



UNIVERSITI PUTRA MALAYSIA

**IMPACT OF DIGITALIZATION ON ECONOMIC GROWTH IN MIDDLE
AND HIGH INCOME COUNTRIES**

KHAIRUL AMIRUL BIN MUZAFAR SHAH

SPE 2020 27



**IMPACT OF DIGITALIZATION ON ECONOMIC GROWTH IN MIDDLE
AND HIGH INCOME COUNTRIES**

By

KHAIRUL AMIRUL BIN MUZAFAR SHAH

**Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

January 2020

COPYRIGHT

All material contained within the thesis, including without limitation text, logos, icons, photographs and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia



DEDICATION

This thesis is dedicated to my family members, supervisors, lecturers and friends. With love, respect and a bunch of memories. Indeed, we belong to Allah and indeed to Him we will return.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

IMPACT OF DIGITALIZATION ON ECONOMIC GROWTH IN MIDDLE AND HIGH INCOME COUNTRIES

By

KHAIRUL AMIRUL BIN MUZAFAR SHAH

January 2020

Chairman : Professor Law Siong Hook, PhD
Faculty : School of Business and Economics

Since the fourth industrial revolution (IR 4.0), there is a stark difference in terms of economic growth between high income and middle income countries, where the former exhibits higher economic growth. Simultaneously, there exist a digital divide between these two income groups when looking at three components of digitalization namely the number of individuals using the internet, number of mobile cellular subscriptions and fixed broadband subscriptions. Which begs the question, is it just a coincidence or are these components contributing toward the growth of these high income countries' economy? If so, how does other country with low digitalization try to narrow or close the gap of the digital divide? Therefore, the first objective of the study is to examine the effects of digitalization on economic growth, where digitalization is measured by the three components stated above. Also, to reduce the digital divide, we look at the second objective, which is to identify the determinants of the digital divide. The Generalized method of moments (GMM) panel data analysis is used to estimate the model comprising data from more than 120 countries, consist of countries in the high and middle income groups, from the years 2000 to 2017. The empirical result shows that all component of digitalization used are positively and statistically significant determinants of economic growth for both countries in high and middle income. Based on the countries' income groups, urbanization, trade openness, age population and human capital are found to be able to influence the adoption of either one, two or all three of the digitalization components in this study. At which, policy makers could devise a plan or approach to generate more trade openness, to incorporate digitalization in workplace and to provide better knowledge of digitalization, as well as to focus on increasing internet penetration rate.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

IMPAK DIGITALISASI TERHADAP PERTUMBUHAN EKONOMI NEGARA BERPENDAPATAN SEDERHANA DAN TINGGI

Oleh

KHAIRUL AMIRUL BIN MUZAFAR SHAH

Januari 2020

Pengerusi : Profesor Law Siong Hook, PhD
Fakulti : Sekolah Perniagaan dan Ekonomi

Semenjak munculnya Revolusi Industri ke-4 (RI 4), terdapat perbezaan yang jelas dari segi pertumbuhan ekonomi di antara negara pendapatan tinggi dan negara pendapatan sederhana, di mana negara pendapatan tinggi mempunyai pertumbuhan ekonomi yang lebih tinggi. Pada masa yang sama, terdapat jurang digital di antara kedua-dua kumpulan negara ini apabila melihat pada tiga komponen digitalisasi iaitu jumlah individu menggunakan internet, jumlah langganan telefon selular mudah alih dan jumlah langganan tetap jalur lebar. Jadi, timbulnya satu persoalan, adakah ini hanya sekadar kebetulan sahaja atau komponen-komponen tersebut sememangnya menyumbang terhadap pertumbuhan ekonomi negara pendapatan tinggi tersebut? Namun, jika benar, bagaimana caranya untuk negara yang mempunyai kadar digitalisasi yang rendah ini menutup atau mengecilkan jurang digital tersebut? Oleh sebab itu, objektif pertama penyelidikan ini adalah untuk memeriksa impak digitalisasi terhadap pertumbuhan ekonomi sesebuah negara. Di mana, digitalisasi diukur menggunakan komponen-komponen yang di sebutkan di atas. Justeru, bagi mengurangkan jurang digital, objektif kedua diguna pakai untuk mengenal pasti penentu-penentu jurang digital. Dengan itu, teknik analisis panel 'Generalized Method of Moment' (GMM) digunakan bagi menganalisis data yang di ambil lebih dari 120 negara yang tergolong di dalam kumpulan negara pendapatan tinggi dan pendapatan sederhana, dari tahun 2000 hingga 2017. Keputusan empirikal menunjukkan kesemua ukuran digitalisasi yang digunakan adalah penting secara statistik dan memberi impak positif terhadap pertumbuhan ekonomi negara pendapatan tinggi dan pendapatan sederhana. Selain itu, berdasarkan kepada kumpulan pendapatan negara, sesetengah faktor seperti pembandaran, keterbukaan perdagangan, populasi umur dan modal manusia di dapati mampu mempengaruhi penggunaan sama ada satu, dua atau ketiga-tiga komponen digitalisasi yang digunakan dalam penyelidikan ini. Justeru, pembuat polisi boleh mengambil langkah untuk mencipta cara atau insentif bagi menggalakkan lebih keterbukaan perdagangan, mengambil guna digitalisasi di dalam tempat kerja, memberi pengetahuan lebih tentang digitalisasi dan juga meningkatkan penembusan internet.

ACKNOWLEDGEMENTS

With the name of Allah the Most Compassionate and Most Merciful. All praise and thanks to Almighty Allah, with His blessing giving me the strength and passion, could manage to finish the research until this manuscript completed be compiled.

I would like to express my utmost appreciation to my supervisor Professor Dr Law Siong Hook for his endless support and dedication in guiding and advising me in order to be able to complete my thesis till this day. Not to mention my supervisory committee, Associate Professor Dr Wan Azman Saini bin Wan Ngah, whom also is there along the way of my master degree's journey, with vigilant guidance, support and encouragement. Without the help of these supervisor, I believe I would not have make it this far. Therefore I thank you sincerely from the bottom of my heart for all that you have given and done for me.

I am also very much thankful towards the support of my whole family. Especially, my mom and dad, in raising and teaching me into being the man that I am right now. Without their sacrifice, none of this would be possible. To my fellow friends, I would like to thank you all as well, for supporting me and always believing in my capabilities of being able to go this far.

