Charles University in Prague

Faculty of Social Sciences
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MASTER THESIS

Family economics: Fertility rate and the pension motive

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Declaration of Authorship

I hereby declare that I compiled this thesis independently, using only the listed resources and literature.

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Prague, May 13, 2013

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Abstract

This work focuses on importance of pension motive for havin children in developed countries. It starts with discussion of conditions, under which old age security hypothesis is likely to hold. It continues with overview of demographic trends in selected developed countries and stresses the negative impact of long term fertility decline on pension systems sustainability and performance. In the next part of this thesis we use cluster analysis to compare pension systems in developed countries and the way developed countries deal with lack of human capital. Special attention is paid to comparison of Scandinavian social welfare state model with Southern European welfare state model and with group of three Asian Tigers.

JEL Classification	H55, J11, J13, J14, J26
Keywords	fertility, pension systems, family economics

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Abstrakt

Tato práce se zaměřuje na význam motivu úspor na stáří pro porodnost ve vyspělých zemích. Práce začíná diskuzí podmínek, za kterých by mohl mít motiv úspor na stáří významný dopad na porodnost. Práce pokračuje přehledem demografických trendů ve vybraných vyspělých zemích a upozorňuje na negativní dopady dlouhodobého poklesu porodnosti na udržitelnost a výkon penzijních systémů. V další části této práce používáme shlukovou analýzu ke srovnání penzijních systémů a způsobů, kterými se vyspělé země vypořádavají s nedostatkem lidského kapitálu. Zvláštní pozornost je věnována srovnání skandinávského modelu s jihoevropským modelem a skupinou třech asijských tygrů.

Klasifikace	H55, J11, J13, J14, J26
Klíčová slova	porodnost, penzijní systémy, ekonomie rodiny

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Master Thesis Proposal

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Proposed Topic:

Family economics: Fertility and the pension motive

Topic Characteristics:

My thesis will focus on the relation between fertility and institutional setting. Billari, Kohler and Myrskyla (2009) pointed out that more than half of the global population lives in areas with fertility rates insufficient to replace population. They focused on the relationship between the human fertility level and Human Development Index (HDI), and found out negative development-fertility relationship in HDI × Fertility space for 1975 data, and reversing development-fertility relationship in HDI × Fertility space for 2005 data. This observation suggests that fertility rates start to increase again as HDI, which combines life expectancy at birth, literacy rate, and wealth measured in GDP per capita into one index, reaches high levels above 0.9, while the development-fertility relationship remains negative for HDI below 0.9, which could be the possible turning point. However, not each country with HDI above 0.9 experienced increase in the human fertility level. Another question is, whether fertility rates increased back to replacement level. I would like to decompose the Human Development Index, and study the relationship between its particular components, total fertility rate and other variables that can contribute to the explanation of reversing fertility development.The neoclassical theory uses the cost-benefit analysis to determine the optimal fertility and the optimal size of a family. According to the neoclassical theory births occur if the present value of the benefits exceeds the present value of the costs associated with having children. This theory has been used to rationalize the well-known observation that population growth rates fall as countries attain high levels of GDP per capita. Economic considerations also imply that parents will have large families if they believe that they can benefit from it. In traditional societies parents invest into their children because they believe that their children will support them in the future. However, Caldwell (1976) argues that family sizes and the movement from high fertility rates to low fertility rates are determined by personal, social (rapid growth of individualism, direction of income flows, religious doctrines, moral codes, community customs…), and physiological reasons, rather than economic ones, although with economic consequences. One of these economic consequences of low

Hypotheses:

1. All components of HDI are statistically significant when explaining fertility.
2. Reversal in fertility decline is not large enough to prevent population decline.
3. Formation of pension systems does not necessarily lead to decline in fertility.

Methodology:

For the purposes of this thesis I need to define institutional setting, under which high fertility is economically rational and pension motive for having children is present. I would like to continue with description of recent fertility trends in selected countries and regions and with comprehensive cross-country analysis of relationship between fertility and development. Based on this analysis, I will identify two types of developed countries. The first one will represent countries, which attained high level of development and enjoy increasing fertility. The second one will represent countries, which attained high level of development but suffer from decreasing fertility. Then, I will discuss differences in the aforementioned institutional setting between these two types of countries.

Outline:

1. The Institution of the Family.
2. Fertility and Socioeconomic Development.
3. Old-Age Security Hypothesis.

Core Bibliography:

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Author

Supervisor

1 Introduction

So called pension system crisis is in fact demographic crisis. During the twentieth century total fertility rates in most developed countries had fallen below simple replacement rate and sharply changing population structures became major socioeconomic challenges. Introduction of generous pension systems and other extrafamilial welfare institutions providing old age security may contribute to the explanation of this unfavourable demographic development, since introduction of these institutions disconnects old age security motive from fertility behaviour.

Increases in social security contribution rates and retirement ages or introduction of additional pillars represent short term solutions only, because these solutions do not address the problem of decreasing human capital stock and focus just on raising real capital, where there is lack of the human one. There are basically two ways how to sustain population and keep the stock of human capital. The first option is to introduce fertility supporting measures and move total fertility rate at simple replacement level or above. The second option is to rely on extensive immigration from countries that do not face serious demographic problems.

This work represents an attempt to contribute with institutional analysis to the discussion over recent total fertility rate trends and their economic consequences in developed countries. It discusses the relevance of pension motive for fertility behaviour in developed countries and shows that the pension motive is not likely to be the main motive for having children in developed countries. After short introduction we move to the second chapter that introduces the concept of institution of family and defines ideal family types that can be recognized among developed countries. The third chapter provides reader with overview of total fertility rate trends in the sample of 30[1] most developed countries. Then, we focus on comparison of developed countries that manage to keep their total fertility rates on level close to 2.00 births per woman with those facing ongoing demographic crisis.

