



***EFFECTS OF NATURAL DISASTER ON FERTILITY RATE AND
QUALITY OF LIFE***

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By

SHALINI A/P NAGARATNAM

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

November 2018

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

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SHALINI A/P NAGARATNAM

November 2018

Chairman : Professor Muzafar Shah Habibullah, PhD
Faculty : Economics and Management

In the recent years, the frequency of disasters have increased along with greater intensity and damages. People living in disaster-prone areas respond to the disasters by adopting different strategies to improve quality of life, which includes altering their choices leading to changes in fertility rates. Fifty years ago, the fertility rates were between 5 and 6 children per woman, and now, at least half the world are below replacement rates. The intended fertility rates are decided based on the standing of their lives' quality, where while some parents experience happiness on their newborn, some struggle to adapt to the new lifestyle. Against this background, this study intends to; (a) analyze the impact of natural disaster on fertility rates, (b) examine the impact of fertility on quality of life, and (c) investigate the international convergence in fertility. For the first and second objectives, the study employed the system Generalized Method of Moments (GMM).

The first objective examines the impact of natural disasters (i.e. floods, earthquake and landslide) on fertility rates using a panel data spanning from the period 1980 to 2014 on 165 countries that faced at least one event of natural disaster, 153 countries that faced at least one event of flood, 57 countries that faced at least one event of earthquake and 32 countries that faced at least one event of landslide. Each natural disaster was measured using four measurements; the number of occurrences, the number of people killed, the number of people affected and the total damages. The analysis also included the one-period of lagged natural disaster. The findings reveal that the occurrences of natural disaster for all types of disaster decreases the fertility rates, but increases at the lagged-period. The damages and number of people affected in the floods and total disaster are positively related to the fertility rates, while the number of people killed has a negative impact on fertility rates for all disaster types. The second objective examines the impact of fertility rates on the quality of life using

a panel data for 129 countries for the period 2008 to 2017. The results reveal that the relationship between fertility rates and quality of life is negative, while the square of the fertility rates had a significant and positive impact on quality of life. This results posits that quality of life and fertility rates has a ‘U’ shaped relationship.

The third objective employed the convergence test using standard convergence using absolute and beta convergence, and innovative dispersion method using the relative dispersion to examine the convergence in fertility among disaster-prone countries. A total of 165 countries were analyzed between years 1975 and 2014. This study suggests countries that experience natural disasters are converging in fertility rates. The presence of convergence in fertility rates indicates that the perceived distinction between the countries is becoming less visible. Discounting the period from 1975 to 2015 when the OECD countries experienced a divergence in fertility rates, we find that the population dynamics in the OECD countries may not be different from the other sampled countries. Fertility rates in the OECD countries have declined as rapidly as the rest of the world. Dispersion in the fertility rates are also negative, indicating that the cross sectional variance in fertility rates are also becoming smaller. Although the relative dispersion showed a possible divergence, the volume of divergence is becoming smaller over the time period. This affirms that the convergence in a relative dispersion will take place in the future. Based on the findings, the study suggests that the government and policy makers place greater emphasis on the disaster preparedness and risk reduction to mitigate the effects of natural disaster on fertility rates and the quality of life. This study also recommends that the government consider taking considerable measures to improve fertility rates through education, and raising income level. In order to improve quality of life, policy measures should focus on improving social capital, institutional quality, and health sectors, which in turn would increase fertility rates.

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

IMPAK BENCANA ALAM KE ATAS KADAR KESUBURAN DAN KUALITI HIDUP

Oleh

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Sejak kebelakangan ini, kekerapan bencana alam telah meningkat dengan intensiti lebih tinggi dan kerugian yang lebih besar. Penduduk yang tinggal di kawasan yang terdedah kepada bencana bertindak balas dengan strategi yang berbeza untuk meningkatkan kualiti hidup, termasuk perubahan pilihan dalam kadar kesuburan. Lima puluh tahun dahulu, kadar kesuburan ialah antara 5 dan 6 anak kepada seorang wanita, dan sekarang, sekurang-kurangnya separuh dunia berada di bawah kadar penggantian, iaitu 2.1. Kadar kesuburan ditentukan berdasarkan kualiti hidup mereka, sementara beberapa ibu bapa mengalami kebahagiaan selepas menerima bayi, beberapa berjuang untuk menyesuaikan diri dengan gaya hidup baru sebagai ibu bapa. Berdasarkan latar belakang ini, kajian ini berhasrat untuk; (a) menganalisis kesan bencana alam kepada kadar kesuburan, (b) mengkaji kesan kesuburan terhadap kualiti hidup, dan (c) mengkaji penumpuan antarabangsa dalam kesuburan.

Kajian ini menggunakan dua metodologi untuk mencapai matlamat. Untuk tujuan pertama dan kedua, kajian ini menggunakan sistem *Generalized Method of Moments* (GMM). Objektif pertama mengkaji kesan keseluruhan bencana alam dan tiga jenis bencana alam (banjir, gempa bumi dan tanah runtuh) pada kadar kesuburan menggunakan data panel dari tahun 1980 hingga 2014 dengan maklumat 165 negara yang menghadapi sekurang-kurangnya satu peristiwa bencana, 153 negara yang menghadapi sekurang-kurangnya satu kejadian banjir, 57 negara yang menghadapi sekurang-kurangnya satu kejadian gempa bumi dan 32 negara yang menghadapi sekurang-kurangnya satu kejadian tanah longsor. Setiap bencana alam menggunakan empat ukuran; bilangan kejadian, bilangan orang terbunuh, bilangan orang yang terjejas dan jumlah kerosakan. Analisis juga termasuk satu tempoh lanjut bencana alam. Penemuan mendedahkan bahawa kejadian bencana alam untuk semua jenis bencana menurunkan kadar kesuburan, tetapi meningkat pada tempoh yang seterusnya. Kerosakan dan jumlah orang yang terjejas akibat banjir dan bencana

mempunyai hubungan positif dengan kadar kesuburan, sementara bilangan orang yang terbunuh mempunyai kesan negatif ke atas kadar kesuburan untuk semua jenis bencana. Objektif kedua meneliti impak kadar kesuburan pada kualiti hidup menggunakan data panel untuk 129 negara untuk tempoh 2008 hingga 2017. Hasilnya menunjukkan bahawa hubungan antara kadar kesuburan dan kualiti hidup adalah negatif, manakala kuadratik kadar kesuburan mempunyai kesan yang signifikan dan positif terhadap kualiti hidup. Ini menyebabkan kualiti hidup dan kadar kesuburan berkongsi hubungan berbentuk 'U'.

Objektif ketiga menggunakan ujian konvergensi menggunakan penggabungan mutlak dan beta, dan kaedah sebaran inovatif menggunakan penyebaran relatif untuk mengkaji konvergensi kesuburan di kalangan negara-negara yang ada bencana. Sebanyak 165 buah negara telah dianalisis dari tempoh masa 1975 dan 2014. Kajian ini mencadangkan bahawa negara-negara yang mengalami bencana alam menumpu pada kadar kesuburan nyata. Penumpuan kadar kesuburan menunjukkan bahawa perbezaan yang dilihat di antara negara-negara menjadi semakin kecil. Selain tempoh dari tahun 1975 hingga 2015 dimana negara-negara OECD mengalami perbezaan dalam kadar kesuburan, kita mendapati bahawa dinamik penduduk di negara-negara OECD mungkin tidak berbeza daripada sampel negara lain dengan kadar penumpuan yang signifikan. Kadar kesuburan di negara-negara OECD telah menurun dengan cepat seperti seluruh dunia. Penyebaran dalam kadar kesuburan juga negatif, menunjukkan bahawa variasi dalam kadar kesuburan juga menjadi lebih kecil. Walaupun penyebaran relatif menunjukkan perbezaan yang jelas, jumlah penyimpangan menjadi lebih kecil dalam tempoh masa. Ini menegaskan bahawa konvergensi dalam penyebaran relatif akan berlaku pada masa akan datang. Berdasarkan penemuan ini, kajian menunjukkan bahawa pemerintah dan pembuat dasar memberi penekanan lebih lanjut mengenai kesiapsiagaan bencana dan pengurangan risiko untuk mengurangkan kesan bencana alam terhadap kadar kesuburan dan kualiti hidup. Kajian ini juga menyarankan agar kerajaan mempertimbangkan untuk mengambil langkah yang lebih baik untuk meningkatkan kadar kesuburan melalui pendidikan, dan peningkatan KDNK per kapita. Bagi meningkatkan kualiti hidup, pendekatan terhadap dasar perlu memberi tumpuan kepada peningkatan modal sosial, kualiti institusi dan sektor kesihatan, yang seterusnya akan meningkatkan kadar kesuburan.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment 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

Q-Q	Quantity-Quality model
GSS	General Social Survey
EU	European Union
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
CRED	Centre for Research on the Epidemiology of Disasters
EM-DAT	Emergency Events Database EM-DAT
WDI	World Development Indicator
WHO	World Health Organization
WHR	World Happiness Report
SWB	Subjective Well-being
ILO	International Labour Organization
OLS	Ordinary Least Square

CHAPTER 1

INTRODUCTION

1.1 Overview

Natural disasters have become more frequent and intense in recent years. These disasters cause damages from the economic perspective but more significantly they affect people directly in areas such as health and emotional well-being (Lutz, 2008). In 2017, 335 natural disasters caused damages totaling to US\$335 billion, which in turn affected more than 95 million people and killed almost 9697 people (Centre for Research on the Epidemiology of Disasters, 2018). Countries that are economically stable have a resilient population which can rise above these effects and recover fast, however in vulnerable countries, a contradicting impact was observed (Raddatz, 2009).