Last but not least, I would like to thank all of the staffs in the Faculty of Economics and Management for teaching me new knowledge, supporting me and guiding me throughout this whole journey of mine, and for that I am thankful.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Law Siong Hook, PhD

Professor
School of Business and Economics
Universiti Putra Malaysia
(Chairman)

Wan Azman Saini bin Wan Ngah, PhD

Associate Professor
School of Business and Economics
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____

Date: _____

Name and Matric No.: Khairul Amirul bin Muzafar Shah, GS 51655

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____

Name of Chairman
of Supervisory
Committee:

Professor Dr. Law Siong Hook

Signature: _____

Name of
Member of
Supervisory
Committee:

Associate Professor Dr. Wan Azman
Saini bin Wan Ngah

TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	ii
ACKNOWLEDGEMENTS	iii
APPROVAL	iv
DECLARATION	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
CHAPTER	
1 INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement	11
1.3 Research Objectives	12
1.4 Scope of the Study	12
1.5 Significance of the Study	13
1.6 Organization of the Thesis	13
2 LITERATURE REVIEW	15
2.1 Introduction	15
2.2 Theoretical Review	15
2.3 Empirical Review	17
2.3.1 Digitalization and Economic Growth	17
2.3.2 Determinants of Digital Divide	18
2.4 Summary and Literature Gap	20
3 METHODOLOGY	21
3.1 Introduction	21
3.2 Theoretical Framework	21
3.3 Empirical Model, Data Sources and Descriptions	22
3.3.1 Objective One	22
3.3.2 Second Objective	25
3.4 Method of Estimation	27
3.5 Summary	28
4 RESULTS AND DISCUSSIONS	29
4.1 Introduction	29
4.2 Digitalization and Economic Growth	29
4.2.1 Descriptive Statistics and Correlation Matrix	29
4.2.2 Estimation Results	30
4.3 Determinants of Digital Divide	36
4.3.1 Descriptive Statistics and Correlation Matrix	36
4.3.2 Estimation Results	38
4.4 Conclusion	43

5	CONCLUSION	44
5.1	Digitalization and Economic Growth	44
5.1.1	Major Findings for High Income Countries	44
5.1.2	Major Findings for Middle Income Countries	45
5.2	Determinants of Digital Divide	46
5.2.1	The Findings for High Income Countries	46
5.2.2	The Findings for Middle Income Countries	47
5.3	Limitation of the Study	48
5.4	Recommendations for Future Studies	49
	REFERENCES	50
	APPENDICES	54
	BIODATA OF STUDENT	56



LIST OF TABLES

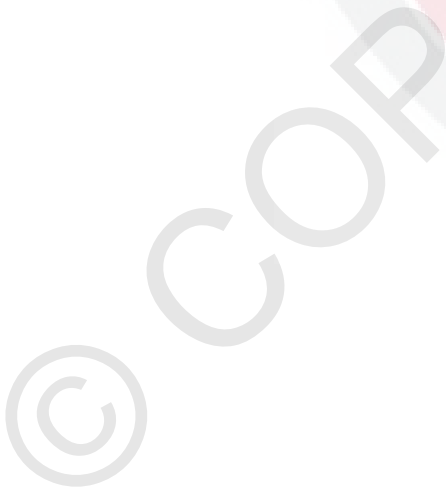
Table	Page
3.1 Variable Description	23
3.2 Variable Description	26
4.1 Mean, standard deviation, minimum and maximum values for High-income countries	29
4.2 Correlation matrix for High-income countries	29
4.3 Mean, standard deviation, minimum and maximum values for Middle-income countries	30
4.4 Correlation matrix for Middle-income countries	30
4.5 System GMM Two-step estimation for High Income and Middle income countries (lintu as digitalization)	31
4.6 System GMM Two-step estimation for High Income and Middle income countries (lmob as digitalization)	33
4.7 System GMM Two-step estimation for High Income and Middle income countries (lfixb as digitalization)	35
4.8 Mean, standard deviation, minimum and maximum values for High-income countries	36
4.9 Correlation matrix for High-income countries	36
4.10 Mean, standard deviation, minimum and maximum values for Middle-income countries	37
4.11 Correlation matrix for Middle-income countries	37
4.12 System GMM Two-step estimation for High Income and Middle income countries (lintu as digitalization)	38
4.13 System GMM Two-step estimation for High Income and Middle income countries (lmob as digitalization)	40
4.14 System GMM Two-step estimation for High Income and Middle income countries (lfixb as digitalization)	42

LIST OF FIGURES

Figure	Page
1.1 Internet User Vs Real GDP Per Capita for 2010 for High Income Country	4
1.2 Internet User Vs Real GDP Per Capita for 2015 for High Income Country	5
1.3 Mobile Cellular Subscription Vs Real GDP Per Capita in 2010 for High Income Country	5
1.4 Mobile Cellular Subscription Vs Real GDP Per Capita in 2015 for High Income Country	6
1.5 Fixed Broadband Subscription Vs Real GDP Per Capita in 2010 for High Income Country	6
1.6 Fixed Broadband Subscription Vs Real GDP Per Capita in 2015 for High Income Country	7
1.7 Internet User Vs Real GDP Per Capita in 2010 Middle Income Country	8
1.8 Internet User Vs Real GDP Per Capita in 2015 for Middle Income Country	8
1.9 Mobile Cellular Subscription Vs Real GDP Per Capita in 2010 for Middle Income Country	9
1.10 Mobile Cellular Subscription Vs Real GDP Per Capita in 2015 for Middle Income Country	9
1.11 Fixed Broadband Subscription Vs Real GDP Per Capita in 2010 for Middle Income Country	10
1.12 Fixed Broadband Subscription Vs Real GDP Per Capita in 2015 for Middle Income Country	10

LIST OF ABBREVIATIONS

AR (2)	Second Different Serial Correlation Test
GDP	Gross Domestic Product
GMM	Generalised Method of Moment
ICT	Information and Communication Technology
IR 4.0	Fourth Industrial Revolution
SATUM	Spatially Aware technology Utilization Model
WDI	World Development Indicator



CHAPTER 1

INTRODUCTION

1.1 Background of the Study

If asked what makes a country great? What makes them stand out from the others? Most of the time, the answer would be related to their states of economic growth or economic development. It contributes towards a country's development, whether domestically or internationally. The economy is usually associated with the ability of a country to produce outputs such as exports and imports, to control their demand and supply, or a simpler term to make money and sustain expenses. Countries such as the United States of America, China, Japan, Germany and the United Kingdom, are all well known for having a stable and high economic state in this 21st century. Every country has had their fair share of ups and down in the process of maintaining or developing their economic state.

Gordon (2016) on his work of "The Rise and Fall of American Growth", which is a book about an idea that economic growth, is not a steady process that creates economic advance at an even, regular pace. Even from the start of the first industrial revolution and through the second industrial revolution, with the introduction of factories, mass production of textiles, iron, steel and chemical, still some countries could not cope with the revolution at that time. Little by little, step by step, countries learn to adapt and join in with the first industrial revolution then, embracing the second industrial revolution and moving toward a brighter future during the time period of 1760 – 1914. Before the introduction of this industrial revolution most people only works for themselves. Then after the industrial revolution arises, companies, firms and businesses started to be develop. Started to expand domestically, generating tons and tons of revenues. After few decades, the businesses or firms then started to branch out, creating franchise in their own countries or even across countries throughout the whole world.