[1] According to 2011 human development index. We excluded from our analysis really small countries such as Luxembourg or Andorra.

The fourth chapter describes methodology and fourth sets of indicators that will be used to analyze social environment and old security policies in developed countries. The fifth chapter describes data. The sixth chapter present results obtained by the cluster analysis of the above mentioned four sets of indicators. The seventh chapter summarizes and interprets the results and concludes.

2 Basic notions

2.1 The institution of family

Let us begin with the definition of the institution of family, which was the provider of protection against poverty in old age in traditional societies. This subchapter offers two basic approaches to definition and description of the institution of family and discusses shortly suitability of concept of economic rationality for modeling optimal fertility decisions. We start with the sociological approach that stresses importance of the role of relationships among family members and focuses on trends in social behaviour to characterize the institution of family. In economics, family becomes an economic agent. Decision to have children is based on economically rational behaviour and can be modelled mathematically. Family is allowed to produce and consume various commodities ranging from laundering services to sperm and eggs.

Giddens (2009) defines family as a group of people who are directly linked by kinship connections. These connections can be formed either by marriage or by the lines of descent (blood relatives). From the sociological point of view we can recognize two basic types of families. The first type, which is typical for Western countries and other developed economies, is so called nuclear family, which consists of two adults and their dependent children living together in one housing unit. The second type is so called extended family, which includes more relatives than parents and their children living in one household or in close and continuing relationships. Then, Giddens adds six general trends, which are typical for todays families and complement previous definition of the institution of family based on kinship relationships. These trends are

1. Declining influence of tribes or clans.
2. Trend towards a free selection of spouse.
3. Trend towards greater recognition of women rights.
4. Trend towards less restricted sexual behaviour.
5. Trend towards extension of childrens' rights.

6. Trend towards greater acceptance of same-sex partnerships.

Moreover, we can observe another four characteristics, which are typical for nowadays Western countries families.

1. The modern family is monogamous. Its monogamous character is established by law and it is not legal to be married to more than one spouse.
2. Marriage is based on romantic love. This statement seems quite natural today, but Giddens argues that the idea of romantic love between partners come into existence in the late eighteenth century, but had not been present in previous times.
3. The family is patrilinear and neo-local. Neo-localism involves partners or married couple leaving their families and establishing a new independent household.
4. The modern family in Western countries is of a nuclear type. Parents live together with their dependent children in one housing unit, but do not form household or close relationships (extended family) with other family members.

Giddens refers to G. Therborn's research who lists three key elements that can be used to characterize the institution of family. These are the degree of male dominance within family, the importance of marriage for the sexual behaviour and control measures of fertility. He argues that the patriarchal power declined globally with significant differences accross particular countries and regions. In general, patriarchal power experienced greater changes in Europe and America than in Africa, Arab World or Asia. Its changes came with the growing participation of women in economic life and in the life outside the family.

The importance of marriage for sexual behaviour has undergone very similar development. In the developed countries the sexual behaviour and intimate relationships have become less restricted by the institution of marriage, religious boundaries or moral codes, while they have not experienced such noticable changes in developing countries and especially in Asia. Finally, the third factor characterizing the institution of family is the availability of effective fertility control measures and subsequent decline in the total fertility rate. We will show that the global total fertility rate had experienced significant decline in the twentieth century. On the other hand, its development across regions or at country specific level differed significantly. In most Western countries major changes in the total fertility rate had appeared at the

beginning of the twentieth century or even in the nineteenth century, while other economies such as Asian tigers experienced fundamental decline in total fertility rate in the second half of the twentieth century.

The institution of the firm and the institution of the family, Mlčoch (2007) argues, are separated from each other in modern economics. Mlčoch refers to Max Weber's and Josef Schumpeter's research and describes the social change of the institution of family in historical context. We already defined two basic sociological types of family – the nuclear family and the extended family. Mlčoch uses his own sorting and defines three key types of family, which are determined by the relationship between family and market.

The first type is family in traditional society, which is not typical for developed Western countries anymore. In this social setting family is independent of the market and its consumption behaviour is driven by consumption habits. The second type of family is the family in industrial society. Family becomes economically dependent on the market, which secures some basic goods and services, but it still faces hard budget constraint and the consumption behaviour is characterized by sovereignty of consumer. The last type is the family in late modernity. Family does not face hard budget constraint anymore and its consumption behaviour is driven by the market.

Mlčoch (2009) identifies two basic self-strengthening disintegrating forces eroding the institution of family. The first one is market, which tends to impose the utilitarian behaviour to relationships among people. Mlčoch argues that the market itself softens households' budget constraints by a system of various loans and other financial products that let consumers to keep their consumption at artificially high levels. In this sense consumer is not sovereign anymore and his sovereignty is just illusory. The second disintegrating force is social welfare state and its tendency to substitute the role of the family.

Let us note that the economic approach to the institution of family can work with terms such as utility function, marginal utility or income and substitution effects, and can be narrowed to pure mathematical modeling. Caldwell (1976), however, argues that not only economic factors but also social norms, customs, religion and health conditions play their role in fertility decision, which suggests that economic approach based on mathematical theorems and definitions might not be adequate. Given high death and infant mortality rates in pre-transitional societies, high fertility

was a rational response to health conditions and was needed to prevent dying out of population. Caldwell asks the question whether fertility decisions must be necessarily economically motivated and argues that the well-known term “economically rational” and the cost-benefit analysis of childbearing are just simplifications used to avoid inconvenient judging social rationality.