During the post disaster period, people responded by adopting different strategies to cope with these unavoidable shock, such as changing their living arrangements (Lutz, 2008; Rendall, 2011) which included a change in the intended number of children. Yet again, the degree of change depended on the resilience of the population measured by the socio-economic development (McBean and Ajibade, 2009). In places where formal insurance mechanisms were limited and children were able to supplement household income, the event of natural disaster had a positive effect on the number of children born in a household (Finlay, 2009). Another possible reason explaining the fertility increase after a disaster is the disruption on contraceptive accessibility (UNFPA United Nation Population Fund, 2018; Finlay, 2009). Fearing the consequences of natural disasters, parents were unprepared to have children while some opted for pregnancy termination, in addition adults were less interested in nuptials (Liu, Han, Xiao, Ma and Chen, 2010; Frankenberg, Gillespie, Preston, Sikoki and Thomas., 2011).

The impact of disasters on an individual is not transient, as many people still live in temporary facilities and shelter, even one year after the disaster (United Nations International Children's Emergency Fund UNICEF, 2016). Prolonged unstable living conditions not only exposes children and women to the risk of early marriages, unintended pregnancy, health issues but also affects the quality of their lives. For example, persistent mental and physical health issues were evident, even one year after Superstrom Sandy (Langfield, 2013). Along with these conditions, the quality of life of new parents reduces after the birth of a child, as they have to adapt to a new lifestyle (Fritjers et al., 2011; Angeles, 2010). Since the size of family can affect the quality of life, then an understanding of the fertility rates is essential.

Fertility rates across the countries have experienced a downward trend, although empirical research has shown that natural disasters have positive impact on fertility rates (Evans, Hu and Zhao, 2010; Nobles, Frankenberg and Thomas, 2015). Projecting

population within disaster-prone countries will provide information on whether the countries are becoming homogenous in terms of fertility rates and so it is important to investigate the convergence in fertility rates across nations. To set the stage, the following sections will provide a background of the study, review some trends and patterns in the occurrences of natural disaster, fertility rates and quality of life across countries and regions.

1.2 Background of the Study

In the 1970s, high fertility rate was a pressing issue for developing countries as the growing population was overburdening the economy. A steady increase in fertility rate translates to overcrowding and was perceived as a peril to the living standards and political stability. It strained the government's budget, employment opportunity, education expenditure, health and sanitation (Bongaarts, 1998).

However, the circumstances have changed and we see a reverse pattern in the tide. These days the constant fall in the fertility rates are rather alarming. Before the 1960s, no country was documented to have a total fertility rate (TFR) below the replacement level of 2.1.¹ As years passed on, more and more countries were declining in their TFR, and today we have more than 50% of countries universally with TFR below the replacement rates including Singapore, China, and Canada (United Nations, 2017; Frejka Thomas, 2017; Population Reference Bureau, 2008; Grossman Richard, 2017).

The interesting issue here is that not even a single country that had a decline in fertility rates below replacement rate has risen above it (Curson, 2012) but is this really a problem? The issues that surround the lunge in fertility rates below the replacement rate, include a rise in the aging population, low workforce input, and the predicament to overcome these issue presses on the government budget, and policy settings (Lutz, O'Neill and Scherbov, 2003; Straughan, Chan and Jones, 2008; Curson, 2012). Fertility transition is the process in which changes are observed in the fertility patterns of a country, normally from a high to a low fertility rate, at times below a low plateau (Strulik and Vollmer, 2015). Europe and the North America experienced the first fertility transition in the late eighteenth and early twentieth centuries. Prior to this transition, on average married woman would expect 8 or more births, while now, many woman chose to not have children at all, bringing the elasticity of fertility to zero or even negative in some cases (Guinnane, 2011). With such a dramatic fall in the statistics, fertility has emerged as a subject of interest in the discipline of demography, sociology, anthropology, medicine and economics.

¹ The total fertility rate (TFR) is the number of children born to a woman. The replacement rate is the TFR which is sufficient to sustain population level. In the case of mortality of the parents, minimum of 2 children would replace the loss.

The fall in the total fertility rates have crucial consequences from the economic perspective, which may be irreversible. With the continuous fall in the fertility rate, the ratio of children to adults in the population is becoming smaller. Although it seems favourable initially as bigger portion of the population is in the labour market which contributes to the economic growth, but in the long run this would make the ratio of working adults to aging adults small too (Blake and Mayhew, 2006; Curson, 2012). Countries will be having a higher percentage of aging population as compared to the working population and children. Also, with the increase of the aging population and also with a generation that does not bear enough children to replace the older generation there would be a significant reduction in the population in time to come.

In most developed countries, the aging population is well cared for with retirement incomes and sponsored medical care. These subsidies are generated by heavily taxing the working population. When the aging population increases, more funds are needed to sustain their income and medical care, thus a government would be put in a dilemma to either force higher tax on the smaller working group or to fork out from the government budget which would compromise other projects. One of the many problems that arises due to the boom in the ageing population as a result of the decline in fertility is the increase in the dependency ratio². If the retirement age is fixed, there will be more people claiming pension benefits and less people paying taxes. To sustain the pension benefits, the shrinking working society will have to be heavily taxed. There will be also increased government expenditure on health care and pension. Higher taxes on the working class may create disincentives to work, which in turn may lead firms to record a fall in the productivity and growth of the workforce. Furthermore, the ageing population would also lead to a shortage of workers, hence wages need to be pushed higher, as demand is higher than supply, causing wage inflation. An increased number of retirees will also create the need for more retirement homes and investment in market of goods and services catered for older people. The increasing ageing population would also lower the rates of the economic growth as higher savings for pensions may reduce the capital investment and reduce the amount of savings available (Feldstein, 2006).

To overcome this problem, governments design immigration policies to attract a diverse group of educated professionals, as seen in Canada, Russia, and France. Singapore, in the face of low labour input due to low fertility rates, relaxed immigration policies to fulfill the need for qualified labour causing the number of non-citizens residing in the country to be higher than the citizens themselves (Yap, 2010). The other alternative to overcome low fertility rates is to promote birth within the country. However, the budget needed to promote birth is exorbitant and may take a very long period to achieve the favoured fertility rates (Straughan, Chan, and Jones, 2008). For example, Germany which has a fertility rate of 1.4, has set up fertility

² Dependency ratio is defined as the ratio of non-active age to those of active age in a given population. OECD Working Party on Private Pensions, 2005, "Private Pensions: OECD Classification and Glossary, 2005 edition", OECD, Paris.

programs to achieve a minimal fertility rates of 2.1, but the likelihoods of achieving this in the short run would be either very expensive or not feasible.

The fertility transition scenario is very often linked to the economic growth, inviting many researchers to investigate this relationship (Herzer, Strulik and Vollmer, 2012; Mills and Blossfield, 2005; Kreyenfeld, 2010; Sobotka, Skirbekk and Philipov, 2011). On one perspective, developed countries would have lower fertility rates as many women will partake in the workforce, and therefore the idea of bearing children would be compromised. Another effect is that developed country would increase the individual's standard of living, which in turn increases the fertility rate. These scenarios will be further reviewed in the following Chapter. Nevertheless, the level of development is just one of the important determinant that will be investigated (i.e. Chesnais, 1992; Lee, 2003; Reher, 2004).

In countries that are stricken by natural disasters, the fertility rate should ideally be high so that the population level will not be affected when disaster strikes, since population is an important factor for the workforce and in turn for development. In 2017, 335 natural disasters incidences were recorded with a death toll of 9,697 affecting 95.6 million people (CRED, 2017). Although these numbers are lower as compared to the previous years, the total damages have increased to US\$335 billion. Countries that have a robust economy have a resilient population which can rise above these effect and recover fast. However, contradicting impacts are seen in vulnerable countries. As these disasters become more pronounced, they pose a threat to human well-being (Lutz, 2008). People respond to this by adopting different strategies to cope with these unavoidable shock, including changing their living arrangements (Lutz, 2008; Rendall, 2011). The degree of changes vary as it depends on the resilience of the population measured by the socio-economic development (McBean and Ajibade, 2009). The impact of natural disaster can be seen through employment well-being, social well-being, wealth well-being, physical well-being and emotional well-being as they affect the fertility choices of the people directly or indirectly.

When natural disasters strike, there is a halt to the employment sector, both white collar and blue collar workers. This hinders the growth of labour skills due to scarcity of labour .One example is Florida which was hit by hurricanes and therefore experienced a slower growth rate in employment (Belasan & Polochek, 2009). The number of jobholders in the household is affected too. There are two ways to this, no job would mean less income and so the fertility choice would be to reduce the number of dependents but on the other hand, lack of other activities could raise the number of dependents. In 1993, for example, Norway experienced a spike in unemployment at 6%, which is associated to the fall in the total fertility (Moen, 2002).

The education system is also crippled due to the loss of infrastructure and manpower. People become demotivated. In 2007, Bangladesh was hit by Cyclone Sidr destroying more than 4000 schools, while an earthquake in Pakistan had brought down the services of more than 600 health facilities (CRED, 2015). The loss of home, assets and infrastructure are among the impact on the wealth well-being. Natural disaster at

an adverse level could even deteriorate the currency and cripple the economy of a country. In Korea, 76% of the total losses from natural disasters was due to just one type of disaster which is the floods. This loss corresponds to 33% of the country's GDP on average (CRED, 2015).