Hence, it was in that era, economic development, were mostly contributed by the massive rise of infrastructures such as factories, building or machinery the helps to creates high output for the country and also toward their export capabilities. Then in the 20th century, the world is introduced to the third industrial revolution in which the world economies learnt to familiarize with the information and communications technology (ICT). At that moment of time, ICT became a new knowledge that countries wants to get their hands on as they see its potential to impact the economy worldwide. At which, a study by Vu (2004) shows that ICT has significant impact on economic growth not only as traditional investment, but also as a boost to efficiency in growth, in which a higher level of ICT capital stock per capita allows an economy to achieve a higher growth rate for given levels of growth in labour and capital inputs.

In addition, ICT is used in various platform in business, marketing, transportation and also became a base in the creation of new technology such as smartphones, Bluetooth, Blu-ray and Wi-Fi, which are now used by people throughout the world. Apart from that, most of these modern technologies require the use or access of the internet, something that most of us are fully aware of its capabilities. This type of technological innovation are the one that started to really show the potential of creating a better economy when technology are incorporated into businesses, policy or trade.

In which, we begin to see the rise of companies such as Apple, Microsoft, Nokia and other technological based companies. Since this is the era of the 4th Industrial Revolution (IR 4.0), or also known as the era of digitization, where IR 4.0 could be simplified as the era of digital and automation technologies. In which, the IR 4.0 are made of nine pillar; Big data, Augmented Reality, Simulation, Internet of Things, Cloud Computing, Cyber Security, Systems Integration, Manufacturing and Autonomous System.

Furthermore, with the emerging IR 4.0 and its pillars, it seems to be the perfect time for a country to start moving towards digital economy, as it already showed some perceived benefits towards a better economy. In which, shows that even business nowadays are moving toward online businesses, restaurant having Wi-Fi coverage and also application or services through mobile phones. Those are the few examples how the digitalization are affecting a businesses or firm's revenue, and consequently reflecting upon their countries' economy in a good way.

Therefore, countries would need to have a high amount of digitalization to fully benefit from the perks of this newly found industrial revolution. In order to measure digitalization, instead of its index, one can look at components of the digitalization such as the number of internet user, mobile cellular subscription and also fixed broadband subscription. Where research by Katz and Koutroumpis (2013), Moroz (2017) and Kotarba (2017) show that these three components are a part of the digital index that can be used to measure digitalization, digitization as well as the digital economy.

However, when it comes to the implementation of digitalization there can be seen an imbalance among countries in terms of the number of internet user, mobile cellular subscription and fixed broadband subscription, especially between high and middle income countries. It is a shame that some countries may not be able to enjoy the benefits of the IR 4.0. This may be due to the limited capability of some countries to adapt with the digital world compared to other countries. They might be lacking the technology to sustain the advancement of the digital era or even lacking the knowledge of how to operate the new found digitize world in its fullest. As well as having different ability to access technology such as the internet or the countries' own desire in not feeling the need of knowing what this new IR 4.0 could bring upon. Therefore, when countries are at their own individual pace in utilizing digitalization, a gap is created among countries in terms of digital usage. In other word, the digital divide among countries.

Digital divide, or according to Gunkel (2003) and Mason and Hacker (2003) “the gap separating those individuals who have access and use new forms of interactive communication and information technology and those who do not”, is the phrase used to call this situation. At which, the interactive communication and information technology refers to technology such as computers, internet, broadband and other technologies. Where in this case the divide is represented by countries in the middle income group that are not able to reach the same rate of digitalization as countries in the high income group.

Similar to a study by Quibria, Ahmed, Tschang and Reyes-Macasaquit (2002), where there was a stark digital divide among the Asian countries with Singapore having the number of internet users of 419 per thousand people to Bangladesh having 0.2 per thousand people having access to the internet in 2002. However, according to the Internet World Stats (2017), the divide is not necessarily factored by the access to the internet, but also by access to ICT and to Media that the different segments of society can use. At which, in order to represent how severe the digital divide is Ramirez-Djumena (2016) found that, 6 billion people are without broadband, 4 billion people without internet, 2 billion people without mobile phones and 0.4 billion people without digital signal.

It would be a tragedy if a country misses out on this golden opportunity to gain full potential of the IR 4.0 when it is arguably at its peak, where according to Davies (2015) this new, digital industrial revolution holds the promise of increased flexibility in manufacturing, mass communication, increased speed, better quality and improved productivity. In which, it is proven internet has a positive and significant effect on labour productivity (Najarzadeh, Rahimzadeh and Reed, 2015). Therefore, if these countries do not figure out how to overcome this digital divide issues, the worst thing that could and would eventually occur is the country's downfall in their economic development.

It is evident that nowadays, almost everything is going towards the futuristic civilization with the online business such as digitalize currency and the high-tech machinery. These entire digitalize infrastructures should be benefited by all country throughout the world. Surely, in the next decade or so, there will be more new and sophisticated advancement to come. Which means, starting from now, every country should have the liberty and capability of accessing and using technology such as internet and mobile phone as a step towards the future and a better state of the economy. Therefore, this study should be able to help countries to know what step or approach needed to be taken in order to have a better digitalization.

Figures 1.1 – 1.12 show the scatter plot in 2010 and 2015 represented by digitalization and economic growth for both high income and middle income group. In which, digitalization will be represented by the number of internet user (% of population), mobile cellular subscription (per 100 people), fixed broadband subscription (per 100 people) and economic growth will be real Gross Domestic Product (GDP) (constant

2010 US\$). Also, at the same time the divide or gap between countries in term of digitalization could also be seen in all the figures below.

Figures 1.1 until 1.6 representing the scatter plot for countries under the high income group consisting data in 2010 and 2015, represented by digitalization and economic growth. In which, digitalization will be the number of internet user (% of population), mobile cellular subscription (per 100 people), fixed broadband subscription (per 100 people) and economic growth will be real Gross Domestic Product (GDP) (constant 2010 US\$).

Figures 1.1 and 1.2 show the scatter plot of total internet user vs Real GDP per capita in 2010 and 2015 for high income countries respectively. There is an increase in term of Real GDP per Capita that can be seen in 2015, where some countries shifts upwards. The same can be said for the internet user in 2015, in which almost all the high income countries' internet user had increase to more than 60 % of their population.

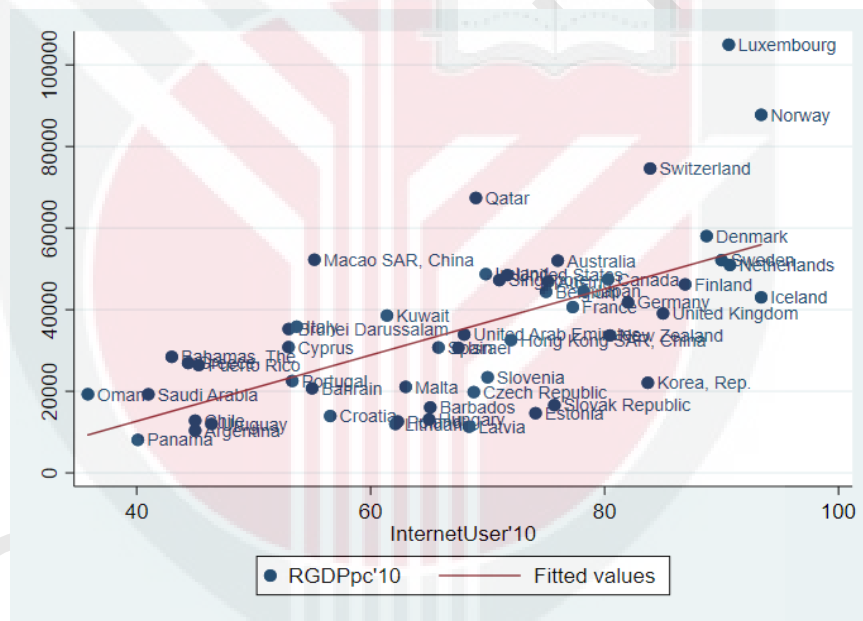


Figure 1.1 : Internet User Vs Real GDP Per Capita for 2010 for High Income Country

