



UNIVERSITI PUTRA MALAYSIA

***IMPACT OF POPULATION AGING ON ECONOMIC GROWTH, HEALTH
CARE EXPENDITURE AND LABOR PRODUCTIVITY IN MALAYSIA***

HAJAH SITI WARDAH BINTI HAJI ABD RAHMAN

FEP 2018 15



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By

HAJAH SITI WARDAH BINTI HAJI ABD RAHMAN

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

January 2018

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DEDICATION

I dedicate this work to my beloved parents.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

IMPACT OF POPULATION AGING ON ECONOMIC GROWTH, HEALTH CARE EXPENDITURE AND LABOR PRODUCTIVITY IN MALAYSIA

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January 2018

Chairman : Associate Professor Normaz Wana Ismail, PhD
Faculty : Economics and Management

Malaysia is aging at a rapid speed but at a lower level of development. The aging process is expected to accelerate in the future. Obviously, it raises the question of how population aging affects the Malaysian economy. Therefore, the first issue is on determining whether population aging will boost economic growth. The second issue highlighted in this study is related to the impact of population aging on health care expenditure. The third issue addressed in this study is about the impact of population aging on labor productivity. In response to these issues, this study underlines three objectives. To answer the three objectives, Autoregressive Distributed Lag (ARDL) model is run using time-series data in the span of 15 to 35 years, in order to study the long-run and short-run impact. The main findings for the first objective showed that the declining fertility rate retards economic growth, as well as old-age dependency ratio and population aged 65+ give negative but insignificant impact on economic growth for the first objective. This implies that aging will inhibit economic growth in the long run, due to increasing dependency ratio. For the second objective, the main findings revealed that higher population aged 65+ raises private health expenditure. This implies aging significantly pushes up health spending in the private healthcare sector in the long run. For the third objective, the main findings showed that older workers give negative but insignificant impact on total labor productivity and they give positive but insignificant impact on labor productivity in the services sector. However, middle-aged workers give a positive and significant impact on total labor productivity and labor productivity in the agriculture and manufacturing sectors. These imply that aging is not found to boost the total labor productivity and labor productivity by sector in the long run. Therefore, we can conclude that the findings bring to light that aging can be a burden to the economy. Malaysia needs to be more prepared for a bigger population of senior citizens that will increase faster.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KESAN PENUAAN PENDUDUK KEPADA PERTUMBUHAN EKONOMI,
PERBELANJAAN PENJAGAAN KESIHATAN DAN PRODUKTIVITI
TENAGA PEKERJA**

Oleh

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Malaysia semakin bertambah tua pada kadar yang semakin cepat tetapi di tahap pembangunan yang lebih rendah. Proses penuaan dijangka akan bertambah laju di masa akan datang. Yang jelas ialah ia menimbulkan pertanyaan bagaimana penuaan penduduk memberi kesan kepada ekonomi Malaysia. Oleh itu, isu pertama adalah untuk menentukan samada penuaan penduduk akan meningkatkan pertumbuhan ekonomi. Isu kedua yang diketengahkan dalam kajian ini adalah berkaitan dengan kesan penuaan penduduk kepada perbelanjaan penjagaan kesihatan. Isu ketiga dalam kajian ini adalah mengenai kesan penuaan penduduk kepada produktiviti tenaga pekerja. Untuk menjawab isu-isu ini, kajian ini menggariskan tiga objektif. Untuk mencapai tiga objektif ini, model *Autoregressive Distributed Lag (ARDL)* telah dijalankan menggunakan data *time-series* dalam jangka masa 15 ke 35 tahun, untuk mengkaji kesan dalam jangka masa panjang dan pendek. Hasil utama kajian untuk objektif pertama menunjukkan bahawa kadar kesuburan yang menurun melambatkan pertumbuhan ekonomi, dan juga nisbah kebergantungan umur tua dan peningkatan penduduk yang berumur 65+ memberi kesan negatif tetapi tidak signifikan terhadap pertumbuhan ekonomi untuk objektif pertama. Ini menandakan yang penuaan akan menghalang pertumbuhan ekonomi, disebabkan bertambahnya nisbah kebergantungan. Untuk objektif kedua, penemuan utama kajian mendedahkan bahawa peningkatan penduduk yang berumur 65+ menaikkan jumlah perbelanjaan kesihatan swasta. Ini bermakna penuaan secara signifikan menaikkan perbelanjaan penjagaan kesihatan di sektor kesihatan swasta dalam jangka masa panjang. Untuk objektif ketiga, hasil utama kajian menunjukkan bahawa pekerja-pekerja yang lebih tua (warga emas) memberi kesan negatif tetapi tidak signifikan kepada produktiviti tenaga pekerja untuk seluruh ekonomi dan mereka memberi kesan positif tetapi tidak signifikan kepada produktiviti tenaga pekerja dalam sektor perkhidmatan. Namun, pekerja-pekerja yang dipertengahan umur memberi kesan positif dan signifikan

kepada produktiviti tenaga pekerja untuk seluruh ekonomi dan produktiviti tenaga pekerja dalam sektor pertanian dan perkilangan. Ini menandakan penuaan tidak dapat meningkatkan produktiviti tenaga pekerja untuk seluruh ekonomi dan produktiviti tenaga pekerja dalam ketiga sektor dalam jangka masa panjang. Oleh itu, kesimpulan yang dibuat ialah hasil kajian menunjukkan bahawa penuaan penduduk boleh menjadi beban kepada ekonomi. Malaysia perlu lebih bersedia untuk menghadapi penduduk warga emas yang lebih ramai yang akan meningkat lebih cepat.



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

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
ADL	Activities of Daily Living
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
CUSUM	cumulative sum of recursive residuals
CUSUMQ	CUSUM of square
EPF	Employees Provident Fund
GDP	Gross Domestic Product
GHE	Public Health Expenditure
GMM	Generalized Method of Moments
HCE	Health Care Expenditure
HES	household expenditure
HIS	Household Income Survey
ICT	Information and Communication Technology
ILO	International Labor Organization
LM	Labor Market
LP	Labor Productivity
LTC	Long-Term Care
MYR	Malaysian Ringgit
NACCE	National Consultative and Advisory Council of Aging
NACSCOM	National Council of Senior Citizens Organization
NCD	Non-Communicable Disease
NCWO	National Council of Women's Organisations Malaysia
NHMS	National Health Morbidity Survey

NPE	National Policy for the Elderly
NPOP	National Policy of Older Persons
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OOP	Out-of-Pocket Health Spending
PERMATA	Universiti Putra Malaysia Women's Association
PHE	Private Health Expenditure
PP	Philip Perron
PPP	Purchasing Power Parity
PRS	Private Retirement Scheme
SBC	Schwartz Bayesian Criterion
USD	U.S. Dollar
TTD	Time to Death
U3A	University of the Third Age

CHAPTER 1

INTRODUCTION

Population aging is the consequence of increased life expectancy, better health, success, and more optimal choices regarding whether and when to have children. The United Nations' Department of Economic and Social Affairs (2009) defines population aging as the process whereby individuals over the age of 60 increasingly account for a proportionally larger share of the total population. In Malaysia, older persons are also defined as those individuals who are 60 years and above. In the context of labor markets¹ (LM), Fertig and Schmidt (2003) offer two definitions of population aging: a decline in the labor supply of younger workers relative to older workers or a decline in the number of workers relative to retirees. On the other hand, Coulmas (2007) provides three classifications of the types of society based on the proportion of elderly: (1) aging society: 7-13% of the population are 65 years or older, (2) aged society: 14-20% of the population are 65 years or older, and (3) hyper-aged society: 21% or more of the population are 65 years or older.

Popular indicators of aging are an increase in the old-age dependency ratio, an increase in the median age, higher life expectancy, and lower fertility rates. Population aging has a profound influence economically; it has long-term impact on economic growth, health care expenditure, and labor productivity. Health care expenditure and labor productivity can also affect economic growth, but they are not the focus of this research study.

According to Rowland (2013), developed countries view aging as a major concern more than developing countries do. Yet population aging is occurring at a faster rate in developing countries (United Nations' Department Economic and Social Affairs, 2009). The aged population in Asia grew from 44% of the total population in 1950 to 51% in 2000, and it may reach 61% in 2050. This increase may negatively impact future welfare which may eventually be inadequate to their populations. Furthermore, developing countries have limited time to adjust to the needs of the elderly because aging is happening at a faster pace at lower levels of socio-economic development.

As far back as Malthus and later Keynes in 1937, aging has been studied and viewed as a hindrance to growth by economic thinkers. However, population aging is a part of "demographic maturation," a long-term process which can potentially improve economic performance that occurs prior to later-stage aging. This process is actually a threshold of workers from the young-dominated labor market becoming more experienced (Prettner, 2013).

¹ Throughout this paper, LM will refer to labor market.

1.1 Background of Study

1.1.1 Population Aging and Economic Growth in Malaysia

Malaysia is in its third demographic transition stage². During this stage of development, fertility rates decline faster than mortality rates. The country's median age is expected to increase from 26.1 years (2010) to 30.3 years (2020). In the year 2050, the median age is expected to be 39.8 years. If this occurs, in the year 2050, half of the population will be 40 years of age or over (Hamid, 2015).

Malaysia's economic opportunities led to the first demographic dividend in the late 1970s. These opportunities are expected to last until the year 2020, when the dependent population's share rises. The first demographic dividend refers to a temporary increase in the productive age, or working-age population. These are people between the ages of 15 and 59. Unproductive age groups include those people between 0 and 14 years old and people that are 60 years of age or above. According to Hamid (2015), the productive age group percentage will peak in the year 2020 at 69.3%. In 2021, it will begin to decline. As advocated by Bloom et al. (2003), Malaysia can take advantage of this "demographic dividend" of economic growth when the majority of their population is comprised of a productive working population. These people have the highest added productivity, as long as proper policies are implemented.

Malaysia is already halfway through this 'demographic window', a window that will close sometime between the years of 2040 and 2050 (Hamid, 2015). A second demographic dividend could take place, if older people accumulate assets. As the per capita income rises and people increase their wealth, greater investments in human capital will occur. This is possible if effective policies are implemented that can sustain continual, stable, and equitable growth.

During the first dividend, individuals and families have more resources available to improve their lives. The second dividend will depend on how well these people manage their savings and investments. The transitory bonus can be invested into greater assets for sustainable development. The second dividend is permanent. However, if people fail to invest their accumulated wealth from a one-time rise in the productive age group share during the first demographic dividend, then the transitory bonus may not be reaped.

² Demographic transition describes how the human population changes over time. The two basic processes that influence this change include birth and death rates. The interrelationship profoundly effects a country's age structure (Hamid, 2015).

1.1.2 Population Aging and Health Care Expenditure in Malaysia

With the improvements in the nutritional, medical, and socio-economic status of the population, Malaysians can expect to live much longer and be in better health than in the past. Despite this, the annual report of Malaysia's Ministry of Health (2011a) highlights the five most common morbidities (sicknesses) seen among the elderly in health clinics, and it has been the same pattern for the past five years. The sicknesses were hypertension, diabetes mellitus, and joint, eye, and respiratory problems. The Global Burden of Disease Study reported that the top risk factor that drives the most death and disability combined in Malaysia in 2015 was dietary risk and the non-communicable diseases (NCDs) cause the most death and disability combined in Malaysia from 2005 to 2015 (Institute for Health Metrics and Evaluation, 2017). Ministry of Health (2015) stated that the National Health and Morbidity Survey (NHMS) in 2015 revealed non-communicable diseases (NCDs) contributed to 73% of total deaths in Malaysia. The biggest contributor of NCDs was cardiovascular diseases including heart attacks and strokes. The data from the previous NHMS showed that the prevalence of NCD risk factors continues to rise. In 2011, 63% of adults aged 18 years and above had at least one NCD risk factor (either obesity, overweight, high blood cholesterol, high blood pressure, diabetes).