Natural disasters may cause an aftermath on the health of the people, including lack of clean water supply, increase in illnesses, food scarcity, pest wave and many others. Some health issues persist even after years of it occurring, for example Superstorm Sandy that struck in 2012. Doctors continued to treat patients with storm-related medical symptoms a year after the hurricane, not to mention that depression levels increased by 25% (Langfield, 2013; Ursula, 2015). Finally, emotional well-being, which is the major part, basically boils down to mental well-being, which is people's happiness. The damages caused by these natural disasters leave people lost in spiritual and mental aspects, above the challenges they face physically and economically. For example, children and adolescents in Thailand faced psychological difficulties after the traumatizing Tsunami that hit in the year 2004 (Tuicomeepe & Romano, 2006). All the mentioned consequences of natural disasters somehow affect the choices people make in determining how they would like their future to be, and how they would like to see their offspring grow into an environment that can be treacherous.

1.2.1 Global trend of natural disaster

Natural disasters are defined as “a situation or event which overwhelms local capacity, necessitating to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage and human suffering” by the Centre of Research on the Epidemiology of Disaster (CRED, 2009).

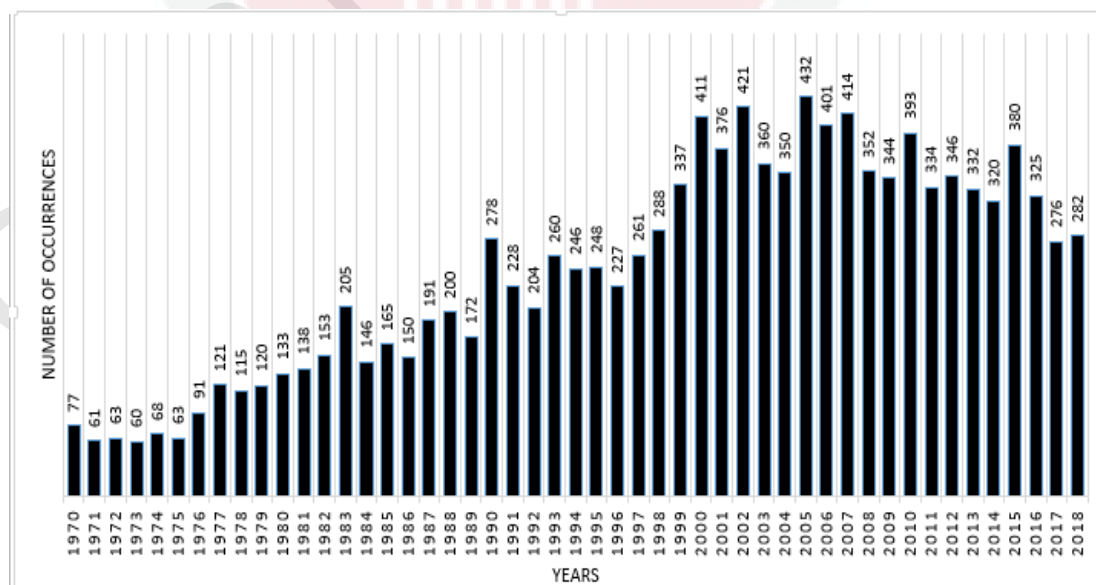


Figure 1.1 : The Number Reported Natural Disasters for the period 1970-2018
 [Source: The International Disaster Database, EM-DAT (2019)]

The occurrences of natural disaster have been increasing since 1970 as shown in Figure 1.1. In fact, it is noticeable that there is an increasing pattern since 1900 where the highest number of natural disaster was recorded in the year 2002 and 2005. During these years, the most frequent disaster was floods. The lowest disaster occurrence after 2005 occurred in 2016, where almost 51% of the incidences were floods that killed 4731 people (Guha-Sapir, Hoyois and Wallemacq, 2016). In the recent years, the occurrences of natural disasters are decreasing, however the economic losses are much greater.

The occurrences of earthquakes, floods and landslide were at low levels until 1960 and began to increase from then onwards. The events of flood continued to rise after 1960 as depicted in Figure 1.2. The highest incidences of flood occurred in the year 2006 with 325 reported events accounting for 55% of all disaster recorded (Hoyois, Scheuren, Below and Guha-Sapir, 2007; CRED, 2016). Flood continued to be the major cause of economic damages amounting to more than US\$23.1 billion losses. The number of occurrences of earthquakes and landslide continued at low counts as compared to floods. Although the events of earthquake are not as high as floods, the economic damages caused by an earthquake is relatively large.

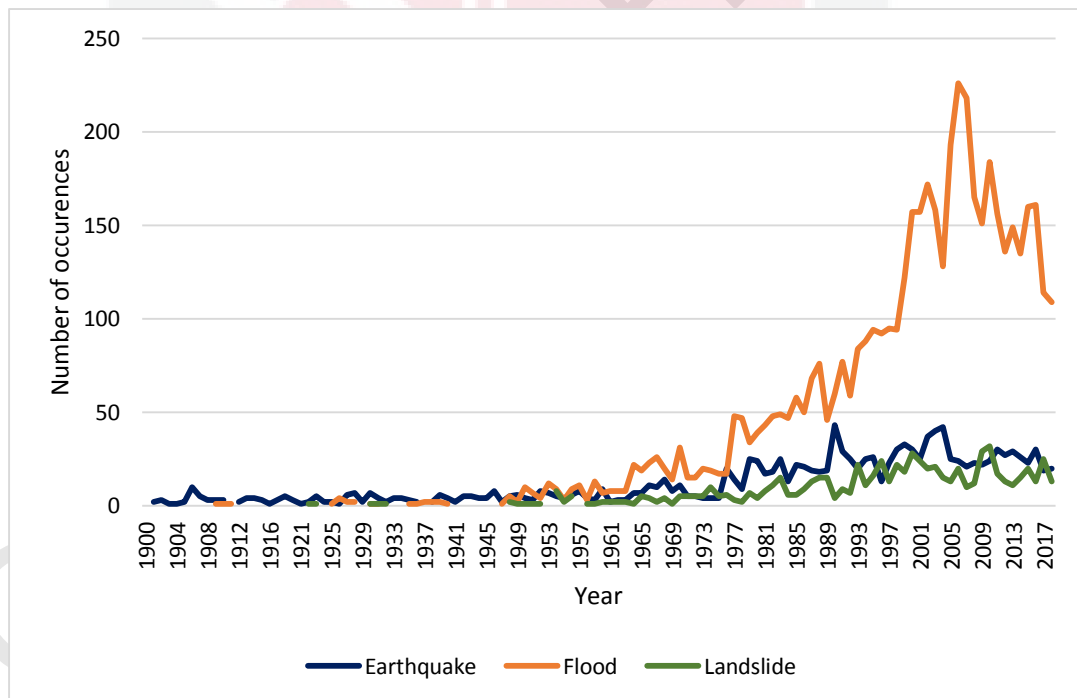


Figure 1.2 : The number of occurrences by earthquakes, flood and landslide from 1900 to 2017

[Source: EM-DAT (2019)]

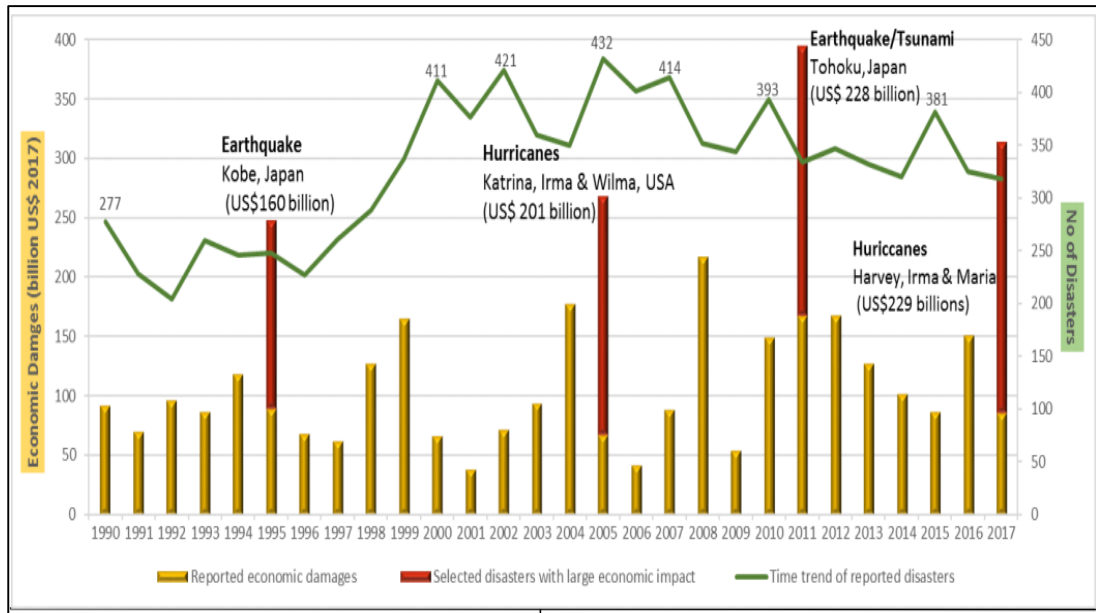


Figure 1.3 : Economic Damages (million US\$) and number of disasters for the period 1990 to 2017

[Source: EM-DAT Database (2019)]

The economic damages and number of natural disasters are simultaneously presented in figure 1.3. Between 2000 and 2017, 504 events of earthquake occurred and in the same timeframe, Europe had 34 earthquakes affecting 257303 people and resulting in 701 deaths, with damages worth US\$29 billion (CRED Crunch 51, 2017). In 2011, the Tohoku earthquake and tsunami caused economic damages amounting to US\$228 billion, which was more than half of the damages recorded for the year as shown in Figure 1.3. The similar pattern is evident in 1995 with event of the Kobe earthquake, although lower events of natural disaster was recorded as compared to the other years. Hurricanes Katrina, Harvey, Irma, Wilma and Maria also had a large economic impact in the year 2005 and 2017, with damages totaling to US\$201 billion and US\$229 billion, respectively.