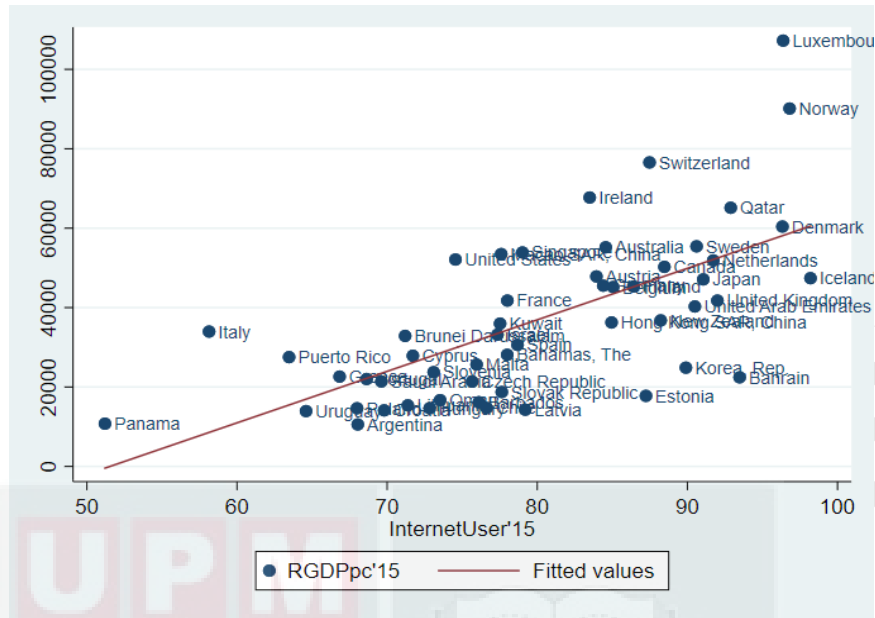


Figure 1.2 : Internet User Vs Real GDP Per Capita for 2015 for High Income Country

Figures 1.3 and 1.4 show the scatter plot of the mobile cellular subscription vs real GDP per capita in 2010 and 2015 for high income countries. Most of the countries are above 100 in term of mobile cellular subscription and many countries had pass 20000 in term of real GDP per capita.

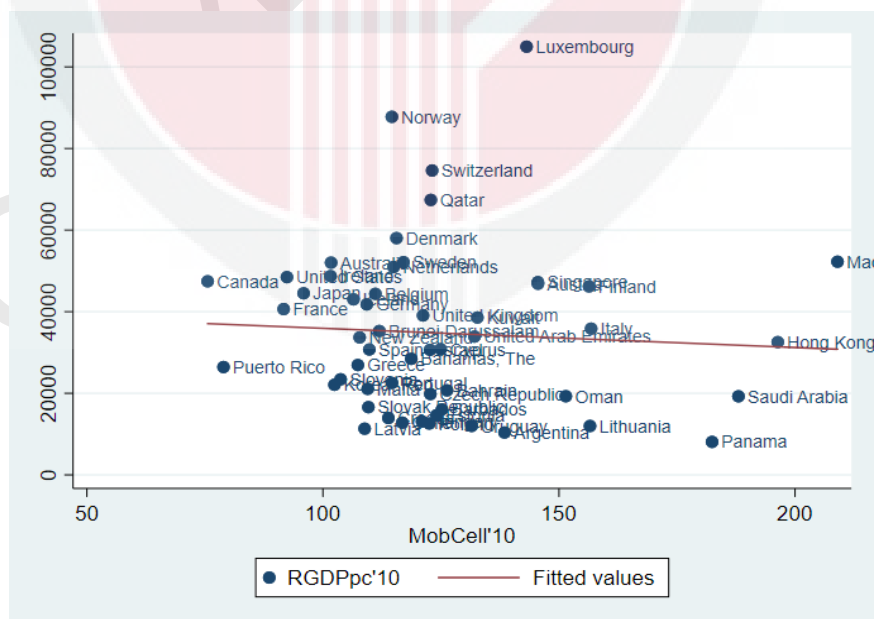


Figure 1.3 : Mobile Cellular Subscription Vs Real GDP Per Capita in 2010 for High Income Country

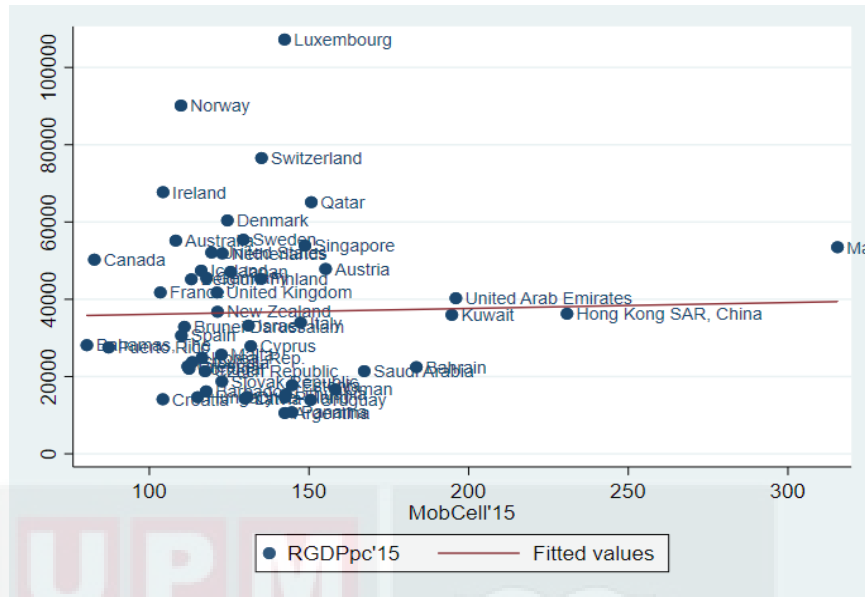
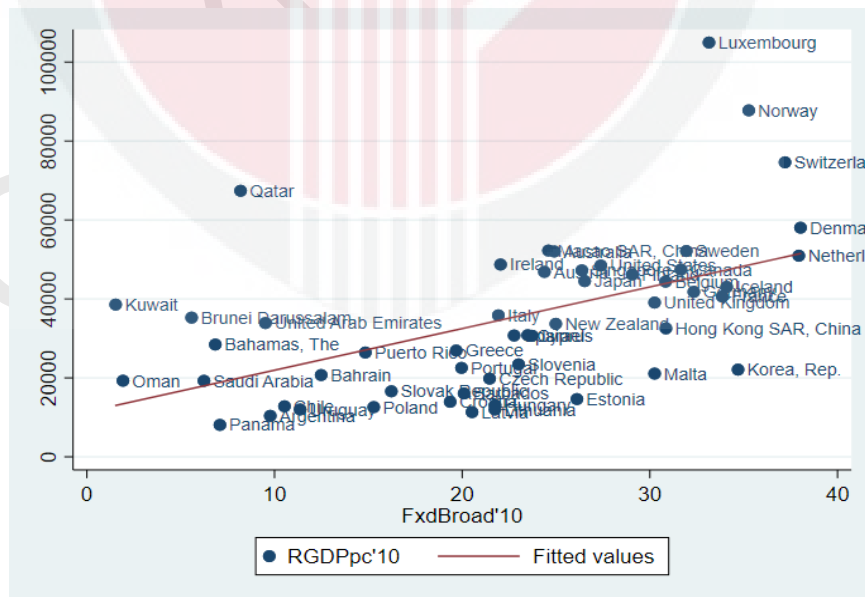