Hamid (2015) states that public healthcare services throughout Malaysia are basically universal, because healthcare services are accessed through a nominal payment of MYR 1 for an outpatient treatment and MYR 5 for specialist care. This robust private healthcare system co-exists alongside the often-congested public healthcare system. Senior citizens are exempt from paying any fees (e.g. standard medications and prescriptions) to treat chronic diseases (e.g. hypertension, hypercholesterolemia, and diabetes). Tax relief is provided for medical treatment, special needs, and caregiver expenses for older parents. Hence, Malaysia's public healthcare system is heavily subsidized. Consequently, the government's healthcare share was 54.95% in 2012 (World Bank, 2017).

1.1.3 Population Aging and Labor Productivity in Malaysia

The minimum retirement age of Malaysia increased from 58 to 60 and 55 to 60³ for public and private sectors, respectively, in 2012 and 2013 (Malaysia. Ministry of Human Resources, 2015). The participation of senior citizens in economic activity impacts their well-being. Participation in the labor force not only ensures financial independence, but it also positively contributes to the economy, although in a smaller proportion. There was a significant shift in Malaysia's economic structure from a more

³ In the United Nations Human Rights' (2013) record, the Human Rights Commission of Malaysia (SUHAKAM) states that under the Minimum Retirement Act 2012, the minimum retirement age of a private sector employee is increased to 60. The act was gazetted on 16 August 2012 and was enforced on 1 July 2013. This move is in line with the increase in the compulsory retirement age of public servants from 58 years to 60 years starting in January 2012. However, employers were allowed to apply to the Ministry of Human Resources of Malaysia to defer the implementation until 31 December 2013.

agriculture-based economy to a non-agriculture-based one, especially in the two decades prior to the 2000 Census. This change significantly affected the economic activities of the elderly population, according to the country's latest monograph series about population aging trends (Department of Statistics, 2000).

Malaysia's Department of Statistics (2000) in its latest monograph series about population aging trends in the country states that among the employed senior citizens recorded in the 2000 Census, 66.8% were self-employed and 25.9% were employees, metrics which increased from 59.1% and 22.4%, respectively, in 1980. The proportion of unpaid family workers significantly declined between 1980 and 2000 from 14.8% to 3.2%. This is attributed to the fact that agricultural activity, which generally accounts for a high percentage of unpaid family workers, declined in Malaysia. This trend also accounts for the decline in the number of the self-employed since 1991. However, in 1991-2000, a trend towards working in the secondary sectors began. It resulted in a higher proportion of employees. As the younger population moved to non-agricultural activities, the older population continued to work in farms and smallholdings. In contrast, the proportion of senior citizens who were employers slowly grew from 3.7% in 1980 to 4.1% in 2000. This was an encouraging trend.

In regards to the distribution of senior citizens by sector, Malaysia's Department of Statistics (2000) states that although agriculture remains their main activity (50% in 2000), it is quickly declining in importance. There has been a gradual shift towards participation in manufacturing, wholesale and retail trade, transport, storage and communication, and public administration and defence. In 2000, almost similar proportions of senior citizens and the economically-active population aged 15-59 years were engaged in wholesale and retail trade (13.4% and 12.4%, respectively) and hotels and restaurants (6.1% and 6.0%, respectively). Some of them were self-employed and did not have formal retirement (i.e., they may keep working until the end of their lives).

As previously mentioned, Fertig and Schmidt (2003) define population aging in the context of labor markets⁴ (LM) as, first, a decline in the labor supply of younger workers relative to older workers, and, second, a decline in the number of workers relative to that of retirees. Using this definition, we can calculate both the ratio of younger workers to older workers and the proxy for the number of workers relative to that of retirees in Malaysia, which is the potential support ratio.

The ratio of younger workers to older workers has been fluctuating but declining after 2010 in Malaysia, as shown in Figure 1. During the first part of the period (1982-1993), the fluctuations were on an upward trend, then the fluctuations started on a slow downward trend, and finally in 2010 the ratio started to decline. From our calculations using Malaysia's Department of Statistics (2015a) data, the ratio of younger workers to older workers in 1982 was 36.79 to one. In 2013, the ratio declined to 34.06 to one.

⁴ Throughout this paper, LM will refer to labor market.

The declining ratio may indicate that the workforce is aging; the number of younger workers is decreasing and the number of older workers is increasing, even though there were fluctuations 1982-2010. But overall the sign of aging is still unclear.

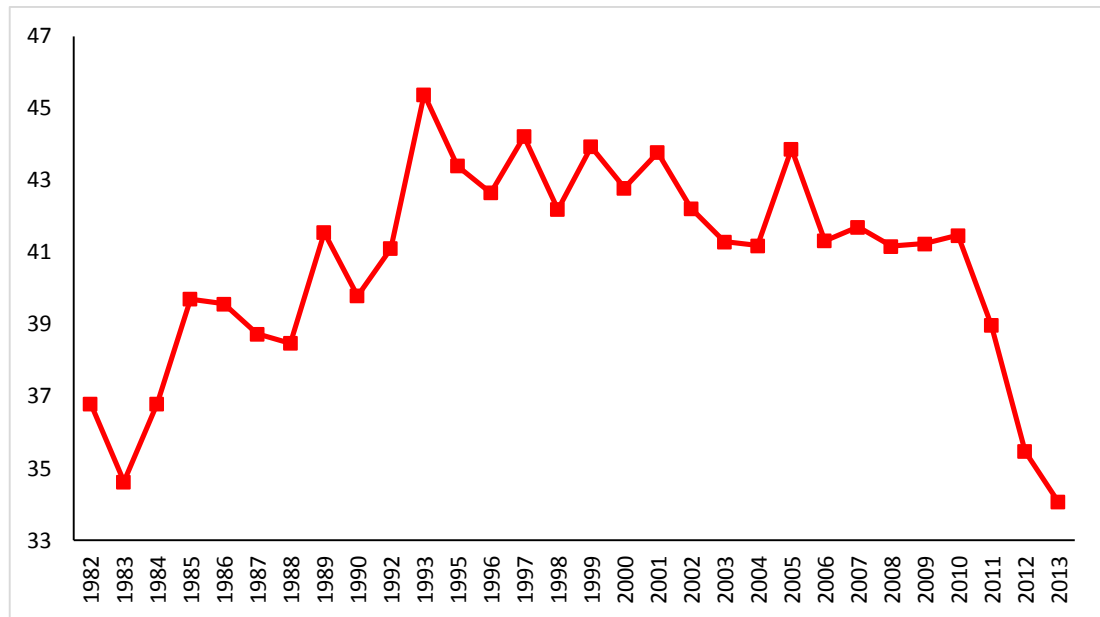


Figure 1 : Ratio of Younger Workers (15-59) to One Older Worker (60-64)
[Source: Author's calculation using Malaysia's Department of Statistics (2015a) data]

On the other hand, another indicator of population aging, the number of workers relative to retirees, can be represented by the potential support ratio⁵. We calculate this ratio by finding the inverse of the old-age dependency ratio using Malaysia's Department of Statistics (2015a) data. Figure 2 shows that in 1960-1999 there were few fluctuations on an upward trend, but in 1999-2012 the potential support ratio started to decline and then finally increased sharply. The ratio was 16.05 working-age persons to one older person in 1980 and declined to 12.80 to one in 2013, but then rose back up 16.47 to one in 2014, exceeding the metric in 1980. For 15 years (1999-2013), this ratio has been declining. This may indicate that the workforce is aging; the number of workers is decreasing and the number of retirees is increasing, even though the ratio rose back up in 2014. But overall the sign of aging is still unclear.

⁵ The potential support ratio is the number of persons aged 15 to 64 who support every person aged 65 or over (United Nations, 2009). It is the inverse of the old-age dependency ratio.

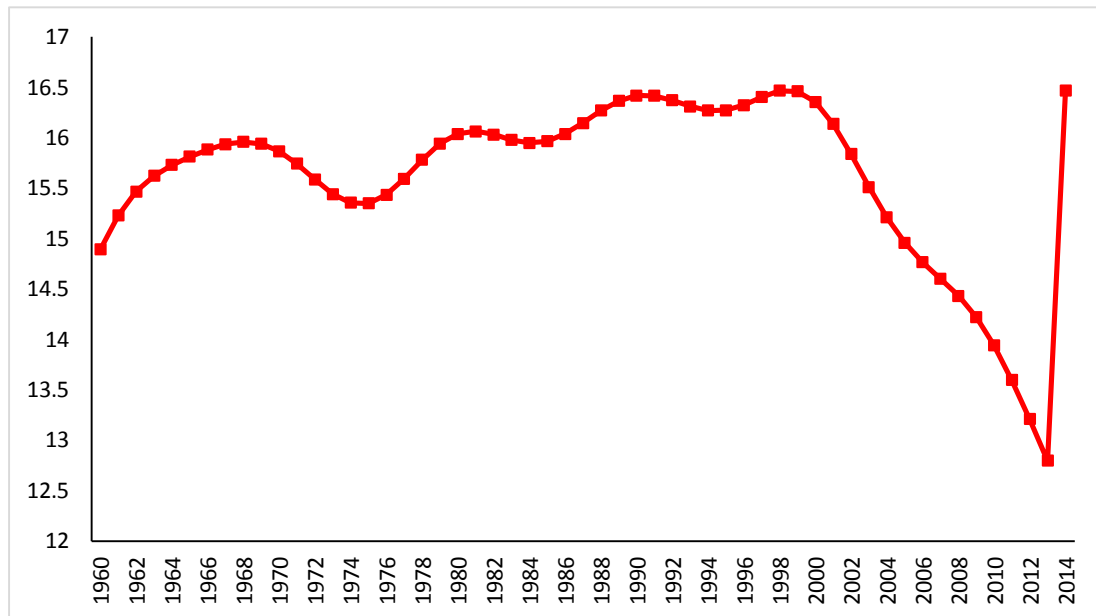


Figure 2: Potential Support Ratio (Number of Working-Age Persons Age 15-64 to One Older Person Ages 65+)

[Source: Author's calculation using Malaysia's Department of Statistics (2015a) data]

1.1.4 The Existing Policies for Aging

The Malaysian government has implemented policies in regards to the aging issue. In 1995, they developed a National Policy for the Elderly (NPE). The NPE was implemented for several years. The number of years and results of the policy were not specified. In 2008, the government decided to review the policy so that it was more relevant for Malaysia's present and future needs. They then designed the new National Policy of Older Persons (NPOP) for 2010-2020. It was endorsed in 2011. In 2008, the Ministry of Health also developed a National Healthcare Policy for Older Persons, which runs simultaneously with the National Policy for Older Persons, because healthcare is part of the well-being of older people. The new NPOP adopted an active and productive aging approach. It also added indicators of achievement. The amended NPOP is under the scope of the Ministry of Women, Family and Community Development, through the Department of Social Welfare. The National Consultative and Advisory Council of Aging (NACCE) was also established in 1996. The NACCE monitors the implementation of the NPOP.

Several initiatives have been developed by the government to encourage savings to strengthen the financial health of the elderly. The government has extended the retirement age for both private and public sector employees to age sixty. Subsequently, the calculation for the pension value has been amended. With this amendment, civil servants can expect to receive a higher pension, attributed to the higher last drawn salary. In addition, an alternative savings channel, known as the Private Retirement Scheme (PRS), was developed to encourage savings for old age (Hamid & Chai,

2013). Members choose to invest through eight approved financial institutions. Young Malaysians who subscribe to the PRS account and invested MYR 1,000 in the same year receive an additional MYR 500 one-off contribution from the government. This incentive is only available for 5 years: 2014 to 2018⁶. Furthermore, the 1Malaysia Retirement scheme was developed for unemployed persons (e.g., housewives, youth and others without formal employment). It is managed by the Employees Provident Fund (EPF). People who subscribe to this scheme would enjoy the same benefit as other EPF members. To promote the scheme, the government matched savings up to MYR 120 per year for three years, from 2014 to 2016.

