case the transmission channels are very complicated and are effected by many institutional conditions.

Quality of institutions also play an important role in the standard of living (Balcerzak and Pietrzak, 2015b). They did a second study in 2015 on the quality of institutions and how it

effects the quality of life in European nations. They found it was very statistically and economically significant when determining quality of life, and that it must be taken into consideration when determining institutional reforms.

Barro (1996) researched what influences GDP growth, which also impacts standard of living. He used panel date over 30 years and concluded that GDP growth rates can increase with better rule of law, less government consumption, and lower inflation. Other variables that impact real GDP growth are starting life expectancy, adult literacy rates and improvements on the terms of trade. There is also a pattern of convergence, meaning countries with lower starting GDP levels are likely to see higher levels of real GDP growth.

4.0 Data and Empirical Methodology

4.1 Data

This study uses annual cross-sectional data gathered from 1996-2014. Most data were obtained from the World Bank Database, and the rest were obtained from the World Governance Indicators Database. Data were gathered from 36 developed nations. Developed nations were classified by the Development Policy and Analysis Division of the Department of Economic and Social Affairs of the United Nations Secratariat. Below are the summary statistics, listed in Tables 1 and 2.

Table 1: Summary Statistics

	PPP GDP/Capita (2011 international $)	Tax revenue (% of GDP)	Research and development expenditure (% of GDP)	Total Patent Applications	Life expectancy at birth, total (years)
Mean	33535	19.9	1.54	27682	77.8
Median	33572	21.0	1.42	1775	78.6
Standard Deviation	14302	9.0	0.89	91021	3.3
Range	87089	62.7	3.71	578802	14.8
Minimum	8488	0.2	0.20	0	68.8
Maximum	95577	62.9	3.91	578802	83.6
Count	684	656	615	684	684

Table 2: Summary Statistics Continued

	Import + Exports (% of GDP)	Gross savings (% of GDP)	Control of Corruption
Mean	97.6	22.1	1.23
Median	82.5	21.8	1.32
Standard Deviation	57.8	5.9	0.86
Range	355.8	38.3	3.41
Minimum	18.3	3.5	-0.82
Maximum	374.1	41.7	2.59
Count	684	640	576

4.2 Empirical Model

This study uses a model based off of Balcerzak and Pietrzak (2015). It is adjusted by using PPP GDP as the dependent variable and also adding several additional independent variables gathered from several other various sources. The model is as follows:

PPP GDP = B0 + B1(tax rate) + B2(R&D) +B3(Patents) + B4(Life Expectancy) + B5(Imports & Exports) +B6(Savings Rate) + B7(Corruption Index) + e

PPP GDP is used to measure the standard of living. This is consistent with other research. By using Purchase Price Parity GDP, this study accounts for the difference in the cost of living across countries and currencies. Various other research studies look into the effect that some of these variables have on the standard of living, but none of them use all of these variables.

The independent variables contain 7 different variables gathered across multiple sources. Each independent variable is discussed further in Part 2.0: Trend. First, tax rate represents a

government's tax revenue as a percent of GDP. Second, R&D represents expenditures on research and development as a percent of GDP. Third, Patents represents total patent applications from both residents and non-residents. Fourth, Life expectancy represents the average life expectancy at birth. Fifth, Imports & Exports represents the total amount of imports and exports as a percent of GDP. Sixth, Savings Rate represents the gross domestic savings as a percent of GDP. Lastly, Corruption Index represents the World Governance Indicators Control of Corruption Index, where -2.5 is the least and 2.5 is the greatest with an average of 0.

5.0 Empirical Results

The empirical estimation results are listed in Table 3. The Hausman Test proved that the fixed effects model should be used to analyze these results. Both results are similar. The fixed effects result shows very little surprises. The only variable that had a sign other than what was expected is the R&D variable. However, it is not statistically significant.

Table 3: Regression Analysis

PPP GDP (2011 $)	Random Effects Model	Fixed Effects Model
Tax Revenue (% of GDP)	69.05* (36.80)	65.21 (39.27)
R&D (% of GDP)	-1018.91 (835.44)	-1290.07 (861.31
Total Patents	0.0198*** (0.00188)	0.0184*** (0.00175)
Life Expectancy at Birth	1467.53*** (159.29)	1464.21*** (151.55)
Total Imports & Exports (% of GDP)	43.26*** (16.56)	42.38*** (14.62)
Gross Domestic Savings Rate (% of GDP)	108.65** (53.10)	103.83* (54.19)
Control of Corruption Index	2963.81*** (916.33)	2372.83** 1034.53
Observations	483	483
F-Stat	881.22	252.18
P Value	0.0000	0.0000
R-squared	0.6536	0.6307

Notes: Robust standard errors in parenthesis. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

The variables that were statistically significant in the fixed effects model are total patents, life expectancy at birth, total imports and exports as a percent of GDP, gross domestic savings rate, and the control of corruption index. The signs on all of these variables are as expected.

For every additional patent application a country receives, it is expected that on average, PPP GDP will rise by $0.0184. This may not seem like very much, but a one patent increase is not very much at all either. Some countries receive over half of a million patents per year. To put this figure in more realistic terms, an increase of 1,000 patent applications is expected to increase PPP GDP by $18.43, which is much more economically significant.

Life expectancy at birth appears to be one of the most significant variables. For every additional year a person is expected to live, it is estimated that on average, PPP GDP will increase by $1464.21. This is a very significant number, especially since this figure rose by several years throughout the time period studied.

Total imports and exports as a percent of GDP has a statistically significant impact on PPP GDP, but it is not as economically significant as I thought it would be. For every 1% increase in imports and exports, PPP GDP is expected to rise by $42.38 on average.

Gross domestic savings rate also has a statistically significant effect on PPP GDP, although only at the 10% level. It is expected that for every additional 1% of savings, PPP GDP will increase by $103.83.

Finally, the control of corruption index has the largest effect on PPP GDP. This is most likely due to the fact that the corruption index changing by 1 value is a very significant chance. A country is unlikely to go from a rating of 0.5 to 1.5 in the matter of a year. When the

corruption index is increased by a value of 1, it is expected the PPP GDP will increase by $2372.83.

6.0 Conclusion

In summary, the most important variables that effect the standard of living are corruption, life expectancy at birth, patent applications, trade openness, and gross domestic savings rate. The results of this paper show that if a developed government wished to increase the standard of living for its citizens, they could decrease corruption, invest in healthcare and technology, reduce trade barriers in order to increase international trade, and encourage savings. Doing these things will help increase the standard of living, which is one of the main purposed of government. This paper only studied the effects of developed countries. It would be very interesting to see how these same variable effect countries that are not developed. They may have different impacts since less developed countries likely do not use their resources as efficiently.

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