Figure 1.4 : Mobile Cellular Subscription Vs Real GDP Per Capita in 2015 for High Income Country

Figures 1.5 and 1.6 represent scatter plot of the fixed broadband subscription vs real GDP per capita for the year 2010 and 2015 for high income countries. Some countries started to surpass the 40 mark for fixed broadband subscription in 2015, and most of the countries surpassing above the 20 mark in 2015. At which the list of countries in the high income group can be seen in Appendix A.



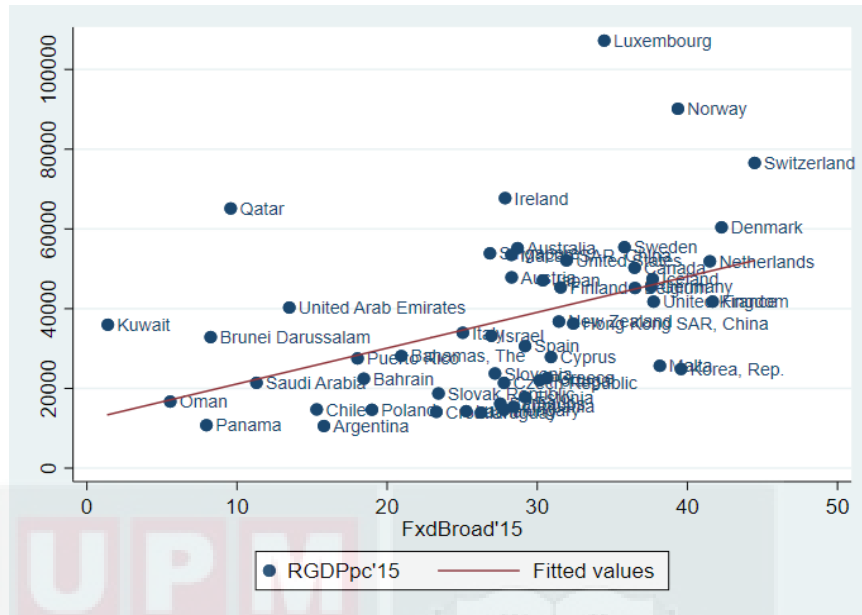


Figure 1.6 : Fixed Broadband Subscription Vs Real GDP Per Capita in 2015 for High Income Country

Figures 1.7 until 1.12 show the scatter plot for countries under the middle income group consisting data in 2010 and 2015 represented by digitalization and economic growth. In which, digitalization will be the number of internet user (% of population), mobile cellular subscription (per 100 people), fixed broadband subscription (per 100 people) and economic growth will be real Gross Domestic Product (GDP) (constant 2010 US\$).

Figures 1.7 and 1.8 show the scatter plot of total internet user vs Real GDP per capita in 2010 and 2015 for Middle Income Countries. There is an increase in both internet user and Real GDP per capita in 2015. Where some countries had shifted upward surpassing the 5000 mark. Also half of the countries in 2010 with internet user below 20% had increase above 20% in 2015. The same thing occur for the countries that were between 20% and 40%, where they were able to surpass 40% in 2015.

100 mark. This somewhat show a rapid increase in term of mobile cellular subscription for the middle income countries.

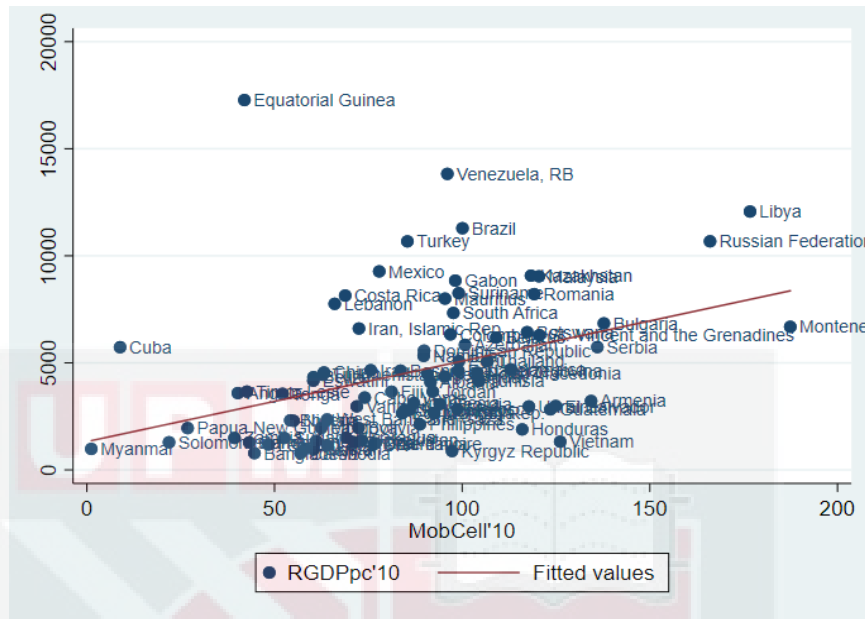


Figure 1.9 : Mobile Cellular Subscription Vs Real GDP Per Capita in 2010 for Middle Income Country