The most significant development concerning financial security is the announcement of the minimum wage for private sector workers. This development ensures that Malaysians earn a sufficient income and are possibly able to save more for their old age. Bank Negara's effort to promote financial literacy among the younger population will also indirectly improve the situation in the future. This is because when people are literate, they would be able to financially plan better, and hence, improve their future financial situation. In addition, the services of the Counselling and Management Agency, in terms of debt management, strive to improve the financial behavior and promote positive habits in people's financial management.

To promote healthy, active, productive aging, the Institute of Gerontology from Universiti Putra Malaysia initiated a life-long learning programme. This programme was based on the University of the Third Age's (U3A) model since 2007. A unique feature of this programme is the joint involvement of the public, private, non-government organizations and university partners to run and sustain the programme. The U3A programme is managed by senior citizens who direct all activities, from scheduling, course content, and evaluations to finances. The Institute focused on replicating the programme and acts as an advisor to the programme. Another intervention programme running at the Institute is the Financial Empowerment of Mature Women, funded by the Citi Foundation through the United Way World. This is a 5-month financial education programme designed especially for women aged between 40 and 60 years with a household income of less than MYR 3,000 per month. The program works in collaboration with the Universiti Putra Malaysia Women's Association (PERMATA) and the National Council of Women's Organisations Malaysia (NCWO). A key aim of the program is to help women, in their old age, to become financially independent and empowered. The curriculum includes: developing personal savings, investment and retirement plans. It also includes inculcating a positive financial behavior to help women living in towns, suburbs and the surrounding areas within the Klang Valley. It was developed based on the training needs assessment of the participants.

The Institute, in collaboration with the National Council of Senior Citizens Organization (NACSCOM), also developed an intervention programme. This

⁶ www.ppa.my/prs

programme trains senior citizens to become the instructors and facilitators of the ICT courses. The knowledge transfer programme's main objectives are to promote ICT knowledge among older persons and to reduce the digital divide among older persons. This peer learning strategy (older persons to older persons) accelerates the knowledge transfer process and promotes a positive learning environment.

1.2 Problem Statement

Three relevant issues that motivate us to study: 1) the impact of aging on economic growth, 2) the impact of aging on health care expenditure and 3) the impact of aging on labor productivity will be explained in the following.

A key to future economic growth will be demographics (Hoagland, 2017). To see where Malaysia stands in aging level among East Asian countries, it is compared to "hyper-aged" society like Japan and its neighboring countries. When it is compared to Japan, Japan doubled its population aging rate from 7% to 14% in 25 years (1970-1995). When it is compared to its neighboring countries, Singapore will double its population aging rate from 7% to 14% in 20 years (1999-2019), Thailand also in 20 years (2002-2022), Indonesia in 25 years which is similar to Malaysia (2025-2050), and Philippines in 39 years (2032-2071) (Oku et al., 2017). In 2016, the populations aged 65+ of Japan, Malaysia, Singapore, Thailand, Indonesia and Philippines are 27%, 6%, 12%, 11%, 5% and 5% respectively, which rose from 6%, 3%, 2%, 3%, 4% and 3% respectively (World Bank, 2018). Like Malaysia, its neighboring countries have not become aging society, in which 7-13% of the total population are 65 years above, as defined by Coulmas (2007). In Southeast Asia, Malaysia's populations aged 65+ is lower (in terms of percentage share of total population) than that of Singapore and Thailand but higher than that of Indonesia and Philippines. Japan utilized its first demographic dividend (1950-1995) that consisted of large support ratio of working-age population to the elderly by saving and effective use of accumulated wealth such as investment in equities and bonds which led to an increase in physical capital, instead of higher consumption (Ogawa & Matsukura, 2005). It has become rich before getting old (i.e. the support ratio of working-age population to the elderly become negative). According to World Bank (2016), the similarities between Malaysia and other countries in East Asia Pacific region are people are living longer and have more years of healthy life expectancy but non-communicable diseases are exploding; more middle-aged people have them and older people have multiple non-communicable diseases often undiagnosed or untreated. Many work until advanced ages especially in rural areas but until less than 80 years old mainly for financial support. Also aging is leading to new health challenges such as dementia which is 5 times higher in Malaysia until 2050. On the other hand, the main difference between Malaysia and other countries in East Asia Pacific region is the poverty in most middle-income countries increases steadily from middle age. However, World Bank (2016) finds from Household Income Survey (HIS) (2012) that reports that poverty rates of elderly-headed households aged 50+ are below average in Malaysia.

The first issue is as follows. The size of Malaysia's elderly population, when compared to the ASEAN nations (i.e. Indonesia, Vietnam, Thailand, and the Philippines) is still much smaller (in terms of number of the elderly). Therefore, its magnitude of the aging problem is limited. However, Malaysia is aging at lower levels of development, but at a rapid speed (Hamid, 2015). If Malaysians are not utilizing the first demographic dividend (in which the working-age population is large and thus presents high support ratio of producers to the dependants) by accumulating or investing in assets and increasing savings for old age, the second demographic dividend where they will reap the rewards of saving and asset accumulation will not happen, and they will still rely solely on smaller government or familial transfer. Consequently, it is feared that the aging population will become burdensome to the government, because the future working-age population may no longer be able to support the more rapidly growing elderly population. Furthermore, the aging process in Malaysia is expected to accelerate in the future. Malaysia will become an aging society by the year 2020, when its elderly population (i.e. 65+) reaches 7% of the total population (Hamid, 2015). When that happens, the speed of aging will increase and the elderly population will double to 14% in just 23 years (2020-2043). Coulmas (2007) defines this as an aged society. Developed countries such as France has taken 115 years to double their elderly populations (i.e. from 7% to 14%) (Kinsella and He, 2009). As such, Malaysia has a shorter time period to adapt to the changes brought by population aging. Consequently, an urgency emerges to prepare the country for the future, because social institution change takes over a decade to be realized. Hence, strategic approaches should be carefully designed to avert aging crisis. At the same time, the needs of the younger population need to be addressed.

Faster aging is a major concern because when Malaysia is getting old before getting rich, it can lead to unsustainable economic growth. This is based on the observation that increasing old-age dependency ratios can lead to growing tax burdens. This can be in the form of generous pension and health care benefits that crowd out public investment spending for infrastructure or education, and then lead to negative effects for capital accumulation and productivity growth (Gonzalez-Eiras & Niepelt, 2012). However, it is not clear whether this is the case for Malaysia. What is clear is that the old-age dependency ratio for the nation has been increasing slowly by nearly 2% between the highest and lowest points from 1999 to 2013, and the young-age dependency ratio has been decreasing significantly by 54.08% from 1965 to 2013. Therefore, the first research question asks: Does aging in Malaysia boost economic growth?

Since good health lies at the heart of productivity, this leads to the second issue, or research question, which is: Does aging in Malaysia lead to an increase in healthcare expenditure? In the life-cycle theory, a higher elderly population results in a decrease in the overall demand for education, since the consumption preferences of the elderly group fall more onto the medical care. Is this true in the case of Malaysia? For Malaysia, Rannan-Eliya et al. (2013) predict health spending will increase 0.7% of GDP from 2010-2030, with aging accounting for less than one third of that growth. For years, the increasing share of HCE in GDP has been an issue of concern in

Malaysia. Using the World Bank's World Development Indicators (2017) data, the annual average real growth rate of HCE per capita (constant at 2005 international \$ and adjusted for PPP) between 1995 and 2012 reached 6.88%. This is high enough to increase the share of the HCE from 2.94% of GDP in 1995 to 3.95% in 2012. It was higher than Spain's annual average real growth rate of public HCE, 4.9% in 1986-2008, which was high enough to increase the share of public HCE to 6% of GDP in 2008 from 4.2% of GDP in 1986 (Blanco-Moreno et al., 2013). As a result of Spain's high increase in the public deficit and debt payment interest, from the beginning of the economic crisis, major reforms are being implemented (e.g. the exclusion of public coverage for different population groups, the redefinition of covered benefits, and the increase of OOP or co-payments to curb the increasing trend of HCE). Note that Spain's population is twice as high as Malaysia (World Bank, 2017). Its elderly population, for 1986-2008, was between 13-17% of the total population (Quandl, 2015).

Malaysia's senior citizens are exempt from paying any fees (e.g. standard medications and prescriptions) for the treatment of chronic diseases (e.g. hypertension, hypercholesterolemia, and diabetes). More rapid population aging can potentially trigger a trend of increasing healthcare spending. However, the working generation bears and pays for the elderly's medical healthcare costs through government tax payments. They pay through government tax payments. Nevertheless, whether older people are responsible for the significant increase in the total, public, private, and out-of-pocket HCE in Malaysia are not clear. To our knowledge, the published yearly HCE for public, private, and out-of-pocket HCE by age group do not include time-series data. Or else, it would be clearer which age group spend most on HCE. No consensus on the impact of the aging on HCE has been reached in the economic literature either. The concern that the aging will lead to an increased utilization of healthcare services is based on the observation that the increasing number of older people may spend on a significant healthcare utilization share if many of them have poor quality of health.

Poorer health states are associated with higher levels of the HCE and vice versa (e.g., Carreras et al., 2013; Dormont et al., 2006; Michaud et al., 2009). Chan et al. (2015) find from National Health Morbidity Survey (NHMS) (2011) that approximately one-fifth of the Malaysian adult population (20.1%) rated their health as poor (men: 18.4% and women: 21.7%). The perceived health status and the actual health status may not be congruent but the perceived one can be a good indicator. Prevalence of poor health increases with age from 16.2% (aged 18 – 29) to 32.0% (aged ≥ 60)⁷. In 2011, 63% of adults aged 18+ have at least one risk factor. 65% of the elderly aged 60-64 suffer hypertension, 75% of the elderly aged 70-74 suffer hypertension, 65% of the elderly aged 60-64 suffer hypercholesterol and 62% of the elderly aged 70-74 suffer

⁷ Several unhealthy lifestyle behaviors and chronic diseases are significantly associated with poor self-rated health among Malaysian adults. Chan et al. (2015) find from National Health Morbidity Survey (NHMS), (2011) that the lifestyle factors that are associated with poor self-rated health include underweight, physical inactivity, former smoker, former drinker and current drinker. Chronic diseases that are associated with poor self-rated health include asthma, arthritis, hypertension, hypercholesterolemia and heart disease.

hypercholesterol according to National Health Morbidity Survey (NHMS) (2015). Yin-Fah et al. (2010) finds that 47% of 2,321 Malaysian elderly respondents aged 55-75 rate their health as good in 2004⁸. In addition, Zweifel et al. (1999) highlights that exclusive emphasis on population aging, as a cause of growth in HCE per capita, runs the risk of creating a red herring (i.e. proximity to death, rather than age, is actually the factor that drives HCE). Similarly, other studies have illustrated that approximately 25% of the overall lifetime HCE (public and private) occurs in an individual's last year of life (Hogan et al., 2001; Lubitz and Riley, 1993).