According to Caldwell, the key determinant of economic rationality is the social framework, which determines the direction of intergenerational flows of wealth. Fertility is economically rational if and only if parents benefit from the intergenerational flow of wealth. On the other hand, fertility can be socially rational at any time. Given the unfavourable development of permanently decreasing global total fertility rate, which will be described in detail in the next chapter, it might seem that high fertility is not economically rational anymore.

One possible explanation of the occurrence of decreasing fertility rates is the disappearance of the pension motive for having children, which was, Neher (1971) argues, main motive for having children in pre-transitional societies. The fundamental question is whether fertility must necessarily decline, when alternate sources of old age security are formed. Neher argues that if market and pension systems break the boundaries of the institution of family, having children induces high rearing costs but brings no old age support benefits. Note that the moment of breaking family boundaries marks the point, at which disintegration of family becomes harmful. One example of these harmful effects is precisely the interruption of linkage between pension motive for having children and decisions over fertility, since financial markets and mandatory pension systems contributions form an alternative to having children.

Moreover, Boldrin and Jones (2002) showed that increase in old age income, which does not depend on the number of children, promotes further fertility decline. Mlčoch (2007) and Billari and Kohler (2004) highlight the role of easily and legally available contraception and childcare sercvices, changing patterns in women's labour force participation and less restricted attitudes to marriage and extra-marrital births. Neher, however, doubts the role of contraception pills and its ability to cause significant decline in total fertility rate without major contribution of other factors and argues, that if parents strongly believe that they can benefit from having children they will simply decide to have children.

2.2 Ideal family types

Vast majority of developed countries is located in Western Europe or North America. We can find persisting social and economic institutional differences between these countries and based on these differences we can recognize several ideal family types. Billari, F. C. and Kohler, H. P. (2004) identified and described shortly four ideal family types, while Mlčoch, L. (2009) identified seven ideal family types. Note that these two above mentioned studies did not focus on developed countries located in othe areas than Europe or North America.

Our own cluster analysis will show that the social and possibly also the enabling economic environments in developed Asian countries are similar to those of the Southern European welfare states, while social and economic environments in Australia and New Zealand are not sharply specified and do not seem to belong to one of the four ideal family type model defined below. However, before we perform our own cluster analysis we pay some attention to above mentioned four ideal family types recognized among developed countries.

The first ideal type is the Scandinavian social welfare state model represented by Denmark, Finland, Norway and Sweden. This model is seemingly successful since it is characterized by combination of high female labour force participation ratio and relatively high total fertility rate. On the other hand it the Scandinavian social welfare state model is characterized by weak family ties, which results into high portion of extra marrital births and high total divorce rate, which are among the highest in the world.

The second ideal family model is the Continental conservative welfare state model represented for example by Germany and Austria. This model is characterized by combination of relatively high female labour force participation ratio and low total fertility rate that is much below the replacement level needed to replace population. This fact is quite frustrating in the light of relatively generous expenditures devoted to family policies. The word conservative suggests that this model is characterized by low portion of extra marrital births and low divorce rates.

The third ideal family model is the Southern European welfare state model represented by Greece, Italy and Spain. Southern European welfare state model is characterized by combination of low female labour force participation ratio and very low fertility rate. Also the governmental spending on family policies is low, since

family is perceived as an private autonomous institution, whose borders should not be broken by state. Family ties are strong and play important role and hence portion of extra marrital births and divorce rates are very low. The last model characterized by relatively high total fertility rate is the Liberal market state model represented for example by United States and United Kingdom.

The above mentioned four ideal family types models cover whole Western Europe and North America. Now let us look at the situation in developed Asian countries that will be covered in our sample. These countries are Hong Kong, Japan, Korea and Singapore. All of them are characterized by low or even lowest-low[2] total fertility rate and all of them exhibit low female labour force participation ratio. Also the social environments in these countries follow conservative values and hence these countries are characterized by very low portion of extra marrital births and very low divorce rates. Thus, it is quite natural to expect these countries to form clusters with Southern European welfare state model countries.

2.3 Pension motive

As we already mentioned the pension motive (or the old age security motive) was main motive for having children in traditional societies, where children were considered as an insurance or protection against poverty in old age and where no other more reliable means of asset accumulation were available. Thus, the protection against poverty in old age was provided by the institution of family. In developed countries, however, this protection against poverty in old age is provided to various extent by market or by state. In this setting children are not the principal security asset anymore and the institution of family is not important for old age security, since the necessary care and support is provided by extrafamilial institutions. The question is what happens if there are no extrafamilial welfare institutions providing care for the elderly.

Cain (1983) and Nugent (1985) argue that if there are no extrafamilial welfare institutions available, children have desirable properties as security assets and pension motive for fertility is strong. In total, Nugent identifies eight conditions under which pension motive for having children is important. The first condition

[2] Total fertiliy rate below 1.3.

assumes that there are no developed capital markets. In the absence of reliable means of assets accumulation children become necessary for protection against poverty in old age. The second condition, which is related to the first one, is the uncertainty about the accumulation necessary for the old age.

This uncertainty may be present even if the capital markets are well developed and free of all market imperfections (information asymmetry, adverse selection, etc.). The source of uncertainty is unknown date of death, because if this date is unknown, the exact quantity of assets needed to be accumulated is also unknown. The last condition of purely financial nature is the absence of efficient insurance programs. Common characteristic of all the three above mentioned conditions is that they are likely to be satisfied in developing countries or only in the rural areas of developing countries.