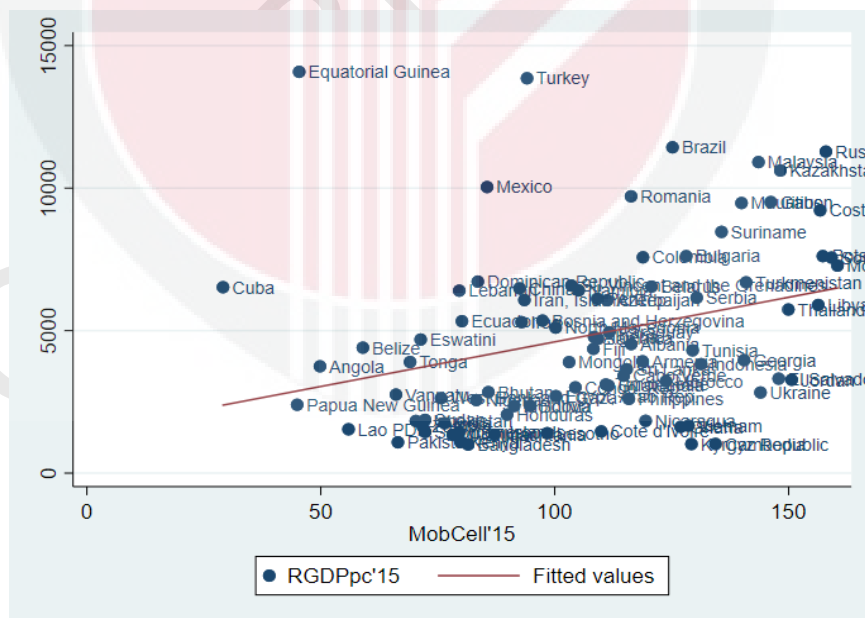


Figure 1.10 : Mobile Cellular Subscription Vs Real GDP Per Capita in 2015 for Middle Income Country

Figures 1.11 and 1.12 represent fixed broadband subscription vs real GDP per capita for the year 2010 and 2015 in the form of a scatter plot. There is not much change in the middle income countries in term of fixed broadband subscription below the 10 mark, in which we can see in 2010 and 2015 almost a similar graphing where only a few countries manage to push above the 5 mark as well as the 15 mark. Some middle income countries are still lagging behind in terms of fixed broadband subscription. Where, the list of countries in the middle income group can be seen in Appendix B.

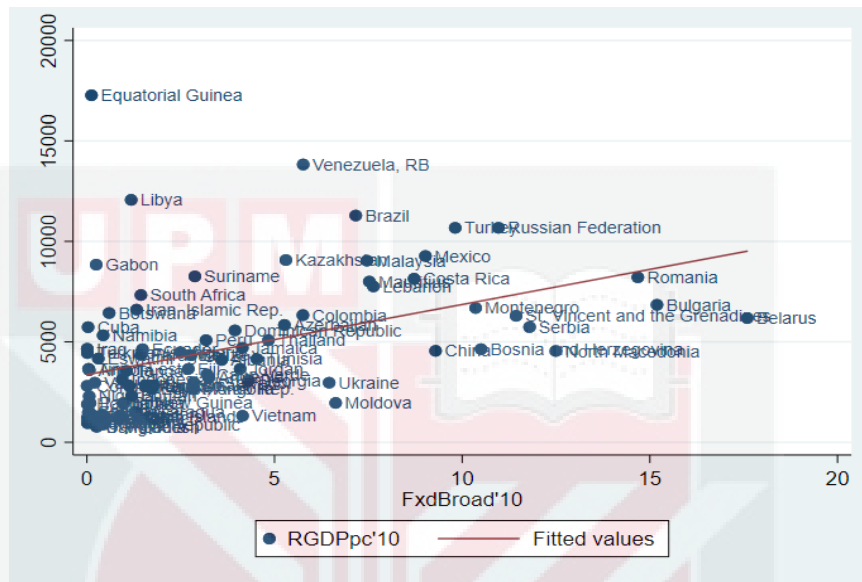


Figure 1.11 : Fixed Broadband Subscription Vs Real GDP Per Capita in 2010 for Middle Income Country

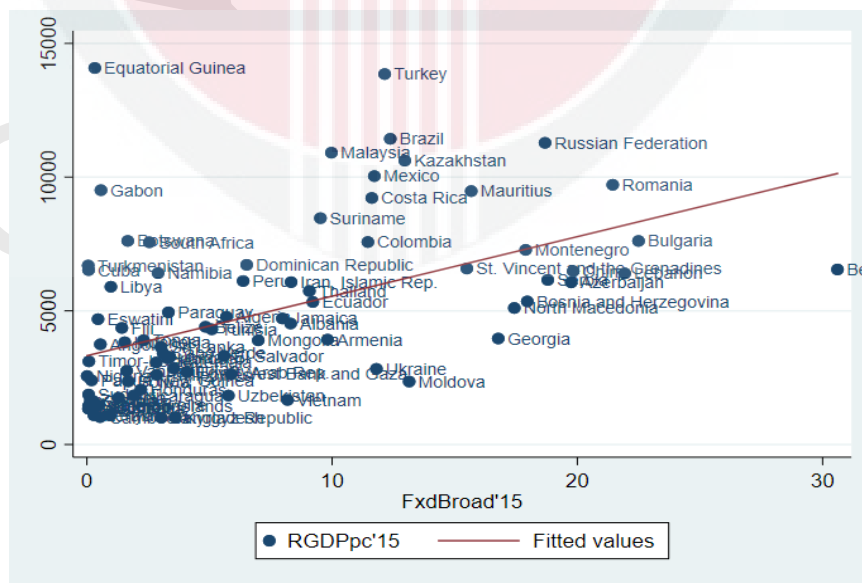


Figure 1.12 : Fixed Broadband Subscription Vs Real GDP Per Capita in 2015 for Middle Income Country

1.2 Problem Statement

Moving from the first industrial revolution, of the coming of age iron and textiles industries through the second, with the much more expanded previous industries such as steel, oil and electricity industries and third industrial revolution which is the era of technology advancement from basic machinery to the high tech and digitize world, the world economies have observed the rapid transformation of countries from poor to a very rich country. In this era of IR 4.0, the world are no longer fully relying on the old industrial revolution as the newly found industrial revolution has shown to be a beneficial asset towards a country's economy. Where it can be seen in the World Bank database there are countries with income per capita of more than USD30, 000. Which make us wonder to what extent does this IR 4.0 really helps our economy?

Moreover, there are some countries that are embracing the idea of digitalization well ahead of other countries. This can be seen when we look at the number of internet users, mobile cellular subscriptions and fixed broadband subscriptions especially in countries such Hong Kong, United Kingdom and Korea Republic. At which their number of digitalization seem to be higher compared to some other countries. However, there are still some countries with significantly low number of digitalization that creates a wide gap between them and other countries. This seems to show that some countries seems to think that digitalization is the next big thing in order to have a greater economy and in order to strive in digital economy, a high amount of digitalization is needed. Which begs the question, does the difference in digitalization affects a country's economic growth? A high or low digitalization are much more preferable? And why?

On the other hand, it is clear that most country in the high income group have a much higher digitalization compared to other countries especially in the middle income group. As mentioned earlier, creating a gap between them in term of digitalization or in other term, creating a digital divide. When referring to the figures in Section 1.1, it clearly shows a significant amount of digital divide that still exist even in this technological era that we live in now. If digitalization actually helps in increasing a country's economic growth, it would be a shame if these countries with lower digitalization could not gain the same benefit as other countries.