Since productivity is a critical factor that lies at the heart of economic growth, this also leads to the third issue, or research question: Does aging in Malaysia retard labor productivity? Theoretically, the increase in the elderly population leads to a lower labor productivity. Most economists argue that a country with a higher proportion of older age people tends to be associated with lower productivity levels (Walder & Döring, 2012; Sharpe, 2011; Mèrette & Georges, 2009). As previously shown, the trend of population aging in terms of Malaysia's ratio of younger workers to older workers and the potential support ratio overall are fluctuating and, mostly declining towards the end. These indicate that the demographic bonus is declining. Even though the Malaysian government increased the minimum retirement age from 58 to 60 and 55 to 60 years in 2012 and 2013 for public and private sectors, respectively (Malaysia. Ministry of Human Resources, 2015), in 2000 approximately 52.4% of the employed elderly aged 60 and above who were self-employed or employed by others were still engaged in the agriculture sector (including hunting, forestry, and fishing). This is according to Malaysia's Department of Statistics (2000) in their monograph series about population aging trends. Some of the government agencies even extended the employment of contracted older workers such as university academics to retain their expertise, which they can use to mentor younger professionals. According to Household Income Survey (HIS) (2009), work is also an important source of income for older Malaysians aged 60+, although less so for women. Majority of the elderly men aged 60-74 is self-employed and majority of the elderly women aged 60+ relies on transfers as their source of income (World Bank, 2016). Moreover, Ang and Madsen (2015) found that educated workers are highly innovative and that the propensity to innovate increases sharply with age. However, it is not clear whether the increase in Malaysia's older workers is contributing productively to the economy.

The literature shows mixed impacts of population aging on labor productivity. This aging can cause a negative impact if the elderly are not contributing much to the economy. Even the elderly who are employed can be economically redundant if they are not productive. If the healthy elderly don't contribute much to the economy once they are retired and the proportion of younger workers decreases, then economic growth will be hindered. On the other hand, population aging can cause a positive impact if the elderly continue to contribute positively to society and the economy, even outside of the workforce, such as when retirees volunteer in non-profit organizations.

⁸ Khan and Flynn (2016) also finds that in Malaysia, the elderly who received financial support from friends or relatives are highly likely to report poor health. On the other hand, those who provide financial supports to others are less likely to report poor health.

As stated by Siliverstovs et al. (2011), even if productivity declines with age for people with paid work, there are several other important productive contributions of aging, namely volunteer work and support within family and private networks, which can positively influence GDP growth and labor productivity.

To find the answer to the research question, apart from studying the impact of aging on the labor productivity for the whole economy, the elderly's labor productivity in the three sectors of agriculture, services, and manufacturing will be compared. It is because the elderly have been heavily engaged in these sectors. In agriculture, they accounted for 62.6% of employment in 1991 and 52.4% in 2000. They were employed in services (e.g. hotels and restaurants, public administration and defence, education, and healthcare and social work) at 28.0% in 1991 and 34.8% in 2000. The elderly manufacturing employment rate was 5.5% in 1991 and 7.2% in 2000 (Malaysia. Department of Statistics, 2000). Siliverstovs et al. (2011) finds that the increase in the elderly population has a statistically significant negative impact on employment shares in agriculture and manufacturing. Their dataset encompasses 51 developing and developed nations including Malaysia covering 1970-2004. The share of the elderly positively affects employment shares in two service sectors: 1) financial and related services, as well as 2) community, social, and personal services. Moreover, the issues highlighted in the Tenth Malaysia Plan (2011-2015) include inadequate skilled jobs and low labor productivity, as stated by Malaysia's Economic Planning Unit (2015). Hence, the Eleventh Malaysia Plan (2016-2020) states that, by 2020, Malaysia aims to have more skilled jobs⁹, especially in the services sector. As aging accelerates, it is vital to find the impact of older workers on labor productivity by sector.

There is a limited work which foregrounds the impact of population aging in Malaysia that answers these research questions so far at macroeconomic level using different aging proxies. Aging literature in Malaysia often focused on microeconomic analysis often in the form of primary data such as survey in a particular year. Macroeconomic analysis is underrepresented in the literature. The use of macroeconomics data allow us to measure the impact of aging on economic growth, health care expenditure and labor productivity at country level in a period of years. It is impossible to use microeconomic data to study this topic that needs yearly data. In the case of Malaysia, there is a limited study on this topic. In the case of Malaysia, there is also a limited study on finding the impact of aging on different types of health expenditure at disaggregate level such as private, public and out-of-pocket health expenditure. The only study that examine the determinants of health care expenditure including aging is done by Khan et al. (2016) but the health expenditure is only at aggregate level. Moreover, there is a limited study that investigate the impact of aging on labor

⁹ Note that Malaysia's Economic Planning Unit (2015) states that skilled workers are comprised of managers, professionals, technicians, and associate professionals. Semi-skilled workers are comprised of clerical support workers, service and sales workers, skilled agricultural, forestry, and fishery workers, craft and related trade workers, and plant and machine operators and assemblers. Low-skilled workers are employed in elementary occupations such as cleaners, helpers and construction laborers.

productivity by sector. In addition, there is a limited study that use different aging proxies for robustness check for Malaysia.

To recap, the first research question asks if aging in Malaysia boosts economic growth. The second research question asks if aging in Malaysia leads to higher health care expenditure. Finally, the third research question asks if aging in Malaysia slows down labor productivity.

1.3 Objectives of Study

The aim of this study is to explore whether population aging in Malaysia increases or decreases economic growth, health care expenditure and labor productivity in the short run and more importantly in the long run.

Therefore, the specific objectives of the study include the following:

- 1) To examine the impact of population aging on economic growth in Malaysia.
- 2) To investigate the impact of population aging on health care expenditure in Malaysia.
- 3) To determine the impact of population aging on labor productivity for the economy as a whole and by sector in Malaysia.

1.4 Significance of Study

1.4.1 Impact of Population Aging on Economic Growth in Malaysia

Since the speed of aging in Malaysia is becoming faster, this study is a useful tool to know how ready the nation is to adapt to aging and whether Malaysians are taking the necessary steps to be healthier and more productive and financially secure in their retirement age. It's a common tradition for elder Malaysians to depend on family support for their wellbeing. However, this trend has been changing as more families are becoming smaller in size and living geographically farther apart, and as more women (the elderly's traditional care-takers) enter the workforce. It's really important for the younger elderly to prepare to be more independent by taking more preventative actions rather than focusing solely on cures and treatments and by staying healthy, productive, and financially secure. Because Malaysia has a shorter time to adapt to the changes caused by population aging, the Malaysian government must begin taking steps to face the challenges and to make full use of the positive opportunities that population aging offers.

If Malaysia does not make adequate preparation for its population aging, then it will exponentially burden a majority of households, especially middle- and low-income families, as well as the government as a whole. Therefore, this study aims to alert policy makers to what should be done and to help formulate government policies that take the necessary precautions against the negative effects of inadequate preparation for aging. Delaying action will only make the necessary changes even more difficult. The goal is to benefit all members of society, including the elderly and their families, as well as tax-payers in the long-run. Focusing on preventative actions will save the Malaysian people and government from experiencing much loss and pain.

This study also provides the demographic basis for verifying the extent and depth of population aging in Malaysia so far. This research is also a useful tool for evaluating the depth of sustainability of economic growth and testing the sensitivity of economic growth to changes in the magnitude of aging. Consequently, this study will help to identify the main factors that affect the intensity of economic growth so that any action taken can focus on these particular factors.

1.4.2 Impact of Population Aging on Health Care Expenditure in Malaysia

There is limited economics research that examines the impact of the aging population on HCE that is disaggregated into public, private, and out-of-pocket health expenditures for Malaysia at the macro level yet. Our findings may provide crucial implications and guidance to policymakers in the country by highlighting the importance of coping with population aging to curb the increasing trend of health care expenditure. This study is a useful tool for evaluating the depth of the sustainability problem in healthcare systems and for testing the sensitivity of HCE to changes in aging factors. Therefore, to keep spending under control, which may be a major challenge for the Malaysian government at the present time, this study will help to identify the main factors that affect the intensity of health care use. Thus, concern should focus on these important factors that significantly affect the intensity of use.

1.4.3 Impact of Population Aging on Labor Productivity in Malaysia

This study can be a useful tool to test the sensitivity of labor productivity to any changes in aging factors in different sectors. Consequently, it helps to analyze how Malaysia can best use its working population in the remaining time it has to adapt to the population aging issues, before it becomes an aging society¹⁰ in 2020 as predicted by Hamid (2015). This study is also helpful in finding out if the elderly are still productive and how elderly-friendly the workforce in Malaysia is. This research also assists in framing how to respond to the challenges of aging in the context of Malaysia. However, a successful policy in one country may not necessarily be suitable to a different cultural or socio-economic setting. Nevertheless, a number of general

¹⁰ Coulmas (2007) defines an aging society as a society when its elderly population 65+ reaches 7% of the total population.

guidelines can be identified. This study also contributes in comparing the labor productivity of senior citizens by sector, mainly agriculture, manufacturing, and services. Determining whether labor productivity varies by sector can be quite useful.



REFERENCES

- Abbas, F., & Hiemenz, U. (2013). What determines public health expenditures in Pakistan? Role of income, urbanization and unemployment. *Economic Change and Restructuring*, 46(4), 341-362.
- Acemoglu, D., & Johnson, S. (2007). Disease and development: the effect of life expectancy on economic growth. *Journal of Political Economy*, 115(6), 925-985.
- Aday, L. A., & Andersen, R. (1974). A framework for the study of access to medical care. *Health Services Research*, 9, 208-220.
- Aisa, R., & Pueyo, F. (2013). Population aging, health care, and growth: A comment on the effects of capital accumulation. *Journal of Population Economics*, 26, 1285-1301.
- Akresh, I. (2009). Health service utilization among immigrants to the United States. *Population Research and Policy Review*, 28, 795-815.
- Alders, P., & Broer, D. P. (2004). Ageing, fertility, and growth. *Journal of Public Economics*, 89, 1075-1095.
- An, C. -B., & Jeon, S.-H. (2006). Demographic change and economic growth: An inverted-U shape relationship. *Economics Letters*, 92(3), 447-454.
- Andersen, R. M. (1968). *A behavioral model of families' use of health services*. Chicago, IL: Center for Health Administration Studies.
- Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*, 36, 1-10.
- Andersen, R. M., Kravits, J., & Anderson, O. W. (1975). *Equity in health services: Empirical analyses in social policy*. Boston, MA: Ballinger.
- Andersen, R. M., & Newman, J. (1973). Societal and individual determinants of medical care utilization in the United States. *Milbank Memorial Fund Quarterly*, 51, 95-124.
- Andersen, R. M., Smedby, B., & Anderson, O. (1970). *Medical care use in Sweden and the United States—A comparative analysis of systems and behavior* (Research Series No. 27). Chicago, IL: Center for Health Administration Studies, University of Chicago.
- Ang, J. B., & Madsen, J. B. (2015). Imitation versus innovation in an aging society: international evidence since 1870. *Journal of Population Economics*, 28, 299-327.

- Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monet Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, 58, 277–297.
- Asia Productivity Organisation. (2015). *Productivity Measurement*. Retrieved from <http://www.apo-tokyo.org/wedo/measurement>
- Azomahou, T., & Mishra, T. (2008). Age dynamics and economic growth: revisiting the nexus in a nonparametric setting. *Economics Letters*, 99, 67–71.
- Balarajan, Y., Selvaraj, S., & Subramanian, S. V. (2011). Health care and equity in India. *The Lancet*, 377(9764), 505–515.
- Banerjee, R., & Wilson, J. K. (2016). Roles of Education in Productivity Growth in Australia, 1860-1939. *Economic Record*, 92(296), 47–66.
- Bannerjee, A., Dolado, J. J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in single equation framework. *Journal of Time Series Analysis*, 19, 267–283.
- Barro, R. J. (1991). Economic growth in a cross-section of countries. *Quarterly Journal of Economics*, 106(2), 407–443.
- Barro, R. J. (1996). *Determinants of economic growth: a cross-country empirical study* (National Bureau of Economic Working Paper No. 5698). Cambridge, MA.
- Barro, R. J. (2008). *Inequality and growth revisited* (Asian Development Bank Working Papers on Regional Economic Integration No. 11). Manila.
- Barro, R. J., & Sala-i-Martin, X. (1995). *Economic Growth*. New York: McGraw-Hill.
- Barro, R. J., & Sala- i- Martin, X. (2004). *Economic Growth*. Cambridge, MA: MIT Press.
- Bartel, A. P., & Sichermann, N. (1993). Technological change and retirement decisions of older workers. *Journal of Labor Economics*, 11(1), 162–183.
- Bech, M., Christiansen, T., Khoman, E., Lauridsen, J., & Weale, M. (2011). Ageing and health care expenditure in EU-15. *European Journal of Health Economics*, 12(5), 469-478.
- Benos, N., & Karagiannis, S. (2016). Do education quality and spillovers matter? Evidence on human capital and productivity in Greece. *Economic Modelling*, 54, 563–573.
- Bertschek, I., & Meyer, J. (2009). Do older workers lower IT-enabled productivity? firm-level evidence from Germany. *Jahrbucher fur Nationalokonomie und Statistik*, 229(2-3), 327-342.