The fourth condition requires children to be loyal to their parents. Likelihood of fulfilment of this condition is connected with nature of the social environment rather than with the degree of economic development. However, we already showed that the traditional conservative family environment suffers from lowest low levels of total fertility rate, which contradicts the idea of positive relationship between fertility level and degree of loyalty of children to their parents.

Moreover, at the beginning of this chapter we defined the institution of family as the institution that is currently characterized by the declining influence of tribes and clans and by the trend towards less restricted sexual behaviour. These two current characteristics suggest that the traditional conservative environment is eroding. But is was precisely the conservative environment and the influence of tribes and clans that keep and enforce the loyalty of children to their parents and maintain this important cultural norm.

The next condition is the absence of nonstandard labour markets. The word nonstandard stands mainly for female or part-time. If there is enough (part-time) opportunities for women to get a job, this condition is not satisfied and pension motive for fertility may not play such an important role. But if we take into account some rural area in developing country characterized by almost no part-time employment opportunities for women, we will notice that pension motive for having children is strong. In this environment, women became dependent on their partners and on their children. Note that this theoretical suggestion somehow contradicts

empirical fact that in developed countries the total fertility rate is positively related to the female labour force participation ratio.

The possible explanation of this observation is that the whole set of conditions we are describing here is not likely to hold in developed countries. Thus, the general motivation for having children may be completely different. Most probably it is not driven by pension motive. Other explanation takes into account the opportunity costs connected with having children. If women who have children are able to rejoin workforce easily these opportunity costs will be lower, women will have more children and the total fertility rate will be higher than in countries where women excluded from the workforce for some time cannot rejoin this workforce without diffculties.

The next condition is the absence or bad availability of markets for goods and services demanded by the elderly. Again, this condition is likely to be satisfied in rural areas of developing countries. If this condition is satisfied, the presence of reliable and profitable means of assets accumulation is of no use, because financial resources cannot be used to buy goods or services and family becomes the principal provider of goods and services demanded by elderly. In this particular situation the pension motive for fertility may be strong, since the family is the only provider of goods and services demanded by the elderly.

Another condition is the absence of a young spouse who could take care for her partner, when he is old. Presence of such a spouse may reduce the need for children support. Let us note that is not always costless or even possible (due to societal rules) to marry much younger spouse. We identify two basic situations where this may happen. The first one is second marriage, the second one is polygyny. When we defined the institution of family we mentioned that legal framework in western countries does not allow anybody to be married to more than one spouse, so the second situation is definitely not the cause of low fertility in developed countries, since it is prohibited by law. Second marriage does not seem to be the cause of low fertility too.

The last condition is the perception of the relative importance of old age. If the old age is not considered to be an important part of human life then the protection against poverty in old age is not a serious problem. This is likely to happen when the life expectancy at birth is extremely low. It is apparent that the lowest life expectancy at birth is observed in the least developed countries. By contrast, the most developed

countries, especially the Asian one, exhibit relatively high life expectancy at birth and the old age or the age at which people do not work and require some kind of economic support from society represents significant part of human life.

Let us note that these conditions can be divided into two categories. The first category of conditions includes those conditions whose fulfilment is somehow related to the degree of the economic development, while the other category of conditions includes those whose fulfilment depends mainly on the social development. The first category of conditions is likely to be satisfied in developing countries or at least in rural areas of developing countries. Fulfilment of the second category of conditions, which includes loyalty of children to their parents and the absence of a younger spouse, does not depend on the degree of economic development.

We argue that the absence or presence of younger spouse does not play any role in developed countries. The loyalty of children to their parents is important cultural norm in some societies and is enforced and maintained. However, given current trends characterizing the institution of family, especially declining influence of tribes and clans and trend towards the extension of childrens' rights, loyalty of children to their parents may be eroding.

Finally, let us note that from the material point of view children are risky a costly investments. They can die before they enter workforce, suffer from some kind of disability or simply not to be able to earn enough money to support their parents. There are many other factors, which may lower their value. Among these are the eroding loyalty of children to their parents and the presence of public pension schemes and wide range of various public services, which allow people to keep adequate or acceptable living standard in old age without having children.

In that environment, there is no strong old age security motive for having children, since state is the principal provider of old age security. However, if we do not treat children as a commodity or an investment yielding benefits in old age, their value is significant. This concerns especially the quality and type of support that children are able to provide to their parents. The difference is apparent in comparison with assets such as land[3], money or precious metals, since none of these commodities is substitute for childrens' companionship.

[3] Moreover, in developing countries, large land holdings are worthless if there are no people (children) who can work on this land.

2.4 Children as net fiscal externality

One way how to deal with demographic crisis is to introduce pension motive for having children by creating pension system design that would reflect number of children that one has. If no such system is introduced, fertility decisions and old age security motive for having children are disconnected. Unfortunately this is quite common in developed countries. In this setting, pension systems relying on favourable demographic development do not represent the appropriate solution. On one hand, they rely on favourable demographic development. On the other hand, they do not relate fertility decisions to old age security.

Let us imagine we are living in a country with PAYGO system and no other family policies. Our country suffers from demographic crisis caused by long term decline in total fertility rate and need pension systém reform. In this country, each child that reaches working age and starts working makes contribution to this PAYGO system. The net present value of all contribution paid by this child represents fiscal externality. If we allow our country to pursue some family policies, this fiscal externality would be reduced by amount that equals public expenditures spend on family policies supporting fertility per child.