In addition, this would be a golden opportunity that any countries should not miss out on. Which begs the question, why? With the fourth industrial revolution and the digital economy that many countries are rapidly embracing, some of these unfortunate countries are still lagging further behind. It is safe to say that countries with low digitalization, most probably are still highly relying on the old industries, as they are not fully aware of the benefits that this new IR 4.0 could bring. It may also be due to their lack of knowledge in this digital economy and how to approach it as well as the lack of expertise or infrastructure on new technology. Therefore, what can these countries do in order to have a better digitalization and to be at par with other countries?

Therefore, the research questions of the study comes at hand:

1. Does digitalization affect a country's economy?
2. How does different components of the digitalization affect the economic growth of a country?
3. Which component of the digitalization are contributing the most towards a country's economic growth?
4. Are there factor that limits the amount of a country's rate of digitalization?
5. What can countries do in order to increase their digitalization and reduce the digital divide?

1.3 Research Objectives

The main objective of this study is to investigate relationship of digitalization on economic growth in high income and middle income countries:

The specific objectives of this study are:

1. To examine the impact of digitalization on economic growth, and
2. To identify the determinants of the digital divide.

1.4 Scope of the Study

Since this is the era of IR 4.0, where the economy are moving more towards digital economy, this research focuses on digitalization that is to see its impacts on economic growth and to know what stimulates the digitalization itself. At which, in this particular study, digitalization is being measured by three different factor, which is the number of individuals using the internet (% of population), number of mobile cellular subscription (per 100 people) and fixed broadband subscription (per 100 people). The study consist of more than 120 countries throughout the world, from the years 2000 to 2017, which is a span of at 18 years. The research consist of data from various countries, dividing it into two group; high income and middle income countries.

At which these country groups were chosen as these income groups have a much better sense in term of digitalization especially regarding with the availability of data as well as their advancement in technology. Where the data is collected from World Development Indicator (WDI) World Bank Database. The data interested in the research are quantitative data, consisting of the countries' Gross Domestic Product (GDP) per capita, individuals using the internet, fixed broadband subscription, mobile cellular subscription, human capital, labour force, physical capital and others. As a result, a multiple regression model is constructed to represent the data for each objectives, and it will be then analysed by using dynamic panel regression by running through the software STATA 15.

1.5 Significance of the Study

This study is an attempt to show that digitalization are contributing towards the development of economy throughout the world. At which, to prove that adopting digitalization in a country would result in a better state of economy for both high income and middle income countries. Thus, countries that are still relying on the old industries, would understand that having a higher digitalization would help to increase their economic state for the better. In addition, various industries or businesses that are still relying on old industrial revolution could use this study as a realisation that this new IR 4.0 is the new source of better revenue for them that could help them to strive in their own respective industries as well as helping in contributing towards their country's own economic growth. Furthermore, with the existing digital divide, countries could now with the help of this research, close or reduce the gap of the digital divide as the determinants of this phenomenon are clearly identified.

At which, policy makers, could devise a plan or action that could be used in order to better approach the determinant identified in the study as it could help in a better digitalization. Thus, closing or narrowing the gap of the digital divide between countries in term of digitalization. All in all, this research would help other countries to compete or catch up with all the well developed countries, as this research proves to show the significant and necessity to implement the benefits of the digitalization and at the same time knowing and understanding the factors that are influencing the adoption of digitalization. Furthermore, future research on similar subject could use this research as reference and see that there are other determinants of the digital divide compared to other existing literature.

1.6 Organization of the Thesis

This thesis are meant to analyse the relationship between digitalization and economic growth. While at the same time determining if there exist a digital divide among countries and to see the factors that may cause the divide. Therefore, the organization of thesis starts in Chapter 2, where we review other research that covers similar matter, to understand the extent of the research so far, what have been done and in what way. This is to help use to diversify our own research and to explore new boundaries if possible.

Then, we move onto Chapter 3, which focus on the method of the research. In which, the research's model are constructed with relevant variables that are needed for each objective are done in this chapter. Also, all the variables used and where it is originated are explained in the section as well. Not to mention the estimation method that we intended to use are also specified here in the best way possible.

Furthermore, after understanding what are the basic model used and the method intended to be implemented. We move to Chapter 4, at which it focus on the analysis

of each model for both objective of the research. Where the result of the analysis are then calculated and interpreted in term of econometric analysis.

Moreover, we progress to Chapter 5. Upon which, a brief insight of the result in chapter 4 that focus on the main variable is constructed in order to better understand why the result is as it is. Then, a summary and conclusion regarding the research are assembled to explain what exactly have the study achieve. Lastly, a short recommendation of the research result and also possibility of future study are also discuss, mainly on what can be done next, what variables may be used and also exploring other method at hand.

Last part of the thesis, which consist of all the number of reference that are used throughout this research from start till finish and any relevant information of the research that are in the appendices.

REFERENCES

- Agarwal, R., Animesh, A., & Prasad, K. (2009). Social interactions and the “digital divide”: explaining variations in internet use. *Information Systems Research*, 20, 277-294.
- Arellano, M. & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58 (2), 277. doi:10.2307/2297968
- Billon, M., Crespo, J., & Lera-Lopez, F. (2017). Educational inequalities: Do they affect the relationship between internet use and economic growth? *Information Development*, 1-13. doi:10.1177/0266666917720968
- Caliskan, H.K. (2015). Technological change and economic growth. *Procedia - Social and Behavioral Sciences*, 195, 649-654. doi:10.1016/j.sbspro.2015.06.174.
- Chaudhuri, A., Flamm, K.S., & Horrigan, J. (2005). An analysis of the determinants of internet access. *Telecommunications Policy*, 29, 731-755.
- Chavula, H.K. (2012). Telecommunications development and economic growth in Africa. *Information Technology for Development*. doi: 10.1080/02681102.2012.694794
- Chinn, M.D., & Fairlie, R.W. (2007). The determinants of the global digital divide: A cross-country analysis of computer and internet penetration. *Oxford Economic Papers*, 59(1), 16-44.
- Choi, C., & Yi, M.H. (2009). The effect of the internet on economic growth: Evidence from cross-country panel data. *Economics Letters*, 105, 39-41.
- Choi, C., & Yi, M.H. (2017). The internet, R&D expenditure and economic growth. *Applied Economics Letters*. doi.org/10.1080/13504851.2017.1316819
- Chu, S. (2013). Internet, economic growth and recession. *Modern Economy*, 4, 209-213.
- Clark, B., Jorgenson, A., & Kentor, J. (2010). Militarization and energy consumption: a test of treadmill of destruction theory in comparative perspective. *International Journal of Sociology*, 40, 23-43. doi:10.2753/IJS0020-7659400202.
- Crenshaw, E.M., & Robison, K.K. (2006). Globalization and the digital divide: The roles of structural conduciveness and global connection in internet diffusion. *Social Science Quarterly*, 87(1), 190-207.
- Davies, R. (2015). Industry 4.0: Digitalization for productivity and growth. *Member's Research Service*, 1-10.