- Blanco-Moreno, Á. N., Urbanos-Garrido, R. M., & Thuissard-Vasallo, I. J. (2013). Public healthcare expenditure in Spain: Measuring the impact of driving factors. *Health Policy*, 111, 34-42.
- Bloom, D. E., Canning, D., & Fink, G. (2010). Implications of population ageing for economic growth. *Oxford Review of Economic Policy*, 26(4), 583-612.
- Bloom, D. E., Canning, D., Fink, G., & Finlay, J. E. (2009). Fertility, female labor force participation, and the demographic dividend. *Journal of Economic Growth*, 14(2), 79-101.
- Bloom, D. E., Canning, D., & Finlay, J. E. (2008). *Population aging and economic growth in Asia* (Program on the Global Demography of Aging Working Paper No. 4008). Boston, MA.
- Bloom, D. E., Canning, D., & Finlay, J. E. (2010). Population aging and economic growth in Asia. In T. Ito & A. Rose (Eds.), *The economic consequences of demographic change in East Asia* (NBER-EASE Vol. 19; pp. 61-89). Chicago, IL: University of Chicago Press.
- Bloom, D. E., Canning, D., Mansfield, R. K., & Moore, M. (2007). Demographic change, social security systems, and savings. *Journal of Monetary Economics*, 54, 92-114.
- Bloom, D. E., Canning, D., & Sevilla, J. (2001). *Economic growth and the demographic transition* (National Bureau of Economic Working Paper No. 8685). Cambridge, MA.
- Bloom, D., Canning, D., & Sevilla, J. (2003). *The demographic dividend: A new perspective on the economic consequences of population change*. Population Matters Series. California: RAND.
- Bloom, D. E., & Williamson, J. G. (1998). Demographic transitions and economic miracles in emerging Asia. *World Bank Economic Review*, 12(3), 419-455.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87, 115-143.
- Bodenheimer, T. (2005). High and Rising Health Care Costs. Part 2: Technologic Innovation. *Annals of Internal Medicine*, 142(11), 932-937.
- Borsch-Supan, A. (2002). Labor market effects of population aging. *Review of Labor Economics and Industrial Relations*, 17, 5-44.
- Breyer, F., Lorenz, N., & Niebel, T. (2015). Health care expenditures and longevity: is there a Eubie Blake effect?. *European Journal of Health Economics*, 16, 95-112.

- Brinda, E. M., Kowal, P., Attermann, J., & Enemark, U. (2016). Health service use, out-of-pocket payments and catastrophic health expenditure among older people in India: the WHO Study on global AGEing and adult health (SAGE). *Journal of Epidemiology and Community Health*, 69(5), 489–94.
- Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for Testing the Constancy of Regression Relationships over Time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 37(2), 149–192.
- Browning, M., & Crossley, T. F. (2001). The Life-Cycle Model of Consumption and Saving. *Journal of Economic Perspectives*, 15(3), 3–22.
- Buchner, F., & Wasem, J. (2006). "Steeping" of Health Expenditure Profiles. *The Geneva Papers on Risk and Insurance - Issues and Practice*, 31(4), 581–599.
- Bustamante, A. V., Fang, H., Garza, H., Carter-Pokras, O., Wallace, S. P., Rizzo, J. A., & Ortega, A. N. (2012). Variations in healthcare access and utilization among Mexican immigrants: The role of documentation status. *Journal of Immigrant and Minority Health*, 14, 146–155.
- Chaabouni, S., & Abednnadher, C. (2014). The determinants of health expenditures in Tunisia: An ARDL bounds testing approach. *International Journal of Information Systems in the Service Sector*, 6(4), 60–72.
- Cabassa, L. J., Zayas, L. H., & Hansen, M. C. (2006). Latino adults' access to mental health care: A review of epidemiological studies. *Administration and Policy in Mental Health and Mental Health Services Research*, 33, 316–330.
- Carreras, M., Ibern, P., Coderch, J., Sánchez, I., & Inoriza, J. M. (2013). Estimating lifetime healthcare costs with morbidity data. *BMC Health Services Research*, 13(1), 1–11.
- Cataldi, A., Kampelmann, S., & Rycx, F. (2011). Productivity-Wage gaps among age groups: Does the ICT environment matter? *Economist*, 159(2), 193–221.
- Ceccobelli, M., Gitto, S., & Mancuso, P. (2012). ICT capital and labour productivity growth: A non-parametric analysis of 14 OECD countries. *Telecommunications Policy*, 36, 282–292.
- Chan, A. (2005). Aging in Southeast and East Asia: Issues and policy directions. *Journal of Cross-Cultural Gerontology*, 20, 269–284.
- Chan, Y. Y., Teh, C. H., Lim, K. K., Lim, K. H., Yeo, P. S., Kee, C. C., ... Ahmad, N. A. (2015). Lifestyle, chronic diseases and self-rated health among Malaysian adults: results from the 2011 National Health and Morbidity Survey (NHMS). *BMC Public Health*, 15(1), 1–12.
- Chang, C. F., Wang, P., & Liu, J. T. (2016). Knowledge spillovers, human capital and productivity. *Journal of Macroeconomics*, 47, 214–232.

- Chou, S. Y., Liu, J. T., & Huang, C. J. (2004). Health insurance and savings over the life cycle - A semiparametric smooth coefficient estimation. *Journal of Applied Econometrics*, 19, 295–322.
- Choudhry, M. T. & Elhorst, J. P. (2010). Demographic transition and economic growth in China, India and Pakistan. *Economic Systems*, 34, 218–236.
- Christ, S. L., Lee, D. J., Fleming, L. E., LeBlanc, W. G., Arheart, K. L., Chung-Bridges, K., ... McCollister, K. E. (2007). Employment and Occupation Effects on Depressive Symptoms in Older Americans: Does Working Past Age 65 Protect Against Depression? *The Journals of Gerontology: Series B*, 62(6), S399–S403.
- Comin, D. (2006). Total Factor Productivity. Retrieved from <http://www.people.hbs.edu/dcomin/def.pdf>
- Coulmas, F. (2007). *Population Decline and Ageing in Japan: The Social Consequences*. London: Routledge.
- Crépon, B., Deniau, N., & Pérez-Duarte, S. (2002). *Wages, Productivity and Worker Characteristics : A French Perspective*. Paris: Centre de Recherche en Économie et Statistique (CREST) and Institut National de la Statistique et des Études Économiques (INSEE).
- Crown, W. H. (2002). Life Cycle Theories of Savings and Consumption. In *Encyclopedia of Aging*. Retrieved from <http://www.encyclopedia.com/doc/1G2-3402200229.html>
- Cutler, D. M., Poterba, J. M., Scheiner, L. M., & Summers, L. H. (1990). An aging society: Opportunity or challenge? *Brooking Papers on Economic Activity*, 1(1), 1–73.
- DaVanzo, J., & Chan, A. (1994). Living arrangements of older Malaysians: Who coresides with their adult children? *Demography*, 31(1), 95 – 114.
- De Gregorio, J., & Lee, J. W. (2003). *Growth and adjustment in East Asia and Latin America* (Central Bank of Chile Working Paper No. 245). Santiago, Chile.
- de la Maisonneuve, C., Moreno-Serra, R., Murtin, F., & Oliveira Martins, J. (2016). *The Drivers of Public Health Spending: Integrating Policies and Institutions* (OECD Economics Department Working Papers No. 1283). Paris.
- De Meijer, C. (2012). *Studies of Health and Long-Term Care Expenditure Growth in Aging Populations*. (Doctoral dissertation). Retrieved from <http://arno.uvt.nl/show.cgi?fid=121902>
- De Meijer, C., Wouterse, B., Polder, J., & Koopmanschap, M. (2013). The effect of population aging on health expenditure growth: A critical review. *European Journal of Ageing*, 10(4), 353-361.

- Deroose, K. P., Gresenz, C., & Ringel, J. (2011). Understanding disparities in health care access—And reducing them—Through a focus on public health. *Health Affairs*, 30, 1844-1851.
- Diamond, A. M. (1986). The Life-cycle Research Productivity of Mathematicians and Scientists¹. *Journal of Gerontology*, 41(4), 520–525.
- Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 49, 1057-1972.
- Disney, R. (1996). *Can We Afford to Grow Older? A Perspective on the Economics of Aging*. Cambridge: MIT Press.
- Dormont, B., Grignon, M., & Huber, H. (2006). Health expenditure growth: Reassessing the threat of ageing. *Health Economics*, 15, 947–963.
- Dow, W. H., & Norton, E. C. (2002). *The red herring that eats cake: Heckit versus two-part model redux* (Triangle Health Economics Paper No. 1). Retrieved from The University of North Carolina website: <http://www.unc.edu/the/ab001.htm>
- Elgin, C., & Tumen, S. (2010). Can Sustained Economic Growth and Declining Population Coexist? Barro-Becker Children Meet Lucas. *Economic Modeling*, 29, 1899-1908.
- Elhorst, J. P., & Zeilstra, A. S. (2007). Labor force participation rates at the regional and national levels of the European Union: an integrated analysis. *Papers in Regional Science*, 86, 525–549.
- Endogenous growth theory*. (n.d.). Retrieved from <http://www.investopedia.com/terms/e/endogenousgrowththeory.asp>
- Engle, R. F. & Granger, C. W. J. (1987). Cointegration and error correction representation: estimation and testing. *Econometrica*, 55, 252–276.
- Evashwick, C., Rowe, G., Diehr, P., & Branch, L. (1984). Factors explaining the use of health care services by the elderly. *Health Services Research*, 19, 357-382.
- Fedeli, S. (2015). The Impact of GDP on Health Care Expenditure: The Case of Italy (1982-2009). *Social Indicators Research*, 122, 347-370.
- Felder, S., & Werblow, A. (2008). Does the Age Profile of Health Care Expenditure Really Steepen over Time? New Evidence from Swiss Cantons. *The Geneva Papers on Risk and Insurance - Issues and Practice*, 33(4), 710-727.
- Fertig, M., & Schmidt, C. M. (2003). *Gerontocracy in motion? : European cross-country evidence on the labor market consequences of population ageing* (Discussion Paper No. 956). Retrieved from Institute for the Study of Labor (IZA) website: <http://ftp.iza.org/dp956.pdf>