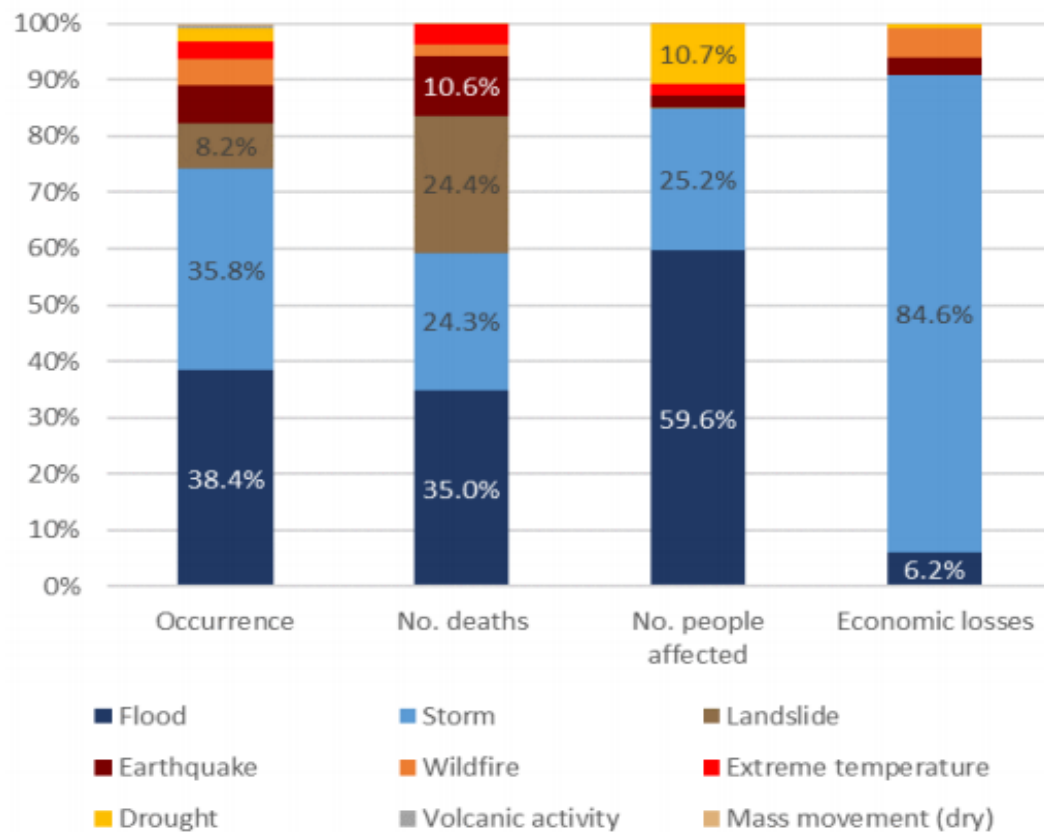


Figure 1.4 : Share by disaster type for 2017
 [Source: CRED (2018)]

Different types of disasters are dissimilar in the number of occurrences, the number of people killed, number of people affected and also economic damages caused as shown in Figure 1.4. For comparison purpose, only year 2017 is selected, to present the number of occurrences, number of death, number of people affected and the economic damages. The highest occurrence of natural disaster in 2017 is the floods (38.4%) but the economic losses is only 6.2% of the total economic losses. The vents of earthquakes was lesser than 10% of the total number of natural disaster, but the number of people killed is greater than 10% of the total number of people killed in a natural disaster. 8.2% of the total number of disasters was landslides, but the number of death stands at 24.4%, with a very small percentage of people affected and almost insignificant share in the economic losses. The storm was the second highest occurrence of natural disaster and had the greatest share in economic losses.

1.2.2 Fertility rates by countries with different disaster risk

The total fertility rates (TFR) is the “average number of children born to a woman over a lifetime given current age-specific fertility rates and assuming no female mortality during reproductive years. TFRs are computed as the sum of age-specific

fertility rates defined over five-year intervals. Data on the TFR come mostly from national statistical offices and other international organizations (e.g. Eurostat and the World Bank). Assuming there was no migration and that mortality rates remain unchanged, a TFR of 2.1 children per woman is generally sufficient to generate a stable population within a given country. A TFR above or below this ‘population replacement rate’ is likely to produce population growth and population decline, respectively” (OECD, 2018).

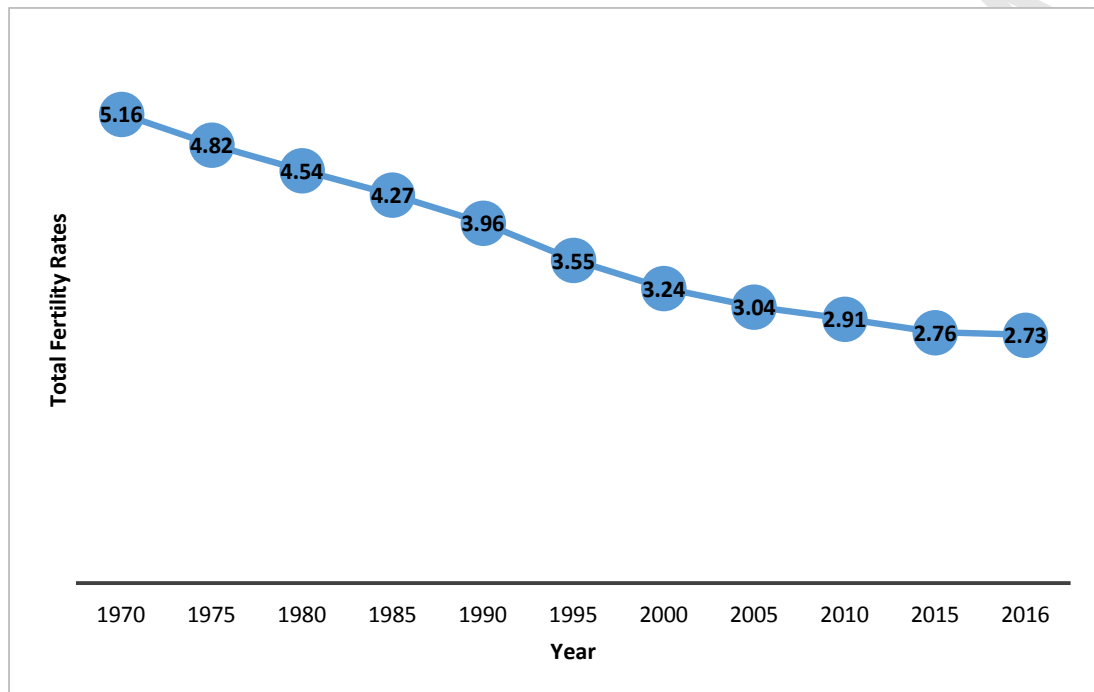


Figure 1.5 : World Total Fertility Rates Trend from 1970- to 2016
[Source: World Development Indicators Online Database, WDI (2018)]

The transition of the world’s total fertility rate as illustrated in figure 1.5 shows that fertility level around the world is declining as the total fertility rate in the 1970s stood at 5.16 and the current average stands at 2.7, just slightly above replacement level. The non-terminating, consistently declining pattern of fertility rates are undoubtedly concerning, especially if it drops below the replacement level. These fertility rates presented in figure 1.5 are averages of the fertility rates of all countries (i.e. the high fertility and low fertility), hence the averages are still above replacement level.