- Feng, Y. (2016). Internet and economic growth – evidence from Chinese provincial panel data. *Modern Economy*, 7, 859-866.
- Fernandes, A. S. C. (2013). The contribution of technology to added value. doi: 10.1007/978- 1-4471-5001-5_2.
- Ghosh, S. (2017). Broadband penetration and economic growth: Do policies matter? *Telematics and Informatics*, 34(5), 676-693. doi: 10.1016/j.tele.2016.12.007.
- Gordon, R.J. (2016). Perspectives on the rise and fall of American growth. *American Economic Review: Paper and Proceedings*, 106(5), 1-7.
- Gunkel, J.D. (2003). Second thoughts: Toward a critique of the digital divide. *New Media & Society*, 5(4), 499-522.
- Hansen, L.P. (1982). Large sample properties of generalised method of moment estimators. *Econometrica*, 50(4): 1029-1054. doi:10.2307/1912775
- Internet World Stats. (2017). The digital divide, ICT, and broadband internet. Retrieved August 20, 2019, from <http://www.internetworldstats.com/links10.htm>
- Jorgenson, A., Clark, B., & Kentor, J. (2010). Militarization and the environment: A panel study of carbon dioxide emissions and the ecological footprints of nations, 1970-2000. *Global Environmental Politics*, 10, 7-29. doi:10.1162/glep.2010.10.1.7.
- Katz, R. & Koutroumpis, P. (2013). Measuring digitization: A growth and welfare multiplier. *Technovation*, 33, 314-319. doi: 10.1016/j.technovation.2013.06.004.
- Kotarba M. (2017). Measuring digitalization – key metrics. *Foundations of Management, Sciendo*, 9(1), 123-138.
- Mardikyan, S., Yildiz, E. A., Ordu, M.D., & Simsek, B. (2015). Examining the global digital divide: A cross-country analysis. *Communications of the IBIMA*, doi: 10.5171/2015.592253
- Mason, S.M. & Hacker, K.L. (2003). Applying communication theory to digital divide research. *IT and Society*, 1, 40-55.
- Moroz, M. (2017). The level of development of the digital economy in Poland and selected European countries: a comparative analysis. *Foundations of Management*, 9. doi: 10.1515/fman-2017-0014.
- Najarzadeh, R., Rahimzadeh, F., and Reed, M. (2014). Does the internet increase labour productivity? Evidence from a cross-country dynamic panel. *Journal of Policy Modeling*, 36. doi:10.1016/j.jpmod.2014.10.003.

- Ng, T.H., Lye, C.T., & Lim Y.S. (2013). Broadband penetration and economic growth in ASEAN countries: A generalized method of moments approach. *Applied Economic Letters*, 20, 857 -862.
- Pick, J. & Sarkar, A. (2016). Theories of the digital divide: Critical comparison. 3888-3897. doi:10.1109/HICSS.2016.484.
- Pradhan, R.P., Bele, S., & Pandey, S. (2013). Internet-growth nexus: Evidence from cross-country panel data. *Applied Economics Letters*, 16, 1511-1515.
- Pradhan, R.P., Arvin, M.B., Norman, N.R., & Bennett, S.E. (2015). Financial depth, internet penetration rates and economic growth: Country-panel evidence. *Applied Economics*. doi:org/10.1080/00036846.2015.1078450
- Qiang, C.Z.W., Rossotto, C.M., & Kimura, K. (2009). Economic impacts of broadband. *Information and Communications for Development*. The World Bank, Washington DC, USA.
- Quibria, M.G., Ahmed, S.N., Tschang, T., & Reyes-Macasaquit, M.L. (2002). Digital divide: Determinants and policies with special reference to Asia. *Journal of Asian Economics*, 13, 811-825. doi: 10.1016/S1049-0078(02)00186-0.
- Ramirez-Djumena, N. (2016). Digital divide. *Finance and development*, 53(3).
- Robison, K.K., & Crenshaw M.C. (2002). Post-industrial transformations and cyberspace: A cross-national analysis of internet development. *Social Science Research*, 31, 334-363.
- Romer, P. (1990). Endogenous technological change. *Journal of Political Economy*, 98, 71-102.
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, 9(1), 86-136.
- Salahuddin, M & Gow, J. (2015). The effects of internet usage, financial development and trade openness on economic growth in South Africa: A time series analysis. *Telematics and Informatics*. doi:10.1016/j.tele.2015.11.006.
- Solow, R. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics*, 39(3), 312-320.
- Sredojevic, D., Cvetanovic, S., & Boskovic, G. (2016). Technological changes in economic growth theory: Neoclassical, endogenous, and evolutionary-institutional approach. *Economic Themes*, 54. doi:10.1515/ethemes-2016-0009.
- Thompson, H., & Garbacz, C. (2011). Economic impacts of mobile versus fixed broadband. *Telecommunication Policy*, 35(11), 999-1009. doi:10.1016/j.telpol.2011.07.004.

Tondl, G. (2001). *Convergence after divergence? Regional growth in Europe*. Wien: Springer-Verlag.

Tun, Y., Azman-Saini, W.N.W & Law, S.H. (2012). International evidence on the link between foreign direct investment and institutional quality. *Engineering Economics*, 23, 379-386. doi:10.5755/j01.ee.23.4.2569.

Vu, K. (2004). Measuring the impact of ICT investment on economic growth. *Journal of Economic Growth*.

Zafar, T., & Aftab, K. (2007). Digital divide: An econometric study of the determinants in information-poor countries. *The Pakistan Development Review*, 46(1), 63-96.



BIODATA OF STUDENT

I am Khairul Amirul Bin Muzafar Shah, born on 29th of August 1994. In 2015 I have obtained my diploma in Quantitative Science, Universiti Teknologi Mara (UiTM), Perak, Tapah Campus. The same year I pursued my bachelor degree which is the Bachelor of Science (Hons) Mathematics in Universiti Teknologi Mara (UiTM), Negeri Sembilan, Seremban 3 Campus. In which, currently I am a student in Universiti Putra Malaysia (UPM) undertaking my master degree, Master of Science (Economics).





UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : Second Semester 2019/2020

TITLE OF THESIS / PROJECT REPORT :

IMPACT OF DIGITALIZATION ON ECONOMIC GROWTH IN MIDDLE AND HIGH INCOME COUNTRIES

NAME OF STUDENT: KHAIRUL AMIRUL BIN MUZAFAR SHAH

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (✓)

- | | | |
|--------------------------|---------------------|---|
| <input type="checkbox"/> | CONFIDENTIAL | (Contain confidential information under Official Secret Act 1972). |
| <input type="checkbox"/> | RESTRICTED | (Contains restricted information as specified by the organization/institution where research was done). |
| <input type="checkbox"/> | OPEN ACCESS | I agree that my thesis/project report to be published as hard copy or online open access. |

This thesis is submitted for :

- | | | |
|--------------------------|---------------|---|
| <input type="checkbox"/> | PATENT | Embargo from _____ until _____
(date) (date) |
|--------------------------|---------------|---|

Approved by:

(Signature of Student)
New IC No/ Passport No.:

Date :

(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentiality or restricted.]