- Feyrer, J. (2007). Demographics and productivity. *The Review of Economics and Statistics*, 89, 100–109.
- Fonseca, R., Michaud, P.-C., Galama, T., & Kapteyn, A. (2009). *On the Rise of Health Spending and Longevity* (Netspar Discussion Paper No. 12/2009-040).
- Fougère, M., & Mérette, M. (2000). Population Ageing, Intergenerational Equity and Growth: Analysis with an Endogenous Growth, Overlapping–Generations Model. In G. W. Harrison, S. E. Hougaard Jensen, L. Haagen Pedersen & T. F. Rutherford (Eds.), *Using Dynamic Computable General Equilibrium Models for Policy Analysis* (pp. 325–361). Amsterdam: North Holland.
- Friedberg, L. (2003). The impact of technological change on older workers: Evidence from data on computer use. *Industrial and Labor Relations Review*, 56(3), 511–529.
- Friedland, R. (1993). Epidemiology, education, ecology of Alzheimer's disease. *Neurology*, 43, 246–249.
- Friedman, M. (1957). *A theory of consumption function*. Princeton, NJ: Princeton University Press.
- Frini, O., & Muller, C. (2012). Demographic transition, education and economic growth in Tunisia. *Economic Systems*, 36, 351–371.
- Futagami, K., & Nakajima, T. (2001). Population aging and economic growth. *Journal of Macroeconomics*, 23(1), 31–44.
- Gbesemete, K. P., & Gerdtham, U.-G. (1992). Determinants of health care expenditure in Africa: A cross-sectional study. *World Development*, 20(2), 303–308.
- Gee, E., & Gutman, G. (Eds.) (2000). *The overselling of population aging: Apocalyptic demography, intergenerational challenges, and social policy*. Oxford: Oxford University Press.
- Gelberg, L., Andersen, R., & Leake, B. (2000). The behavioral model for vulnerable populations: Application to medical care use and outcomes for homeless people. *Health Services Research*, 34, 1273–1302.
- Gemmell, N. (1996). Evaluating the impacts of human capital stocks and accumulation on economic growth: some new evidence. *Oxford Bulletin of Economics and Statistics*, 58, 9–28.
- Getzen, T. E. (1992). Population aging and the growth of health expenditure. *Journal of Gerontology: Social Sciences*, 47, S98–S104.
- Giuri, P., Mariani, M., Brusoni, S., Crespi, G., Francoz, D., Gambardella, A., ... Verspagen, B. (2007). Inventors and invention processes in Europe: results from the PatVal-EU survey. *Research Policy*, 36, 1107–1127.

- Göbel, C., & Zwick, T. (2009). *Age and productivity - evidence from linked employer employee data* (Centre for European Economic Research Discussion Paper No. 09–020). Retrieved from ZEW website: <ftp://ftp.zew.de/pub/zew-docs/dp/dp09020.pdf>
- Göbel, C., & Zwick, T. (2013). Are personnel measures effective in increasing productivity of old workers? *Labor Economics*, 22, 80–93.
- Gomez, R., & De Cos, P. H. (2008). DOES POPULATION AGEING PROMOTE FASTER ECONOMIC GROWTH?. *Review of Income & Wealth*, 54(3), 350–372.
- Gonzalez-Eiras, M., & Niepelt, D. (2012). Ageing, government budgets, retirement, and growth. *European Economic Review*, 56(1), 97–115.
- Gordo, L. R., & Skirbekk, V. (2013). Skill demand and the comparative advantage of age: Jobs tasks and earnings from the 1980s to the 2000s in Germany. *Labor Economics*, 22, 61–69.
- Gregersen, F. A. (2014). The impact of ageing on health care expenditures: a study of steepening. *European Journal of Health Economics*, 15, 1–11.
- Grönqvist, C. (2009). *The effect of labour force ageing on productivity in Finland*. Retrieved from <https://helda.helsinki.fi/bof/bitstream/handle/123456789/8471/161455.pdf?sequence=1>
- Gruescu, S. (2007). *Population Ageing and Economic Growth: Education Policy and Family Policy in a Model of Endogenous Growth*. (W. A. Muller & Martina Bihn, Eds.). Heidelberg, Germany: Springer-Verlag Berlin and Heidelberg GmbH & Co.
- Grund, C., & Westergaard-Nielsen, N. (2005). *Age Structure of the Workforce and Firm Performance* (Discussion Paper No. 1816). Retrieved from Institute for the Study of Labor (IZA) website: <http://ftp.iza.org/dp1816.pdf>
- Guest, R. (2014). Population ageing and productivity: A survey with implications for New Zealand. *New Zealand Economic Papers*, 48(2), 153–168.
- Guillemette, Y. (2003). *Slowing Down with Age: The Ominous Implications of Workforce Aging for Canadian Living Standards* (C. D. Howe Institute Commentary No. 182).
- Guo, Z., Liu, L., & Liu, X. (2016). Population Aging, Marginal Propensity to Consume, and Economic Growth. *Asian Economic and Financial Review*, 6(9), 534–546.
- Hafner, K. A., & Mayer-Foulkes, D. (2013). Fertility, economic growth, and human development causal determinants of the developed lifestyle. *Journal of Macroeconomics*, 38, 107–120.

- Hakkinen, U., Martikainen, P., Noro, A., Nihtila, E., & Peltola, M. (2008). Aging, health expenditure, proximity to death, and income in Finland. *Health Economics, Policy and Law*, 3(02), 165-195.
- Halliday, T. J., He, H., Ning, L., & Zhang, H. (2017). Health Investment Over the Life-Cycle. *Macroeconomic Dynamics*, 1–38.
- Haltiwanger, J. C., Lane, J. I., & Spletzer, J. R. (1999). Productivity differences across employers: The roles of employer size, age, and human capital. *American Economic Review*, 89(2), 94-98.
- Hamid, T. A. (2015). *Population Ageing in Malaysia: A Mosaic of Issues, Challenges and Prospects*. Inaugural series. Serdang: UPM Press.
- Hamid, T. A., & Chai, S. T. (2013). Meeting the needs of older Malaysians: Expansion, diversification and multi-sector collaboration. *Malaysian Journal of Economic Studies*, 50(2), 157–174.
- Harris, R., & Sollis, R. (2003). *Applied time series modeling and forecasting*. Hoboken: Wiley.
- Hashimoto, K., & Tabata, K. (2010). Population aging, health care, and growth. *Journal of Population Economics*, 23(2), 571–593.
- Hassan, G., & Cooray, A. (2015). Effects of male and female education on economic growth: Some evidence from Asia. *Journal of Asian Economics*, 36, 97-109.
- Heijdra, B. J., & Mierau, J. O. (2011). The Individual Life Cycle and Economic Growth: An Essay on Demographic Macroeconomics. *Economist*, 159(1), 63–87.
- Hellerstein, J. K., Neumark, D., & Troske, K. R. (1999). Wages, productivity, and worker characteristics: Evidence from plant-level production functions and wage equations. *Journal of Labor Economics*, 17(3), 409-446.
- Hertzog, C., Hultsch, D. F., Dixon, R. A. (1999). On the problem of detecting effects of lifestyle on cognitive change in adulthood. *Psychology and Aging*, 14, 528–534.
- Higgins, M. D. (1998). Demography, National Savings, and International Capital Flows. *International Economic Review*, 39(2), 343-369.
- Hirsch, B. T., MacPherson, D. A., & Hardy, M. A. (2000). Occupational age structure and access for older workers. *Industrial and Labor Relations Review*, 53(3), 401–418.
- Hoagland, G. W. (2017). The Economic, Fiscal, and Financial Implications of an Aging Society. *Generations*, 40(4), 16–22.
- Hoisl, K. (2007). *A closer look at inventive output—the role of age and career paths* (Munich School of Management Discussion Paper No. 12). Munich.

- Hogan, C., Lunney, J., Gabel, J., & Lynn, J. (2001). Medicare Beneficiaries' Cost of Care in the Last Year of Life. *Health Affairs*, 20(4), 188–95.
- Hou, J. W., & Li, K. (2011). The aging of the Chinese population and the cost of health care. *Social Science Journal*, 48, 514–526.
- Hou, J. W., & Tsao, H. (2008). Universal healthcare: Experience and lessons from the Taiwan case. In S. Lin (Ed.), *Exploration of China's Social Security System*. Beijing: China Financial Economics Press.
- Huber, C. A., Schneeweiss, S., Signorell, A., & Reich, O. (2013). Improved prediction of medical expenditures and health care utilization using an updated chronic disease score and claims data. *Journal of Clinical Epidemiology*, 66(10), 1118–1127.
- Ilmakunnas, P., Maliranta, M., & Vainiomaki, J. (2004). The roles of employer and employee characteristics for plant productivity. *Journal of Productivity Analysis*, 21(3), 249-276.
- Ilmakunnas, P., & Miyakoshi, T. (2013). What are the drivers of TFP in the Aging Economy? Aging labor and ICT capital. *Journal of Comparative Economics*, 41(1), 201-211.
- Institute for Health Metrics and Evaluation. (2017). *Global Burden of Disease 2015: Malaysia*. Retrieved from <http://www.healthdata.org/malaysia>
- Irmen, A., & Kuehnel, J. (2009). Productive government expenditure and economic growth. *Journal of Economic Surveys*, 23(4), 692–733.
- Isaacs, J. B. (2009). Public spending on children and the elderly from a life-cycle perspective. Retrieved from http://www.brookings.edu/~media/Research/Files/Reports/2009/11/05-spending-children-isaacs/3_lifecycle_pespective_isaacs.PDF
- Jalava, J., & Pohjola, M. (2007). ICT as a source of output and productivity growth in Finland. *Telecommunications Policy*, 31, 463–472.
- Johansen, S. (1988). Statistical analysis of cointegrating vectors. *Journal of Economic Dynamics and Control*, 12, 231–54.
- Jorgenson (Ed.), *Postwar U.S. Economic Growth*. Cambridge: MIT Press.
- Jorgenson, D. W., Frank M. G., & Barbara M. F. (1987). *Productivity and U.S. Economic Growth*. Cambridge: Harvard University Press.
- Jorgenson, D. W., & Griliches, Z. (1995). The explanation of productivity change. In D. W.

- Joshua, O. O. (2016). The Impact of Physical and Human Capital Development on Economic Growth in Developing and Developed Countries : A Comparative Panel Data Approach. *Economy*, 3(1), 1–18.
- Kachan, D., Fleming, L. E., Christ, S., Muennig, P., Prado, G., Tannenbaum, S. L., Yang, X., Caban-Martinez, A. J., & Lee, D. J. (2015). Health Status of Older US Workers and Nonworkers, National Health Interview Survey, 1997–2011. *Preventing Chronic Disease*, 12, E162.
- Kelley, A. C., Schmidt, R. M. (2005). Evolution of recent economic-demographic modeling: a synthesis. *Journal of Population Economics*, 18, 275–300.
- Kinsella, K., & He, W. (2009). *International Population Reports P95/01-1*. Washington, DC: US Government Printing Office.
- Khan, H. N., Khan, M. A., Razli, R. B., Shafie, A. B., Shehzada, G., Krebs, K. L., & Sarvghad, N. (2015). Health Care Expenditure and Economic Growth in SAARC Countries (1995-2012): A Panel Causality Analysis. *Applied Research in Quality of Life*, 1-23.
- Khan, H. N., Razali, R. B., & Shafie, A. B. (2016). Modeling determinants of health expenditures in Malaysia: Evidence from time series analysis. *Frontiers in Pharmacology*, 7(MAR).
- Khan, H. T. A., & Flynn, M. (2016). Self-Reported Health Status of Older Adults in Malaysia and Singapore: Evidence from the 2007 Global Ageing Survey. *Applied Research in Quality of Life*, 11(3), 687–705.
- Kreishan, F. M., & Hawarin, I. M. A. (2011). Education and Economic Growth in Jordan: Causality Test *International Journal of Economic Perspectives*, 5(1), 45–53.
- Kuhn, M., Wrzaczek, S., Prskawetz, A., & Feichtinger, G. (2015). Optimal choice of health and retirement in a life-cycle model. *Journal of Economic Theory*, 158, 186–212.
- Lallemand, T., & Rycx, F. (2009). Are older workers harmful for firm productivity? *De Economist*, 157, 273–292.
- Le Carret, N., Lafont, S., Letenneur, L., Dartigues, F., Mayo, W., & Fabrigoule, C. (2003). The effect of education on cognitive performances and its implication for the constitution of the cognitive reserve. *Developmental Neuropsychology*, 23, 317–337.
- Lee, Y. (2015). Flexicure employment of older people in Super-Aged societies. *Transylvanian Review of Administrative Sciences*, (44), 144–160.