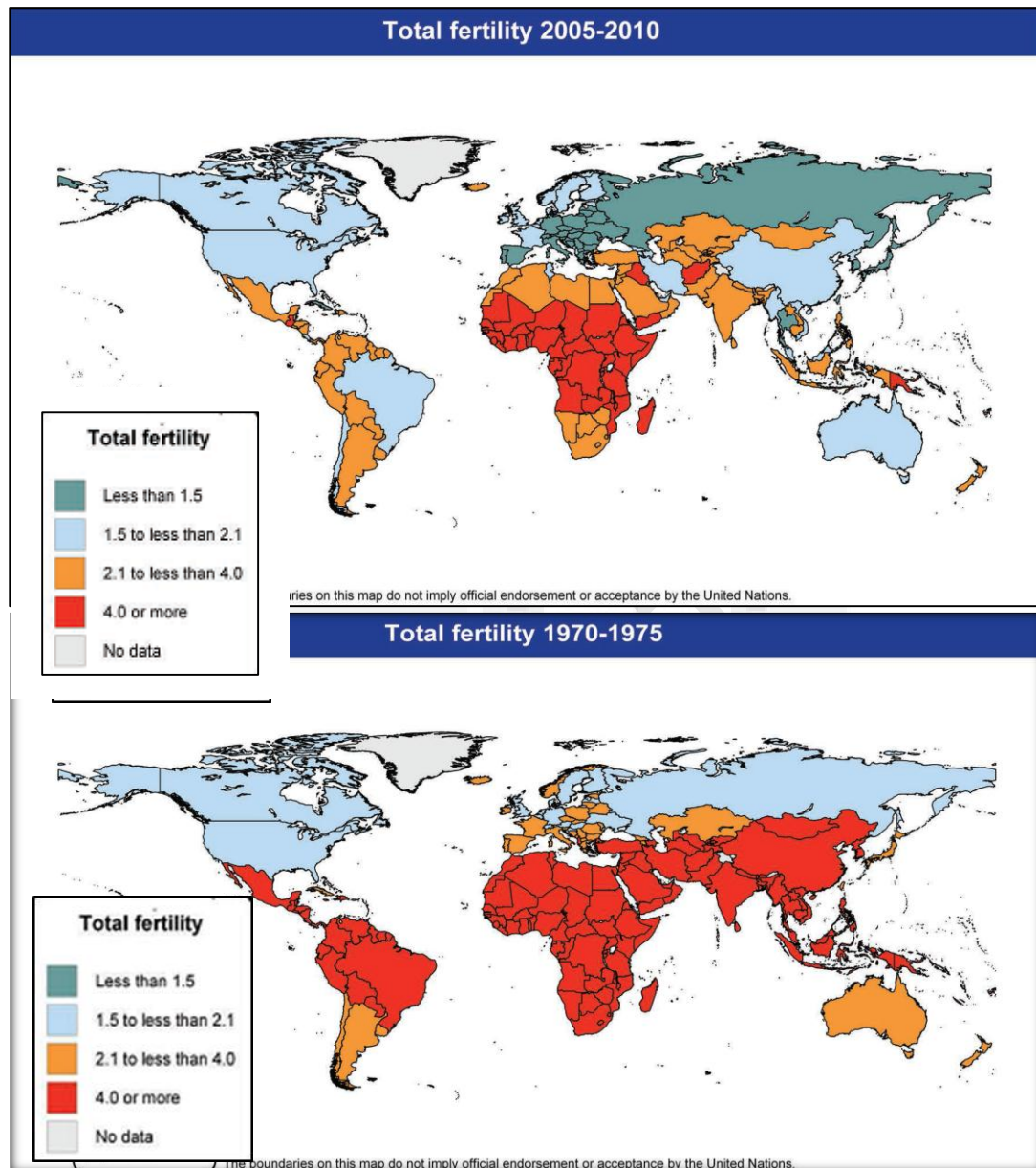


Figure 1.6 : Total Fertility Rates around the world in 1970-1975 and 2005-2010
 Reproduced from [Source: United Nations, Department of Economics & Social Affairs, Population Division, World Fertility Pattern (2013)]

The world map shown in Figure 1.6 illustrates the total fertility rate for countries and continents in two periods, 1970-1975 and 2005-2010. In the earlier period, about half of the world's parents had at least 4 kids which includes all of the African continent, a large part of South Asia and some parts of South Africa. These concentration of high fertility rates changed over time, leaving only some parts of the African continent with fertility rates of more than 4 kids as presented in the second map in Figure 1.6. Australia's fertility rates declined from more than 2.1 in the year 1970-1975, to less than 2.1 in the year 2005-2010. Brazil had a sizeable fall in the fertility rates, from more than 4.0 in the first period, to less than 2.1 in the next period.

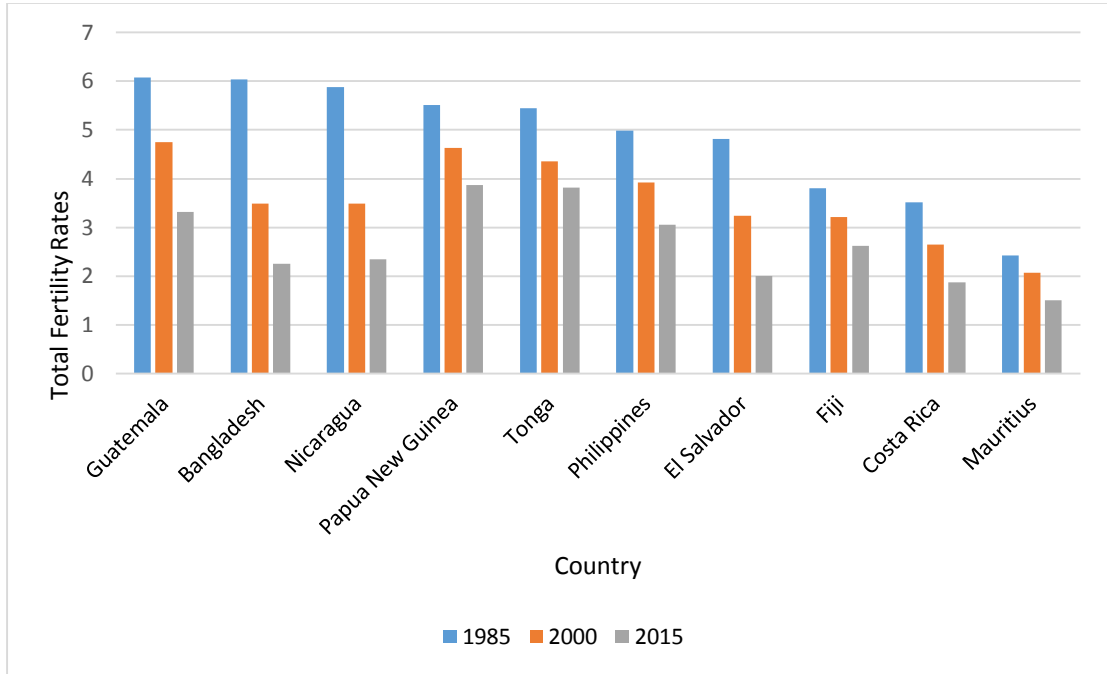


Figure 1.7 : Fertility Rates (total birth per woman) for the high disaster risk countries in the year 1985, 2000 and 2015
 [Source: WDI (2019)]

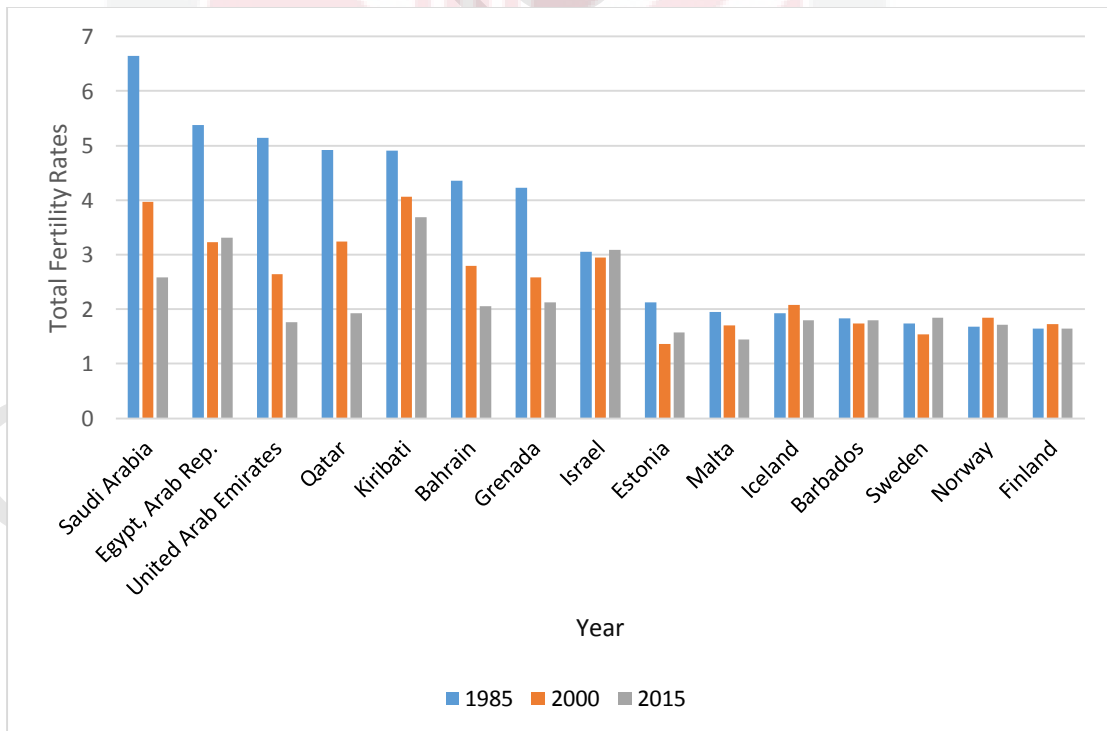


Figure 1.8 : Fertility Rates (total birth per woman) for the low disaster risk countries in the year 1985, 2000 and 2015
 [Source: WDI (2019)]

Figure 1.7 reveals rather interestingly that countries with high disaster risks experienced a decrease in their total fertility rates. Among these countries, 70% of them were high fertility countries in 1985 with fertility rates above 4.8. A decline in fertility rates, leaves all countries with total fertility rates below 4.0 in the year 2015. A majority of countries with low disaster risk countries also experienced a fall in the fertility rates from 1985 to 2015, as shown in Figure 1.8. The most evident decrease was seen in almost 50% of the countries. Saudi Arabia, Egypt, Emirates, Qatar, Bahrain and Grenada had fertility rates above 4.0 in the year 1985, but declined drastically to rates as low as 2.1. Malta, Estonia, Iceland, Barbados, Norway and Finland, however, did not have a steep fall in fertility rates.