However, even if we substract these public expenditures, the resulting amount is likely to be positive. Thus, each additional child represents some net external effect. Sinn (1997) estimated this externality in Germany to be DM 175,000, which is not a negligible amount of money. How can the pension system design address this problem? There are basically three possibilities. The first one is to set tax deductions that equal the value of the additional in PAYGO system and internalize the externality. The second possibility is to introduce second pillar that would be mandatory for those who do not have children. The third solution is the combination of the previous two.

Obligatory funded system for those who do not have children raises real capital exactly where there is a lack of human capital. To put the issue as simply as possible childless people compensate the lack of human capital by making contributions to the second pillar. This means that people who have children contribute to pension system simply by having children and by making contributions to the first pillar, while childless people contribute to pension system by making

contributions not only to the first pillar, but also to the second pillar, which is mandatory for them.

Let us note that the introduction of mandatory second pillar only for people without children addresses the problem of justice, which is not addressed by pension system with unique design applying to everybody. Families with children and making contributions to the first pillar face two fiscal burdens. The first ones are child rearing related expenditures, the second ones are contributions paid to the second pillar. By contrast, childless people face just one burden – first pillar contributions.

If we introduce mandatory second pillar, the situation for families with children would become even worse. Then, these families would face three burdens. Costs connected with rearing children, contributions paid to the first pillar and contributions paid to the second pillar. On the other hand, childless families would face just two burdens. If we introduce tax deductions for families with children and funded system mandatory only for those without children the issue of justice would be partly solved.

3 Recent fertility trends in selected developed countries

3.1 Demographic transition

If I had to choose just one thing that characterizes global demographic development in developed countries in the last or even in the two last centuries, I would choose demographic transition. Demographic transition can be most easily described as a transition from high birth and death rates to low birth and death rates. This transition is accompanied by specific economic development and has two important consequences. The first one is the change in population structure. The second one is the increase in overall dependency ratios.

Demographic transition has several stages and timing of these particular stages differs significantly across various countries and geographical regions. Lee (2003) dates the beginning of the demographic transition in Europe back to the end of the nineteenth century and the beginning of the twentieth century (1890 – 1920) and to the twentieth century in the less developed regions. The initial stage of the demographic transition is characterized by a decline in death rates. Decline in death rates (mainly on the youngest ages) in the initial stage of the demographic transition is caused mostly by reductions in communicable diseases and famine mortality. This decline leads to an increase in child-dependency[4] ratio after the first stage.

The second stage of the demographic transition, which is currently estimated to last between 40 and 50 years, is characterized by reduction in fertility rates. Combination of consequences of the first and the second stage of the demographic transition leads to temporary decrease in overall dependency ratio, since decline in fertility in the second stage decreases the child dependency ratio back to lower levels and the growth rate of the workforce is greater than the growth of population. The last stage of demographic transition is characterized by increased longevity, which

[4] Ratio of people below 15 years to people aged 15 – 64.

leads inevitably to population ageing and increases in both old age dependency[5] ratio and overall dependency ratio[6].

As Figure 3.1 shows, there were significant differences in total fertility rates across geographical regions in the end of the twentieth century. In 1980 the total fertility rate was already low in Western countries, while the global total fertility rate and the total fertility rate in the Arab World[7] were still relatively high at that time. However, total fertility rates in Arabic countries fell faster than world's population weighted total fertility rate. We can see that the global total fertility rate and the total fertility rate in Arab World had been relatively high and fairly above the replacement level in 1980 but continued to fall as Arab countries and the global economy advanced to higher levels of economic development.