- Lee, H. -H., Huh, H. -S. H., Lee, Y. -Y., & Lim, J. -Y. (2013). Effects of Population Aging on Economic Growth: A Panel Analysis. *Seoul Journal of Economics*, 26(4), 401-432.
- Lee, R., & Mason, A. (2014). Is low fertility really a problem? Population aging, dependency, and consumption. *Science*, 346(6206).
- Lee, R. D., Mason, A. & Miller, T. (2001). Saving, Wealth and Population. In S. W. Birdsall, N., Kelley, A. C. & Sinding (Ed.), *Population Does Matter: Demography, Poverty and Economic Growth* (pp. 137–164). Oxford: Oxford University Press.
- Leff, N. H. (1969). Dependency rates and saving rates. *American Economic Review*, 59, 886–895.
- Levin, S. G., & Stephan, P. E. (1991). Research Productivity Over the Life Cycle: Evidence for Academic Scientists. *The American Economic Review*, 81(1), 114–132.
- Liik, M., Masso, J., & Ukrainski, K. (2014). The contribution of R&D to production efficiency in OECD countries: econometric analysis of industry-level panel data. *Baltic Journal of Economics*, 14(1-2), 78-100.
- Lindh, T., & Malmberg, B. (2009). European Union economic growth and the age structure of the population. *Economic Change and Restructuring*, 42(3), 159-187.
- Lisenkova, K., Mérette, M., & Wright, R. (2013). Population ageing and the labor market: Modelling size and age-specific effects. *Economic Modelling*, 35(0), 981-989.
- Liu, J.-T., Tsou, M.-W., & Wang, P. (2010). Workforce Composition and Firm Productivity: Evidence from Taiwan. *Economic Inquiry*, 48, 1032–1047.
- Liu, S., & Hu, A. (2013). Demographic change and economic growth: Theory and evidence from China. *Economic Modelling*, 35, 71–77.
- Longman, P. (1987). *Born to pay: the new politics of aging in America*. Boston: Houghton Mifflin.
- Lubitz, J. D., & Riley, G. F. (1993). Trends in Medicare payments in the Last Year of Life. *New England Journal of Medicine*, 328(15), 1092–1096.
- Mahlberg, B., Freund, I., Crespo Cuaresma, J., & Prskawetz, A. (2013). Ageing, productivity and wages in Austria. *Labor Economics* 22, 5-15.
- Maksymenko, S. (2009). Fertility, money holdings, and economic growth: Evidence from Ukraine. *Comparative Economic Studies*, 51, 75–99.

- Malaysia. Department of Statistics. (2000). *Population Ageing Trends in Malaysia. Population and Housing Census of Malaysia. Monograph series No. 1.* Putrajaya: Department of Statistics Malaysia.
- Malaysia. Department of Statistics. (2015a). *Labor Force Survey Time Series Data 1982 – 2013.* Retrieved from https://www.statistics.gov.my/index.php?r=column/ctimeseries&menu_id=NHJLaGc2Rlg4ZXlGTjh1SU1kaWY5UT09
- Malaysia. Department of Statistics. (2015b). *Statistical Yearbook: School Enrolment.* From Department of Statistics e-services.
- Malaysia. Department of Statistics. (2015c). *Population by Age Group.* Retrieved from Department of Statistics e-services.
- Malaysia. Economic Planning Unit. (2015). *Eleventh Malaysia Plan (2016-2020): Anchoring Growth on People.* Retrieved from <http://rmk11.epu.gov.my/index.php/en/>
- Malaysia. Institute for Public Health. (2016). *National Health & Morbidity Survey (NHMS) 2015 [Fact Sheet].* Retrieved from <http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2015-FactSheet.pdf>
- Malaysia. Ministry of Health. (2011a). *Annual Report Ministry of Health 2011.* Retrieved from <http://www.moh.gov.my/english.php/pages/view/196>
- Malaysia. Ministry of Health. (2011b). *Malaysia National Health Accounts: Ministry of Health (MOH) Sub-Account (1997-2009).* Retrieved from <http://www.moh.gov.my/english.php/pages/view/196>
- Malaysia. Ministry of Health. (2012). *Malaysia National Health Accounts: Out-Of-Pocket (OOP) Sub-Account (1997-2009).* Retrieved from <http://www.moh.gov.my/english.php/pages/view/196>
- Malaysia. Ministry of Health. (2014). *Malaysia National Health Accounts: Health Expenditure Report 1997-2014.* Retrieved from <http://www.moh.gov.my/english.php/pages/view/56>
- Malaysia. Ministry of Health. (2015). *National Health & Morbidity Survey 2015: Non-communicable diseases, risk factors & other health problems volume II.* Retrieved from <http://www.iku.gov.my/images/IKU/Document/REPORT/nhmsreport2015vol2.pdf>
- Malaysia. Ministry of Human Resources. (2015). *How Minimum Retirement Age Act Affects Working People.* Retrieved from: <http://www.mohr.gov.my/index.php/en/archives/92-archive-news/322-how-minimum-retirement-age-act-affects-working-people>

- Mankiw, N. G., Romer, D., & Weil, D. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107, 407–437.
- Mason, A., (Ed.). (2001). *Population Change and Economic Development in East Asia: Challenges Met, and Opportunities Seized*. Stanford: Stanford University Press.
- Mason, A. & Lee, R. (2004). Reform and Support Systems for the Elderly in Developing Countries: Capturing the Second Demographic Dividend. In *International Seminar on the Demographic Window and Healthy Aging: Socioeconomic Challenges and Opportunities*. Beijing: China Centre for Economic Research, Peking University.
- Mason, A., & Lee, S. -H. (2012). Population, wealth, and economic growth in Asia and the Pacific. In D. Park, S. -H. Lee & A. Mason (Eds.), *Aging, Economic, Growth, and Old-Age Security in Asia* (pp. 32-82). Cheltenham: Edward Elgar.
- Matteo, L. Di. (2009). Policy choice or economic fundamentals: what drives the public–private health expenditure balance in Canada? *Health Economics, Policy and Law*, 4(01), 29–53.
- McGrail, K., Green, B., Barer, M. L., Evans, R. G., Hertzman, C., & Normand, C. (2000). Age, costs of acute and long-term care and proximity to death: evidence for 1987-88 and 1994-95 in British Columbia. *Age Ageing*, 29(3), 249-253.
- Meade, J. (1966). Life-cycle savings, inheritance and economic growth. *The Review of Economic Studies*, 33(1), 61–78.
- Mendelson, D. N., & Schwartz, W. B. (1993). The Effects of Aging and Population Growth on Health Care Costs. *Health Affairs*, 12(1), 119–25.
- Mèrette, M., & Georges, P. (2009). *Demographic changes and the gains from Globalisation: An Overlapping generations CGE Analysis* (Working Paper No. 0903E). Retrieved from University of Ottawa Department of Economics website: <https://socialsciences.uottawa.ca/sites/default/files/public/eco/fra/documents/0903E.pdf>
- Michaud, P. C., Goldman, D., Lakdawalla, D., Zheng, Y., & Gailey, A. H. (2009). *Understanding the economic consequences of shifting trends in population health* (National Bureau of Economic Research Working Paper. No. 15231). Cambridge, MA.
- Minami, U., Nishi, M., Fukaya, T., Hasebe, M., Nonaka, K., Koike, T., & Fujiwara, Y. (2015). Effects of the Change in Working Status on the Health of Older People in Japan. *PLOS ONE*, 10(12), e0144069.
- Mizuno, M., & Yakita, A. (2013). Elderly labor supply and fertility decisions in aging-population economies. *Economics Letters*, 121, 395–399.

- Mo, P. H. (2007). Government Expenditures and Economic Growth: The Supply and Demand Sides. *Fiscal Studies*, 28(4), 497-522.
- Modigliani, F., & Ando, A. (1957). Tests of the Life-Cycle Hypothesis of Savings. *Bulletin of the Oxford University Institute of Economics and Statistics*, 19, 99-124.
- Modigliani, F., & Brumberg, R. (1954). Utility Analysis and the Consumption Function. In K. Kurihara (Ed.), *Post-Keynesian Economics* (pp.151-170). New Brunswick, N.J.: Rutgers University Press.
- Mohanty, S. K., Chauhan, R. K., Mazumdar, S., & Srivastava, A. (2014). Out-of-pocket Expenditure on Health Care Among Elderly and Non-elderly Households in India. *Social Indicators Research*, 115, 1137-1157.
- Mollick, A. V. (2011). The world elasticity of labor substitution across education levels *Empirical Economics*, 41, 769-785.
- Moffatt, M. (n. d.). Definition of labor productivity. Retrieved from http://economics.about.com/od/termsbeginningwithl/g/labor_productivity.htm
- Murthy, N. R. V., & Okunade, A. A. (2000). Managed care, deficit financing, and aggregate health care expenditure in the United States: A cointegration analysis. *Health Care Management Science*, 3(4), 279-285.
- Murthy, V. N. R., & Okunade, A. A. (2009). The core determinants of health expenditure in the African context: Some econometric evidence for policy. *Health Policy*, 91, 57-62.
- Murthy, V. N. R., & Okunade, A. A. (2016). Determinants of U.S. health expenditure : Evidence from autoregressive distributed lag (ARDL) approach to cointegration. *Economic Modelling*, 59, 67-73.
- Narayan, P. K. (2005). The Saving and Investment Nexus for China: Evidence from Cointegration Tests. *Applied Economics*, 37, 1979-1990.
- Narciso, A. (2010). *The impact of population ageing on international capital flows* (MPRA Paper No. 26457). Retrieved from MPRA website: https://mpra.ub.uni-muenchen.de/26457/1/MPRA_paper_26457.pdf
- Nardi, M. D., French, E., & Jones, J. B. (2006). *Differential mortality, uncertain medical expenses, and the saving of elderly singles* (National Bureau of Economic Research Working Paper No. 12554).
- Neoclassical growth theory. (n. d.). Retrieved from <http://www.investopedia.com/terms/n/neoclassical-growth-theory.asp>
- Newhouse, J. P. (1977). Medical care expenditure: a cross-national survey. *Journal of Human Resources Resource*, 12(1), 115-125.