A close comparison between the fertility rates of the high natural disaster risk countries with low natural disaster risk countries show that fertility rates of the high risk countries have experienced a steep decrease in fertility rates over the years but mixed trends are seen for the low disaster risk countries. Judging by the charts and figures, there seems to be a great interest in studying the changes in fertility rates within countries that experienced natural disasters.

1.2.3 Quality of life

The general well-being of life is said to sum up to the quality of life of an individual in the context of international development, healthcare, politics and employment (World Happiness Report, 2013). Among the indicators of quality of life are GDP per capita, human development index. The happiness index, which both objectively and subjectively measures real GDP, health life expectancy, perceived freedom, corruption and generosity happiness index has been widely used in current researches. It is important to establish the term well-being and happiness which will be used interchangeably to quantify the quality of life.

Among the literature studying the quality of life (Clark, Frijters and Shields, 2008; Frijters, Johnston and Shields, 2011), very few investigated the role of fertility. Pervaded by the cultural beliefs, that children increases the well-being of the parents, especially women. It is important to understand that the effects of having children on parents' happiness and well-being would explain parent's fertility behavior. Parenthood changed lives in two ways: having a child brings joy, strengthens social ties with friends and family along with the new role and responsibilities (Gallagher and Gerstel, 2001; Umberson and Gove, 1989; Sieber, 1974; Hoffman and Manis, 1979), while on the other hand, it also increases the workload, decreases the quality of time spent with partner, and can psychologically strain their well-being (Sanchez and Thomson, 1997; Crohan, 1996; Lavee et al., 1996; Mc Lanahan and Adams, 1987).

The happiest countries are those in the North America as well as Australia, with happiness index above 6.98, as illustrated by Figure 1.9. Countries in the African continent were mostly having low to middle level of happiness index, between 2.84 to 5.75. Among the Asian countries, northern parts of the Asian region had a higher

happiness index as compared to southern Asia. Figure 1.13 depicts the top 20 countries ranked the happiest. There are indefinitely many factors that contribute to happiness, which include GDP per capita, social capital, health life expectancy, and freedom to make life choices, generosity, perception of corruption and everything. The happiness of ‘everything else’ takes up a big portion as compared to the other factors. We intend to see how fertility rates or the number of children will affect the happiness as a portion of the unexplained happiness in the figure below. As the number of children increases beyond a certain point, the level of happiness begins to reduce (Myrskylä and Margolis, 2014), thereafter showing an inverted U curve. A majority of the studies show that more children equals to more happiness and vice versa (i.e Myrskylä, 2015; Aasve et al., 2012; Kohler, Behrman and Skyttke, 2005).

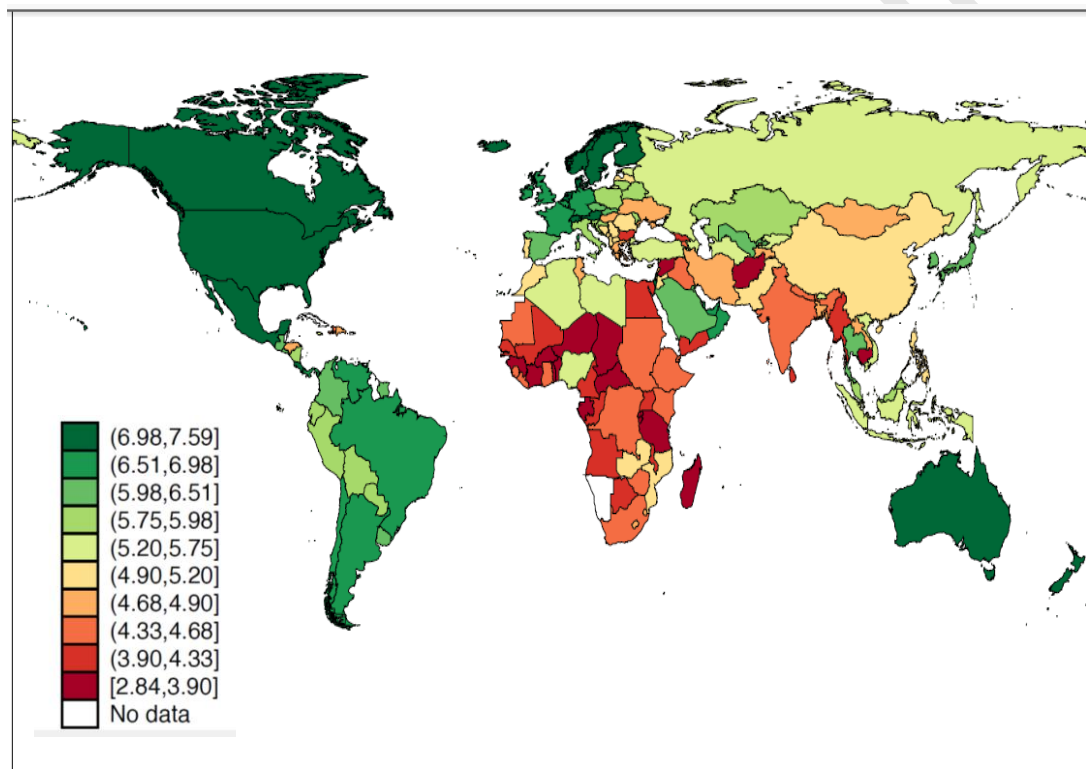


Figure 1.9 : World Map of Happiness Index Over the World 2012 - 2014
 [Reproduced from: World Happiness Report 2015 (2019)]

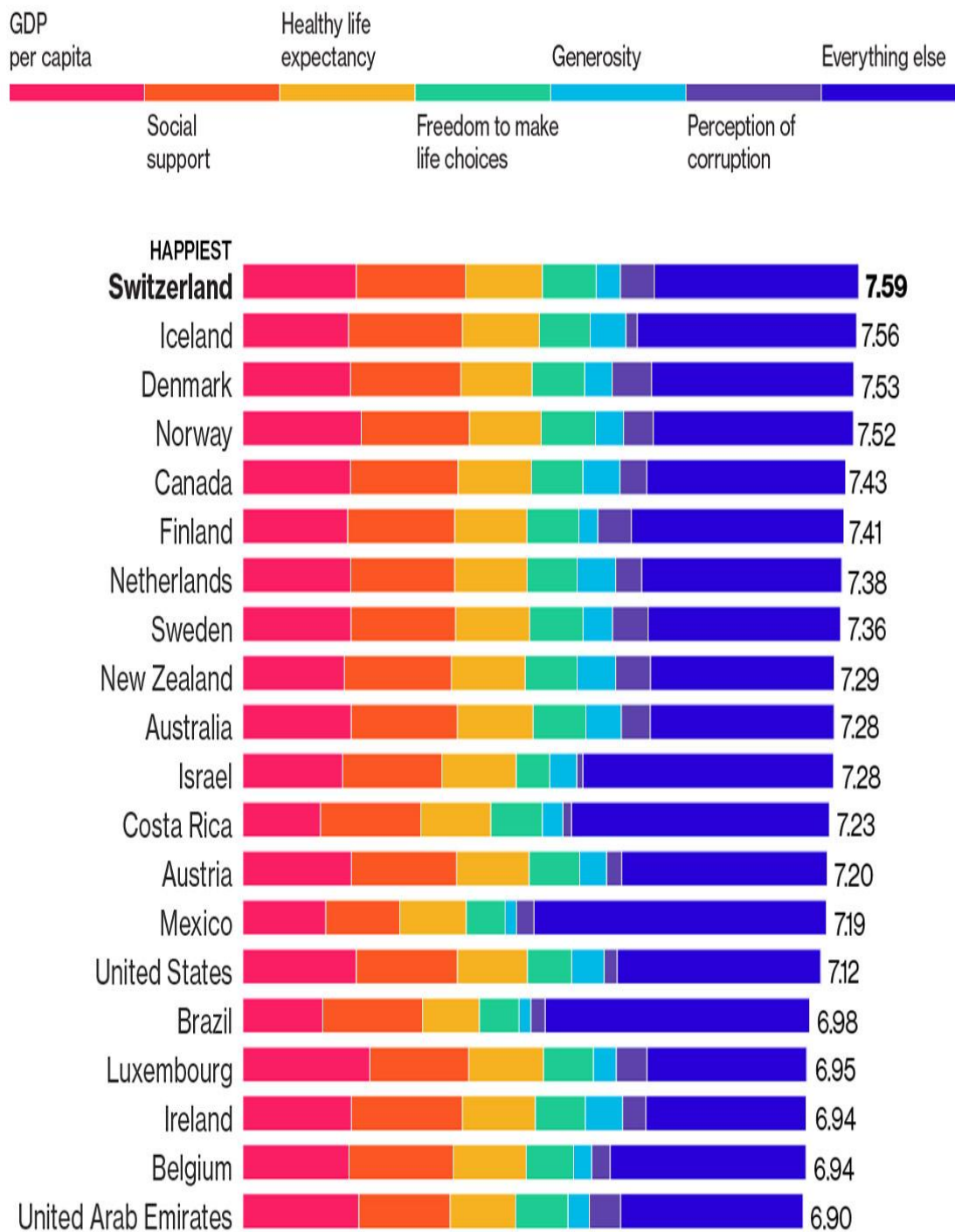


Figure 1.10 : Happiness Index Over the World 2012 - 2014
 [Reproduced from: World Happiness Report, WHR (2015)]