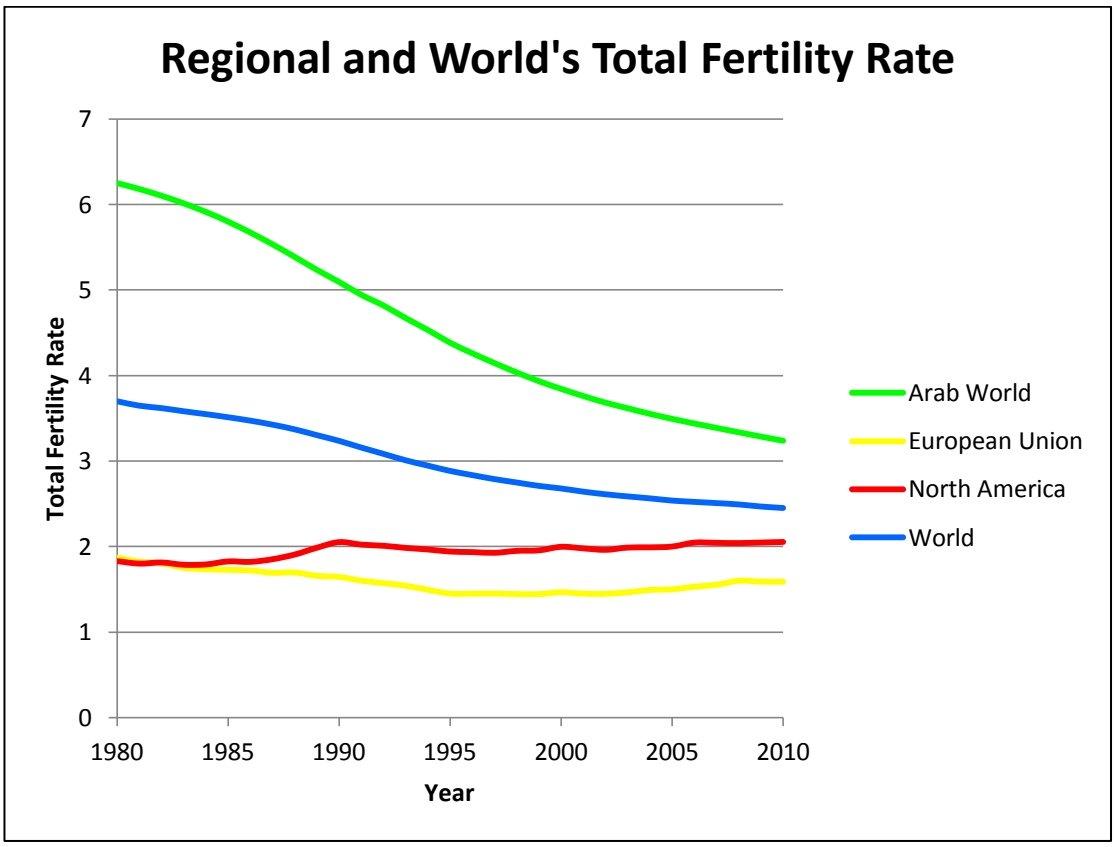

Figure 3.1: Global and regional total fertility rates during the period 1980-2010.
Source: World Bank, http://worldbank.org

[5] Ratio of people aged 65+ to people aged 15 – 64.
[6] Overall dependency ratio is given as a sum of child dependency ratio and old dependency ratio.
[7] 22 Territories including 21 sovereign Arab states and Occupied Palestinian territories.

On the other hand, total fertility rates in the North America and in the European Union, the most developed regions in the world at that time, were already below replacement level in 1980. However, these total fertility rates did not experience the same development in the last thirty years. In 1980, the total fertility rate in the European Union was 1.87, while in the North America it was 1.83. Since 1982, the total fertility rate in the North America remained higher than the total fertility rate in the European Union and ended at 2.06[8] in 2010. The total fertility rate in the European Union fall until 1995 and then remained within very narrow range 1.44 – 1.46 between years 1996 – 2003. At the end of the sample period it experienced some increases, mainly thanks to favourable development in Scandinavian countries, and ended at 1.59 in 2010.

The world's total fertility rate dropped from 3.70 in 1980 to 2.45 in 2010, which corresponds approximately to 1.3% decrease per year. Also the total fertility rate in the Arab world faced rapid and permanent decrease between 1980 and 2010 and fell from 6.25 to 3.24 (approximately 2.1% decrease per year). Note that the total fertility rate in the Arab world is relatively high but it does not reflect differences between particular states. Even in the Arab world, there are countries with fertility rates close to replacement level 2.1. These countries are Qatar (2.23 in 2010), Kuwait (2.30 in 2010), Oman (2.24 in 2010), and Algeria (2.22 in 2010).

Then there are two Arab countries with total fertility rates below the replacement level. These countries are the United Arab Emirates (1.75 in 2010) and Lebanon (1.78 in 2010). At the other end of the sample as measured by 2010 total fertility rates there are Jordan (3.80 in 2010), Iraq (4.70 in 2010) and Yemen (5.09 in 2010) with fertility rates that are much higher than the population weighted average total fertility rate in the Arab world (3.24 in 2010).

3.2 Total fertility rate and human development

Let us continue with closer description of the relationship between total fertility rate and development measured by the human development index (HDI)[9].

[8] Let us note that the total fertility rate in the North America is population weighted average of the total fertility rates in the United States (2.1 in 2010) and in Canada (1.68 in 2010). Thus, the total fertility rate in the United States has approximately 10 times greater impact on the total fertility rate in the North America than the total fertility rate in Canada

[9] Definition and technical notes are available at http://hdr.undp.org/en/statistics/hdi/

Human development index is a single dimensional index, which combines a country's achievements in health, wealth and education (three particular subindices). Human development index is published by the United Nations Development Programme (UNDP) and serves as a basic indicator of human development.

The methodology for human development index computation was changed in year 2010[10]. In general, change of the methodology lead to decrease in human development index. Current human development index is no longer based on arithmetic mean, which is probably the most important difference between current and previous human development index. This means that low achievement in any of the three dimensions cannot be linearly compensated by high achievement in either of the two other dimensions. Education was previously measured by a combination of school enrollment rates and adult literacy rate, which does not hold anymore. Wealth was previously measured in GDP per capita (PPP $). The process of calculation of human development index can be divided into two basic steps.

Firstly, we need to compute the three particular dimension subindices. Secondly, we need to compute the geometric mean of the three subindices in order to get a single index. To be able to create respective subindices, we need to know minimum and maximum values of each dimension. Maximums are defined as the highest observed values troughout the period 1980 - 2011 and minimums are set at subsistence (life expectancy at birth below the age of reproduction, GNI[11]) or minimum possible (mean years of schooling, expected years of schooling, combined education index) levels.

Health is measured by life expectancy at birth. Education is determined by combination of mean years of schooling and expected years of schooling. Wealth, which is the only human development index component that measures country's economic performance, is measured in GNI per capita (PPP $). Maximum and minimum values, which were used for the calculation of the human development index in the year 2011 are summarized in the following table:

[10] For more details see Frequently Asked Questions (FAQs) about the Human Development Index (HDI), available at: http://hdr.undp.org/en/media/FAQs_2011_HDI.pdf

[11] Society with life expectancy at birth below the age of reproduction (20 years) would die out. GNI per capita at PPP $ 100 is lower than the lowest observed value and thus considered to be the minimum possible value.