- Newhouse, J. P. (1992). Medical Care Costs: How Much Welfare Loss? *The Journal of Economic Perspectives*, 6(3), 3-21.
- O'Connell, J. M. (1996). The relationship between health expenditures and the age structure of the population in OECD countries. *Health Economics*, 5(6), 573-578.
- OECD. (1988). *Aging population: the social policy implications*. Paris: OECD Publishing.
- Ogawa, N., & Matsukura, R. (2005). *Ageing In Japan: The Health And Wealth Of Older Persons*. Retrieved from http://www.un.org/esa/population/meetings/Proceedings_EGM_Mex_2005/ogawa.pdf
- Oku, A., Ichimura, E., & Tsukamoto, M. (2017). *Aging population in Asian countries – Lessons from Japanese experiences*. (Discussion Paper Series No. 17(A-12)). Retrieved from Policy Research Institute (PRI) website: https://www.mof.go.jp/pri/research/discussion_paper/ron299.pdf
- Park, D., & Shin, K. (2011). *Impact of Population Aging on Asia's Future Growth* (Working Paper Series No. 281). Retrieved from Asian Development Bank (ADB) website: <http://www.adb.org/publications/impact-population-aging-asias-future-growth>
- Peng, X. (2008). Demographic shift, population ageing and economic growth in China: A computable general equilibrium analysis. *Pacific Economic Review*, 13(5), 680-697.
- Pesaran, M. H., & Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. In S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century the Ragnar Frisch Centennial Symposium* (pp. 371–413). Cambridge: Cambridge University Press.
- Pesaran, H., Shin, Y., & Smith, R. (2001). Bound testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-329.
- Pesaran, M. H., & Pesaran, B. (1997). *Working with microfit 4.0: Interactive Econometric Analysis*. Oxford: Oxford University Press.
- Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75, 335-346.
- Polder, J. J., Barendregt, J. J., & van Oers, H. (2006). Health care costs in the last year of life-The Dutch experience. *Social Science and Medicine*, 63(7), 1720-1731.
- Prettner, K., Bloom, D. E., & Strulik, H. (2012). *Declining fertility and economic well-being: do education and health ride to the rescue?* (Working Paper No. 84). Retrieved from Program on the Global Demography of Aging (PGDA) website: <http://www.hsph.harvard.edu/pgda/working.htm>

- Prettner, K. (2013). Population aging and endogenous economic growth. *Journal of Population Economics*, 26, 811-834.
- Prskawetz, A, Fent, T. & Guest, R. (2007). Workforce ageing and labour productivity. The role of supply and demand of labour in the G7. In A. Prskawetz, D. E. Bloom & W. Lutz (Eds.), *Population Aging, Human Capital Accumulation, and Productivity Growth: A supplement to Population and Development Review*. New York : Population Council.
- Prskawetz, A., Mahlberg, B., Skirbekk, V., Freund, I., Winkler-Dworak, M., Lindh, T., ... Andersson, F. (2006). The Impact of Population Ageing on Innovation and Productivity Growth in Europe. *Vienna Institute of Demography, Austrian Academy of Sciences*.
- Quandl. (2015). *Population* [Fact sheet]. Retrieved from <https://www.quandl.com/collections/demography/population-above-age-64-by-country>
- Rannan-Eliya, R. P., Anuranga, C., Manual, A., Wickramasinghe, R., Perera, P., Saleem, S. & Chandrasiri, J., Pathmanathan, I. (2013). *Malaysia Healthcare Demand Analysis: Inequalities in Healthcare Demand and Simulation of Trends and Impact of Potential Changes in Healthcare Spending*. Kuala Lumpur: Institute for Health Systems Research.
- Rauber, M., & Ursprung, H. W. (2007). *Life cycle and cohort productivity in economic research: the case of Germany* (CESIFO Working Paper No. 2093). Retrieved from IDEAS website: https://ideas.repec.org/p/ces/ceswps/_2093.html
- Rauber, M., & Ursprung, H. W. (2008). Life cycle and cohort productivity in economic research: The case of Germany. *German Economic Review*, 9(4), 431–456.
- Romer, P. (1990). Capital, Labor and Productivity. *Brookings Papers on Economic Activity: Microeconomics*, 337-67.
- Roos, N. P., Montgomery, P., & Roos, L. L. (1987). Health care utilization in the years prior to death. *The Milbank quarterly*, 65(2), 231-254.
- Roth, F., & Thum, A. E. (2013). Intangible capital and labor productivity growth: Panel evidence for the EU from 1998-2005. *Review of Income and Wealth*, 59(3), 486–508.
- Rowland, D. T. (2013). Population aging: The transformation of societies. *Australasian Journal on Ageing*, 32(1), 68.
- Salas, C., & Raftery, J. P. (2001). Econometric Issues in Testing the Age Neutrality of Health Care Expenditure. *Health Economics*, 10(7), 669–71.

- Scarth, W. (2002). Population ageing, productivity and living standards. In A. Sharpe, F. St-Hilaire, & K. Banting (Eds.), *The review of economic performance and social progress: Towards a social understanding of productivity* (pp. 145–156). Montreal: IRPP.
- Scarth, W. (2009). Some Macroeconomic Effects of Population Aging on Productivity Growth and Living Standards. In M. G. Abbott, C. M. Beach, R. W. Boadway, & G. MacKinnon, James (Eds.), *Retirement Policy Issues in Canada* (pp. 1–27). Kingston, Ontario: McGill-Queen's University Press.
- Scarth, W., & Souare, M. (2002). *Baby Boom Aging and Average Living Standards* (Social and Economic Dimensions of an Aging Population Research Paper No. 68). McMaster University.
- Schleife, K. (2006). Computer use and the employment status of older workers - an analysis based on individual data. *LABOR: Review of Labor Economics and Industrial Relations*, 20(2), 325–348.
- Seshamani, M., & Gray, A. (2004). Ageing and health-care expenditure: The red herring argument revisited. *Health Economics*, 13(4), 303-314.
- Sharpe, A. (2011). Is Ageing a Drag on Productivity Growth? A Review Article on Ageing, Health and Productivity: The Economics of Increased Life Expectancy. *International Productivity Monitor*, 21, 82-94.
- Silverstovs, B., Kholodilin, K. A., & Thiessen, U. (2011). Does aging influence structural change? Evidence from panel data. *Economic Systems*, 35(2), 244-260.
- Silver, S. D. (2015). Human capital in personal consumption and labor force productivity: evidence from an OECD panel. *Applied Economics Letters*, 22(7), 529–538.
- Simon, J. (1986). *Theory of Population and Economic Growth*. Oxford: Blackwell.
- Singh, T. (2010). Does domestic saving cause economic growth? A time-series evidence from India. *Journal of Policy Modeling* 32, 231-253.
- Skirbekk, V. (2004). Age and Individual Productivity: A Literature Survey. In G. Feichtinger (Ed.), *Vienna Yearbook of Population Research* (pp. 133-153). Vienna: Austrian Academy of Sciences Press.
- Slifkin, R. T. (2002). Developing policies responsive to barriers to health care among rural residents: What do we need to know? *Journal of Rural Health*, 18, 233-241.
- Spillman, B. C., & Lubitz, J. (2000). The Effect of Longevity on Spending for Acute and Long-Term Care. *New England Journal of Medicine*, 342(19), 1409-1415.

- Stein, J., Andersen, R., & Gelberg, L. (2007). Applying the Gelberg-Andersen behavioral model for vulnerable populations to health service utilization in homeless women. *Journal of Health Psychology*, 12, 791-804.
- Stober, E. O. (2015). Aging population - a cloud on Romania's economic future. *Management Research And Practice*, 7(4), 32-42.
- Strulik, H., & Werner, K. (2016). 50 Is the New 30—Long-Run Trends of Schooling and Retirement Explained By Human Aging. *Journal of Economic Growth*, 21, 165-187.
- Tabata, K. (2005). Population aging, the costs of health care for the elderly and growth. *Journal of Macroeconomics*, 27, 472-493.
- Tamakoshi, T., & Hamori, S. (2015). Health-care expenditure, GDP and share of the elderly in Japan: a panel cointegration analysis. *Applied Economics Letters*, 22(9), 725-729.
- Tang, J., & MacLeod, C. (2006). Labour Force Ageing and Productivity Performance in Canada. *The Canadian Journal of Economics / Revue Canadienne d'Economique*, 39(2), 582-603.
- The Conference Board. (2015). *The Conference Board Total Economy Database: Output, Labor and Labor Productivity, 1950-2015*. Retrieved from <http://www.conference-board.org/data/economydatabase/>
- Thornton, J. A., & Beilfuss, S. N. (2015). New evidence on factors affecting the level and growth of US health care spending. *Applied Economics Letters*, 23(1), 15-18.
- Tyers, R., & Shi, Q. (2007). Demographic change and policy responses: Implications for the global economy. *World Economy*, 30(4), 537-566.
- United Nations. Department of Economics and Social Affairs. Population Division. (2009). *World Population Ageing 2009*. Retrieved from http://www.un.org/esa/population/publications/WPA2009/WPA2009_WorkingPaper.pdf
- United Nations Human Rights. Human Rights Commission of Malaysia. (2013). *Information and good practices for the public consultation on the rights of older persons pursuant to the human rights council resolution no. 21/23*. Retrieved from www.ohchr.org/Documents/Issues/.../MalaysiaHRCommission_SUHAKAM.doc
- Van Ours, J. C., & Stoeldraijer, L. (2011). Age, Wage and Productivity in Dutch Manufacturing. *De Economist*, 159(2), 113-137.
- Vandenbussche, J., Aghion, P., Meghir, C. (2006). Growth, distance to frontier and composition of human capital. *Journal of Economic Growth*, 11, 97-127.

- Walder, A. B. & Döring, T., (2012). The Effect of Population Ageing on Private Consumption – A Simulation for Austria based on Household Data up to 2050. *Eurasian Economic Review*, 2, 63-80.
- Wamboye, E., Adekola, A., & Sergi, B. (2016). ICTs and Labour Productivity Growth in Sub-Saharan Africa. *International Labour Review*, 155(2), 231–252.
- Wattenberg, B. (1987). *The Birth Dearth*. New York: Pharos Books.
- Wei, Z., & Hao, R. (2010). Demographic structure and economic growth: Evidence from China. *Journal of Comparative Economics*, 38(4), 472–491.
- Werblow, A., Felder, S., & Zweifel, P. (2007). Population ageing and health care expenditure: A school of 'Red Herrings'? *Health Economics*, 16(10), 1109-1126.
- World Bank (2015). *Tables 2.21 World Development Indicators: Mortality*. Retrieved from <http://wdi.worldbank.org/table/2.21>
- World Bank (2017). *World Development Indicators*. Retrieved from <http://data.worldbank.org/country/malaysia>
- World Bank. (2016). *Live Long Prosper: Aging in East Asia and Pacific*. Retrieved from <https://openknowledge.worldbank.org/handle/10986/23133?locale-attribute=en>
- World Bank. (2018). *Population ages 65 and above (% of total)*. Retrieved from <https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?locations=SG-JP-PH-ID-TH-KR-BN-MY>
- World Health Organization. (2015). *Noncommunicable Diseases (NCD) Country Profiles, 2014*. Retrieved from http://www.who.int/nmh/countries/mys_en.pdf?ua=1
- Xu, K., Saksena, P., & Holly, A. (2011). *The Determinants of Health Expenditure: A Country-Level Panel Data Analysis*. (World Health Organization Working Paper). Retrieved from WHO website: http://www.who.int/health_financing/documents/report_en_11_deter-he.pdf
- Yang, Z., Norton, E. C., & Stearns, S. C. (2003). Longevity and health care expenditures: The real reasons older people spend more. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, 58(1), S2-S10.
- Yin-Fah, B., & Paim, L. (2010). The future of the Malaysian older employees: An exploratory study. *International Journal of Business and Management*, 5(4), 125–132.
- Yorulmaz, Ö. (2016). Can healthcare ever be less than a necessity in MENA countries? A semiparametric estimation of the relationship between healthcare expenditure and GDP. *Quality and Quantity*, 50(3), 1233–1244.

Yunus, N. M., Said, R., & Hook, L. S. (2014). Do Cost of Training, Education Level and R&D Investment Matter towards Influencing Labor Productivity? *Jurnal Ekonomi Malaysia* 48(1), 133 - 142.

Zhou, C., Long, Q., Chen, J., Xiang, L., Li, Q., Tang, S., ... Huan, S. (2016). The effect of NCMS on catastrophic health expenditure and impoverishment from tuberculosis care in China. *International Journal for Equity in Health*, 15(172), 1-8.

Zweifel, P., Felder, S., & Meiers, M. (1999). Ageing of population and health care expenditure: A red herring? *Health Economics*, 8(6), 485-496.

Zweifel, P., Felder, S., & Werblow, A. (2004). Population ageing and health care expenditure: New evidence on the red herring. *Geneva Papers on Risk and Insurance: Issues and Practice*, 29(4), 652-666.