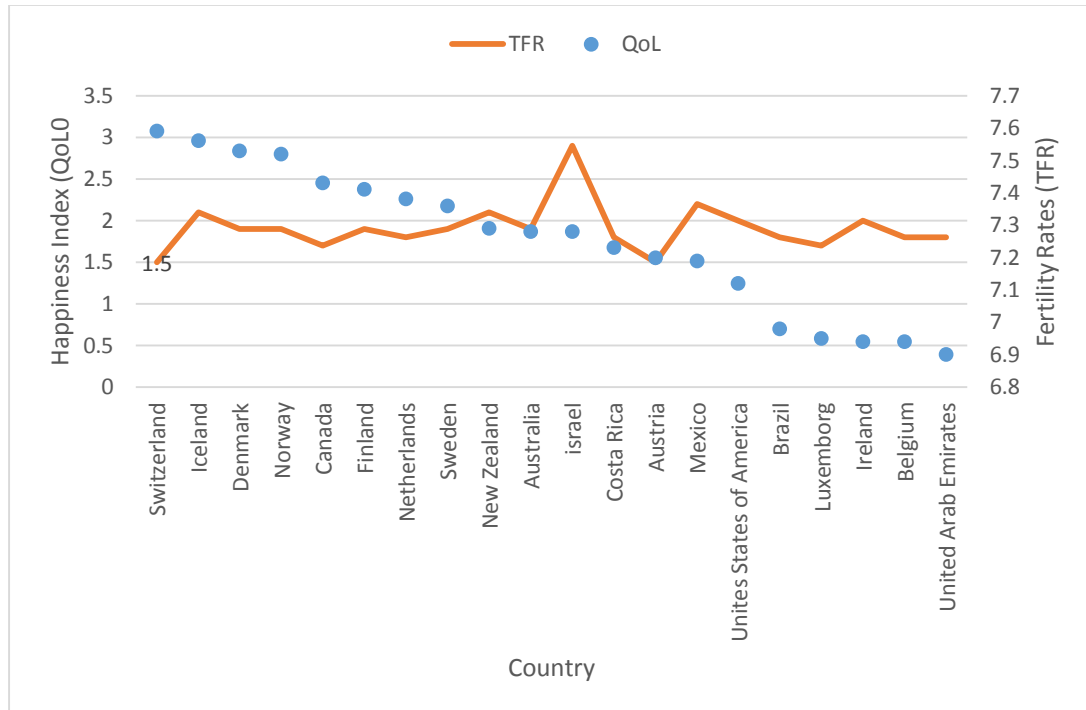


Figure 1.11 : Fertility rates of the Happiest Countries (2013)
 [Source: World Happiness Report and World Fertility Report 2013]

Among the happiest nations, not a single country had fertility rate of above 3.0 as depicted in Figure 1.11. The country with the highest fertility rate in this group was Israel, with rates close to 3.0, while the lowest fertility rate recorded was for Switzerland, at 1.5. 85% of these countries fell below the replacement rates. Only Iceland, New Zealand and Mexico were merely at the replacement rate of 2.1. Does this suffice to vouch that there is evidence of low fertility rates among happy countries, while high fertility countries experienced lower happiness? Although the relationship is seen clearly, it is imperative to also understand that the income levels of these countries differ. Among the happiest countries only three countries have GDP per capita of lower than USD13 000 which are Costa Rica, Mexico and Brazil.

1.2.4 Converging Global Trends in Fertility Rates

The global fertility rates have declined substantially from 1970 to 2016, as illustrated in Figure 1.5. Fertility rates stood at around 6 children per woman in 1970 as compared to 2.7 children per woman in 2016. However, the decreasing trend varies across continents, as shown in Figure 1.12. The fertility rates in East Asia & Pacific, Latin America & Caribbean, North America, Europe and Central Asia, Middle East and North Africa and South Asia seem to have converged to between two and three children per woman in the 2016. The Sub Saharan Africa still had a fall in fertility rates but not as dramatic as other continents. A steep decline was seen for East Asia and Pacific especially around 1965 to 1980. Europe and Central Asia started at below 4.0 in 1960 and fell below replacement rate somewhere in 1990. Looking at the overall

picture, all continents have fertility rates of below 3.0, with Sub Saharan being the only continent above the replacement level.

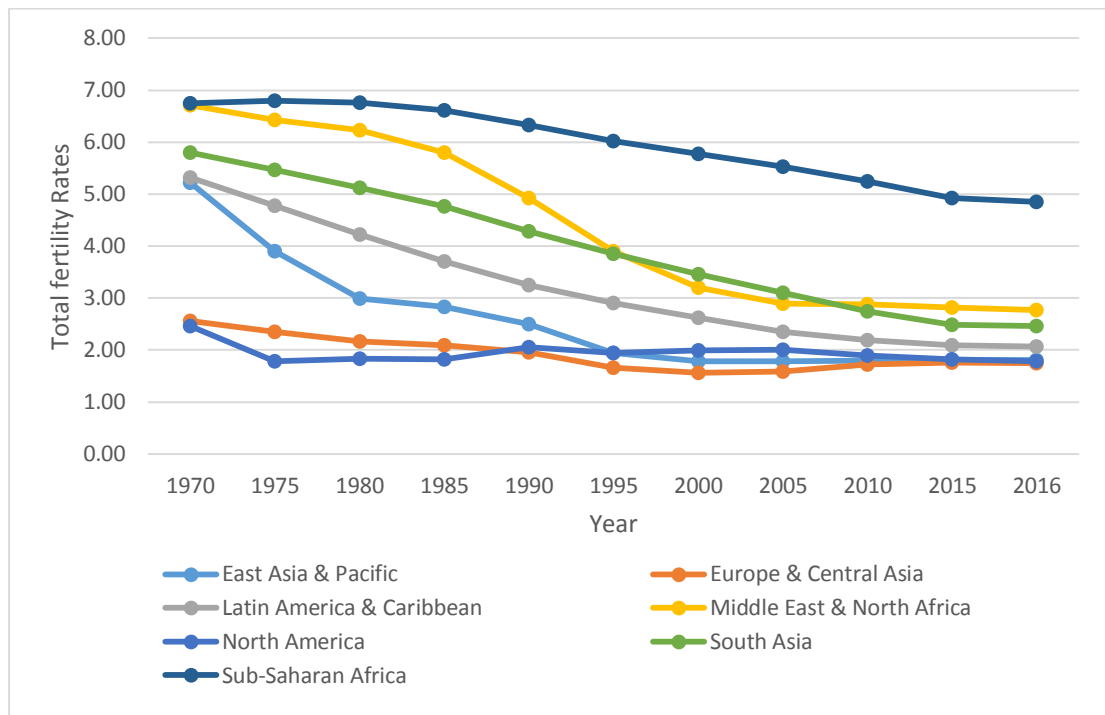
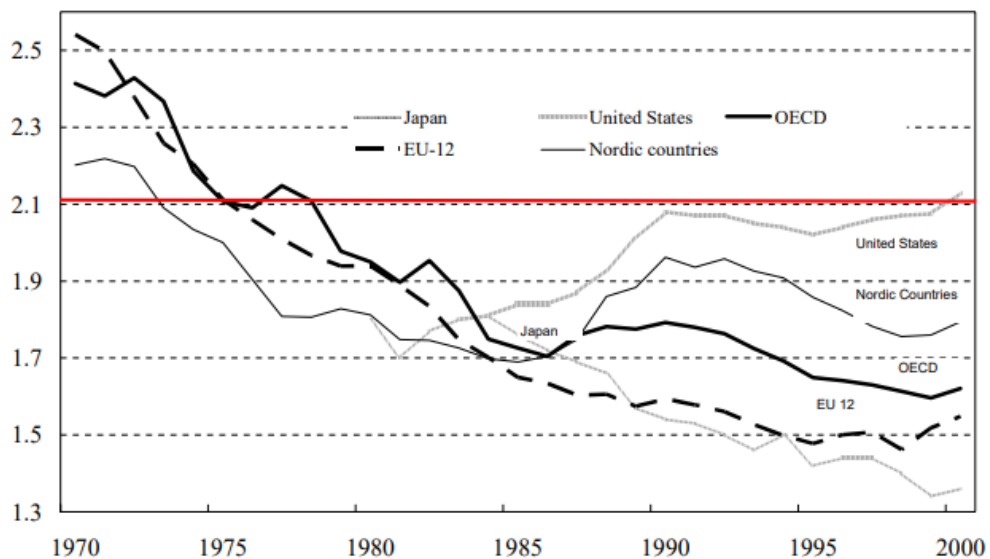


Figure 1.12 : Total Fertility rates across continents from the year 1970 – 2016
[Source: WDI (2019)]



Note. The horizontal line corresponds to the level of total fertility rates needed to assure a constant population.
Source: OECD (2002), *Society at a Glance. Social Indicators 2002*, Paris (www.oecd.org/els/social/indicators)

Figure 1.13 : Trends in Fertility Rates of OECD countries against others from year 1970-2001

[Reproduced from source: OECD (2013)]

In the last 30 years, OECD countries have experienced a decline in fertility rates, from 2.6 children per woman in 1970 to 1.6 children per woman in 2001. Based on Figure 1.13, it can be seen that from 1970 to 2000, the fertility trends of OECD countries against Japan, EU-12, Nordic countries and United States vary substantially. The fertility rates of all the selected countries were all above the replacement rates in 1970 before starting to decline. Sometime between 1983 and 1986, all the countries became homogenous, with fertility rates between 1.7 and 1.8, exhibiting a very small variance. The fertility rates for United States and Japan begin to diverge from the OECD countries after 1985, while Nordic countries and EU had a small deviation from the OECD fertility rates. Graphically, it can be seen that the fertility rates over the continents are converging towards a point eventually, but its validity must be preceded with empirical evidence.