Dimension	Observed maximum	Minimum
Life expectancy at birth	83.4	20.0
Mean years of schooling	13.1	0
Expected years of schooling	18.0	0
Combined education index	0.978	0
Per capita income (PPP $)	107,721	100

Table 3.1: Maximum and minimum values for human development index subindices. *Source: United Nations Development Programme (UNDP)*

With this values we are able to compute subindices for particular country by using the following formula:

$$Dimension\ index = \frac{actual\ value - minimum\ value}{maximum\ value - minimum\ value}$$

$Education\ index$

$$= \frac{\sqrt{mean\ years\ of\ schooling\ index \cdot expected\ years\ of\ schooling\ index - minimum\ value}}{maximum\ value - minimum\ value}$$

Human development index is given as geometric mean of the three equally weighted dimension indices:

$$HDI = \sqrt[3]{I_{Life} \cdot I_{Education} \cdot I_{Income}}$$

Billari, Kohler, and Myrskyla (2009) documented reversing relationship between development measured by the human development index and the total fertility rate. They collected data for years 1975-2005 and described cross-country relationship between total fertility rate and human development index.

This relationship changes from negative to positive as countries attain high levels of development. They found that once countries had attained levels higher than 0.86, this relationship changed to a positive one. However, as we will se later from data on total fertility rates in developed countries, the reversal in fertility development relationship is not strong enough to push total fertility rates above

replacement levels (2.1). Note that no country attained human development index level above 0.9 in 1975.

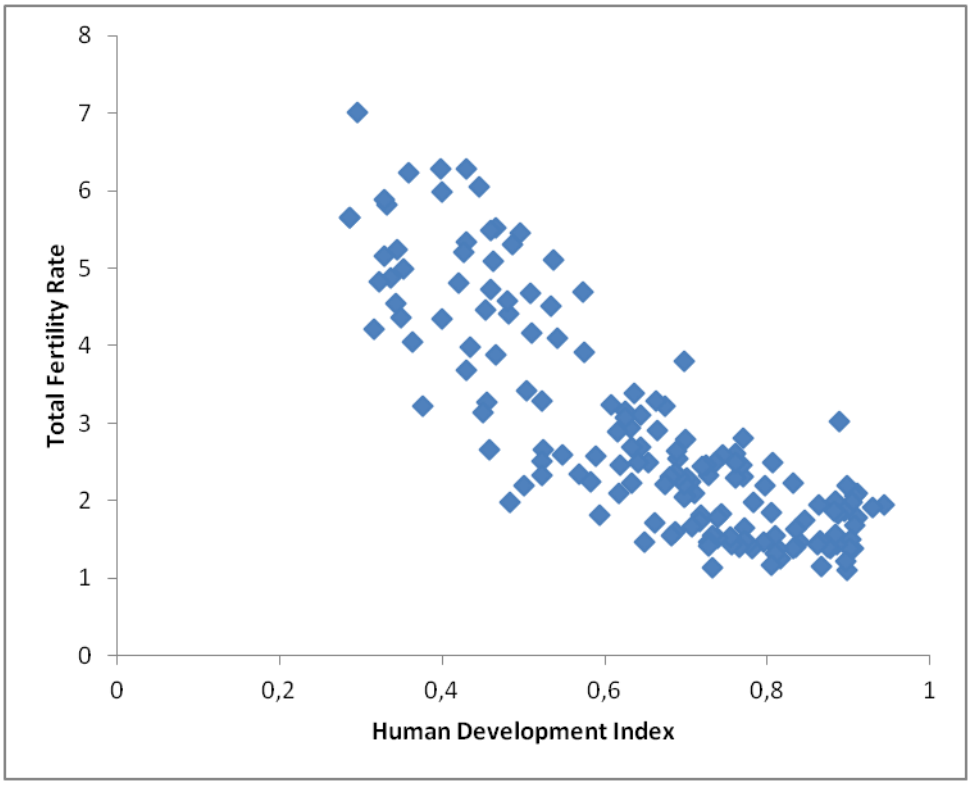

Figure 3.2: Human development index and total fertility rate in 2011
Source: United Nations Development Programme (UNDP)

Figure 3.2 shows the human development index × total fertility rate space in 165 countries in 2011. 2011 human development index ranges from 0.943 in Norway to 0.286 in Democratic Republic of the Congo. Highest fertility was observed in Niger with total fertility rate 7.01, that was the only country in the world with fertility above 7.00. The lowest fertility was in Hong Kong with total fertility rate 1.108 followed by Singapore with 1.15. In order to describe this relationship in a more elaborate way we will estimate the following model:

$$TFR_i = \beta_0 + \beta_1 \cdot HDI_i + \varepsilon_i$$

	Estimate	**st. error**	***p*-value**
(Intercept)	7.24445	0.23264	1.62e-070 ***
HDI	-6.72472	0.34334	1.10e-044 ***

R-squared: 0.70181

Based on this estimate all explanatory variables seem to be statistically significant and sign of β_1 supports the idea of negative relationship between total fertility rate and human development index. With this model we are able to explain 70% of variance. The second model uses all the three particular subindices that form human development index as explanatory variables.

$$TFR_i = \beta_0 + \beta_1 \cdot Education_i + \beta_2 \cdot Health_i + \beta_3 \cdot Income_i + \varepsilon_i$$

	Estimate	**st. error**	***p*-value**
(Intercept)	8.20374	0.29856	1.13e-062 ***
Education	-2.10366	0.52293	8.82e-05 ***
Health	-4.78465	0.65907	1.56e-011 ***
Income	-0.549112	0.60898	0.3686

R-squared: 0.736143

In this model the income dimension is not statistically significant explanatory variable and the model should be reduced to

$$TFR_i = \beta_0 + \beta_1 \cdot Education_i + \beta_2 \cdot Health_i + \ + \varepsilon_i$$