1.3 Problem Statement

The decline in the world's fertility rates is staggering. Fifty years ago, the worldwide average for the number of children a woman would have was between 5 to 6, and now it stands at 2.5. At least half the world now is at below replacement rates, including Europe, East Asia, North America, parts of South America and Australia. In the developed countries, the fertility rates dropped precipitously from 2.8 children per woman in 1955 to only 1.7 children per woman today. In developing countries, fertility rates declined from 6 in the early 1950s to 2.6 in 2011. But a wide variation still exists. In sub-Saharan Africa, the total fertility rate is 5.2 but in China it has plummeted to 1.5. All the countries in the world had a fall in the total fertility rates, and it is distressing that not a single country which fell below the replacement rate has risen above it. The dramatic fall in the fertility rates has brought about the shift in the population age towards older populations (Curson, 2012; Blake and Mayhew, 2006).

In more developed countries, old people constitute 16% of the population and this is expected to increase to 26% by 2050 (Curson, 2012). Japan continues to have the oldest population in the world, with 23% of its population above the age of 65. European countries also face a similar situation, Germany, for example, has currently 21% of its population aged above 65 and this percentage is expected to increase to more than 33% by 2050. Many developing countries like South Korea are also experiencing unprecedented rates. China's population is rapidly moving towards the ageing group due to its steep fertility decline motivated by the "One Child Policy" in 1979. Problems arising from a booming ageing population as a result of the dramatic fall in fertility rates are among others, increase in the dependency ratios, shrinkage of the workforce, heavier tax on the working class, increase in government expenditure for healthcare and more (Straughan et al., 2008; Bloom, Canning and Sevilla, 2003; Feldstein, 2006).

In the recent years, the frequency and magnitude of disasters have increased. Almost every day, somewhere in the world, a country is faced with natural disaster and it is becoming more recurrent. Empirical studies linking disasters to fertility have emerged but almost all have concentrated on a particular disaster or a particular country (Finlay,

2009; Evans et al., 2010; Lin, 2010). Among the studies on the relationship between natural disaster and fertility rate, more attention was given to major disasters like the Red River Catastrophic Flood (Tong, Zotti and Hsia, 2011), earthquakes (Liu et al., 2010; Finlay, 2009), hurricanes (Evans et al., 2010) and many more. With respect to mortality, the deadliest disaster was the 2004 Indian Ocean Tsunami, which claimed 225 000 lives in the Southeast and South Asia countries, comprising Indonesia, Sri Lanka, India and Thailand. The fertility study on this disaster revealed that mothers who lost one or more child after the tsunami were significantly more likely to bear more children, which accounted for 13% of the aggregate increase in fertility (Nobles et al., 2015). Countries with higher growth rates have lower fertility (World Health Statistics, 2007) and this was seen in the G7 countries (Baerlocher, 2007). It was observed that the fertility rates among developing countries were negatively associated with the income (Wang, 2013). Thus the motivation of this study is to analyze the effects of natural disaster, regardless of the high and low risks on all countries based on three types of natural disasters. It is crucial to understand how differently each type of disaster, along with economic growth will affect the fertility patterns on a global context.

The concept of the number of children influencing the parent's quality of life has a great potential to explain fertility behaviors. Though important, the relationship has been inadequately studied. Analyses done in Europe suggest that fertility differences could partially explain the compatibility between well-being and the number of children (Billari, 2008). Does having more children cause parent's happiness to continuously elevate? Researchers suggest that the number of children and happiness may not have a linear relationship (Kravdal, 2014; Boushey, 2008). On the other hand, economics of happiness suggest that income, unemployment, social capital, health and institutional quality play a role in determining happiness without much emphasis on the fertility rates. Appreciating the determinants of happiness can guide policymaking in understanding the trade-off between institutional condition on happiness, so increasing transparency, accountability and social cohesion may be desirable from the point of view of increasing the quality of life (Frey and Stutzer, 2002). This study will address the gaps in the literature, with the hope of providing new evidences that we believe, would assist policy makers in their decision.

The trend where the fertility of every country has been declining, brings about the doubt if all of them are converging towards a similar fertility rate. These countries could share best practices and form standardized policies to aid them in rising above the similar issues faced. Convergence in fertility is still an area to be explored because low fertility seems to be a problem faced by all countries. Countries that are homogenous in the trend of fertility rates may need to work together to mitigate the greying population and counter other domino effects with immigration policies, standardized health policies and many more. Although shifting the focus to intra-country's convergence (Ariokiasamy and Goli, 2012) may seem favorable for certain researchers, the international convergence is still crucial especially to understand if countries are forming homogeneity in fertility while having natural disaster, economic growth and other components controlled for. The set of objectives for international

and intra-country convergence have different mitigation strategies. Thus, convergence in fertility with respect to the selected variables is deemed vital to be investigated.

Hence, this study intends to address the following questions:-

- Does natural disaster have a role in influencing fertility rates?
- Is there an empirical link between the quality of life and fertility rates?
- Does international convergence in fertility exist among countries with natural disaster and similar development level?

1.4 Objectives of the Study

The general objective of this study is to examine how different types of natural disaster affect fertility rates and the quality of life using different measures of natural disaster. This study embarks on the following specific objectives:

- i. To analyse the relationship between natural disaster and fertility rates.
- ii. To examine the impact of fertility rates on the quality of life.
- iii. To investigate the international convergence in fertility rates.

1.5 Significance of the Study

This study will provide a wider perspective on the impact of natural disaster on fertility rates and quality of life. In this study, we seek to analyze how different types of disaster affect fertility rates differently, using four different measurements for natural disaster. As suggested in previous studies, once the fertility rate falls below plateau, it is harder to spring back. Thus, in considering natural disasters as a crucial factor in determining the fall and rise of the fertility rate, proper policy has to be in place to ensure that the fertility rate does not fall below the desired level. Hence, the findings of this study is useful to policy makers to provide different types of prevention and mitigation plans while taking into consideration how different disasters, economic growth, education, urbanization, inflation, institutional variables and mortality affects fertility rates.

Natural disasters have a long term effect on fertility rates. Hence, distinct from other literature, this study will provide new insights on the delayed effect of different types of natural disasters on fertility rates. It is imperative to study these delayed effect as it will have a persistent effect on the population dynamics, as natural disaster are becoming more frequent and intense. It will provide policy makers the needed information to, either promote birth rates or prioritize the contraception availability, during a disaster response.

This study is also significant because it provides alternative options in testing the quality of life using Cantril ladder. Measuring the quality of life through surveys which requires people to subjectively state their well-being not only reinforces, but at times alters an understanding based on standard objective indicators. By examining the impact of fertility rates on the quality of life of people affected by natural disasters, this study hopes to shed light and provide recommendations for better policy making. Furthermore, this study intends to also answer the following questions: Does fertility rates continuously reduce the quality of life? Having this in mind, the study hopes to provide more insight by researching the impact of fertility-squared on the quality of life. Despite the existence of various studies on fertility, only a handful have investigated on the convergence in fertility. There is a lot of room for further investigation, as fertility rates are declining rapidly in many parts of the world and during this same period, the population growth of humanity has nearly doubled. This study hopes to contribute to the existing literature on fertility convergence by providing an elaborate understanding of the falling trend in fertility rates using innovative techniques, within countries that are susceptible to natural disasters.

In addition to that, understanding the mechanism of population projection through fertility convergence would enable countries to monitor demographic trends, health sector efficacy and other areas for long term policy goals. Countries with homogenous fertility patterns can share best practices, standardized migration policies and even conduct forums to debate issues that are similarly experienced. For example, knowing the fertility trend among countries could help the health sector to provide for the needs of the specific age groups, either focusing on retirement home for ageing population or first class child care for promoting the number of births. Hence, this study is carried out, with the hope of providing a platform for improved public policy making, as the insights gained from this study on the convergence in fertility will aid the government to rethink policies that are aimed at enhancing fertility rates.

1.6 Scope of the study

The study focuses on countries that have one or more incidences of natural disaster. The data for the study covers a period between 1975 and 2017, although variation in time is observed for each objective. The first objective of the study on the impact of natural disasters on fertility rates, will focus on countries that have one or more incidences of: 1) natural disaster 2) earthquake 3) flood and 4) landslide, with data from 1980 to 2014. The second objective (quality of life-fertility nexus) and the third objective (convergence in fertility) employs data from 2008 to 2017 and 1975 to 2014, respectively. The time period selected was based on the availability of the panel data from the countries that had at least one incidence of natural disaster.

1.7 Organisation of the Chapters

Chapter 1 provides an overview of the study, which includes background of the study, problem statement, research objectives, significance of the study and organization of the thesis. Chapter 2 reviews the theoretical and empirical literature that have been

carried out, related to the issues of this study. The review highlights major findings and contradictory information relating to natural disaster, fertility rate and quality of life. Chapter 3 provides detailed information about the methodology used, empirical model specification, estimation techniques and data description that this study intends to employ to fulfill the objectives. The findings of the estimation and discussion to these findings are provided in Chapter 4, while Chapter 5 draws conclusions, provide policy implications, highlights the limitation of the study and makes suggestions for future research.



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