	Estimate	**st. error**	***p*-value**
(Intercept)	8.25183	0.29359	3.45e-064 ***
Education	-2.34317	0.45018	5.81e-07 ***
Health	-5.06580	0.58031	3.00e-015 ***

R-squared: 0.73481

Now, we focus on highly developed countries only. We take into account the sample of 30 most developed countries according to 2011 Human Development Index ranking and estimate few models describing the relationship between total

fertility rate and development. The first model uses human development index as explanatory variable.

$$TFR_i = \beta_0 + \beta_1 \cdot HDI_i + \varepsilon_i$$

	Estimate	**st. error**	***p*-value**
(Intercept)	-1.93726	2.56511	0.4563
HDI	4.11908	2.88604	0.1646

R-squared: 0.06782

Estimate of coefficient β_1 is positive for this sample but not statistically significant. Also the estimate of β_0 is not statistically significant and amount of explained variance is very low. Moreover, Billari, Kohler, and Myrskyla also point out that their empirical analysis does not explain the causes of continuing decrease in total fertility rates in countries, which attain high levels of development (they named examples of Japan and Korea), and that we should turn our attention to institutional factors. This is the basic motivation for the next chapter and basically for the rest of this thesis. But first, we need to identify countries, which experience similar economic development but different development in fertility rates.

Table 3.2 shows the list of development characteristics for the sample of 30 most developed countries. The population weighted average human development index of this sample is 0.897 and the population weighted average total fertility rate is 1.744. For top 10 ranked countries these figures change significantly. The population weighted average human development index of the first ten countries is 0.910 and the population weighted average total fertility rate in these countries is 1.918. If we took into account just the top 5 countries, the population weighted average human development index would be 0.912 and the population weighted average total fertility rate would be 2.073, which is almost the replacement level.

Note that these figures change, if the computed average is not based on the population size of particular country. If each country was assigned equal weight, the average human development index and the average total fertility rate in the whole sample would be respectively 0.888 and 1.722. For top 10 countries we would obtain 0.913 and 1.848, and 0.920 and 1.972 for top 5 countries. However, regardless of the method our observation still suggests that there might be positive relationship

between human development measured by human development index and the total fertility rate in countries that attain high levels of development.

Ranking	Country	HDI	Education	Health	Income	TFR
1	Norway	0.943	0.985	0.964	0.883	1.95
2	Australia	0.929	0.981	0.976	0.837	1.92
3	Netherlands	0.91	0.931	0.958	0.845	1.79
4	United States	0.91	0.939	0.923	0.869	2.1
5	New Zealand	0.908	1	0.957	0.783	2.1
6	Canada	0.908	0.927	0.962	0.84	1.677
7	Ireland	0.908	0.963	0.955	0.814	2.07
8	Germany	0.905	0.928	0.953	0.838	1.39
9	Sweden	0.904	0.904	0.969	0.842	1.98
10	Switzerland	0.903	0.878	0.983	0.858	1.5
11	Japan	0.901	0.883	1	0.827	1.39
12	Hong Kong	0.898	0.837	0.99	0.874	1.108
13	Iceland	0.898	0.912	0.975	0.814	2.2
14	Korea	0.897	0.934	0.956	0.808	1.22
15	Denmark	0.895	0.924	0.928	0.836	1.87
16	Israel	0.888	0.907	0.972	0.796	3.03
17	Belgium	0.886	0.882	0.947	0.832	1.84
18	Austria	0.885	0.858	0.96	0.842	1.44
19	France	0.884	0.87	0.971	0.819	2
20	Slovenia	0.884	0.933	0.936	0.79	1.57
21	Finland	0.882	0.877	0.946	0.828	1.87
22	Spain	0.878	0.874	0.969	0.799	1.39
23	Italy	0.874	0.856	0.976	0.799	1.4
24	Singapore	0.866	0.751	0.964	0.897	1.15
25	Czech Republic	0.865	0.924	0.91	0.769	1.49
26	United Kingdom	0.863	0.815	0.949	0.832	1.94
27	Greece	0.861	0.861	0.945	0.783	1.44
28	United Arab Emirates	0.846	0.741	0.892	0.916	1.749
29	Cyprus	0.84	0.798	0.94	0.79	1.468
30	Estonia	0.835	0.916	0.865	0.734	1.63

Table 3.2: The first thirty[12] countries in 2011 ranked by human development index

Source: United Nations Development Programme (UNDP)

[12] We excluded small countries such as Andorra and Luxembourg.

Total Fertility Rate	# of
2.00<	5
1.76 – 2.00	9
1.51 – 1.75	4
1.26 – 1.50	9
<1.25	3

Table 3.3: Distribution of the total fertility rate among 30 most developed countries
Source: United Nations Development Programme (UNDP)

Table 3.3 complements Table 3.2 and shows the distribution of the total fertility rate among the sample of 30 most developed countries. Note that all the three countries with lowest fertility[13] are from Southeast Asia. These countries are Korea (1.22 in 2011), Singapore (1.15 in 2011) and Hong Kong (1.108 in 2011). Another interesting observation is that 4 out of 9 countries with the total fertility rate within the range 1.76 – 2.00 are Scandinavian countries. Most of the countries with total fertility rate within the range 1.26 – 2.00 are geographically located in Europe, since majority of the most developed countries are European countries (except Australia, Japan and United Arab Emirates). Geographical location of countries with the total fertility rate above 2.00 (United States of America, New Zealand, Ireland, Iceland, Israel) is quite heterogeneous.

[13] Total fertility rate below 1.3 is sometimes called lowest-low total fertility rate.

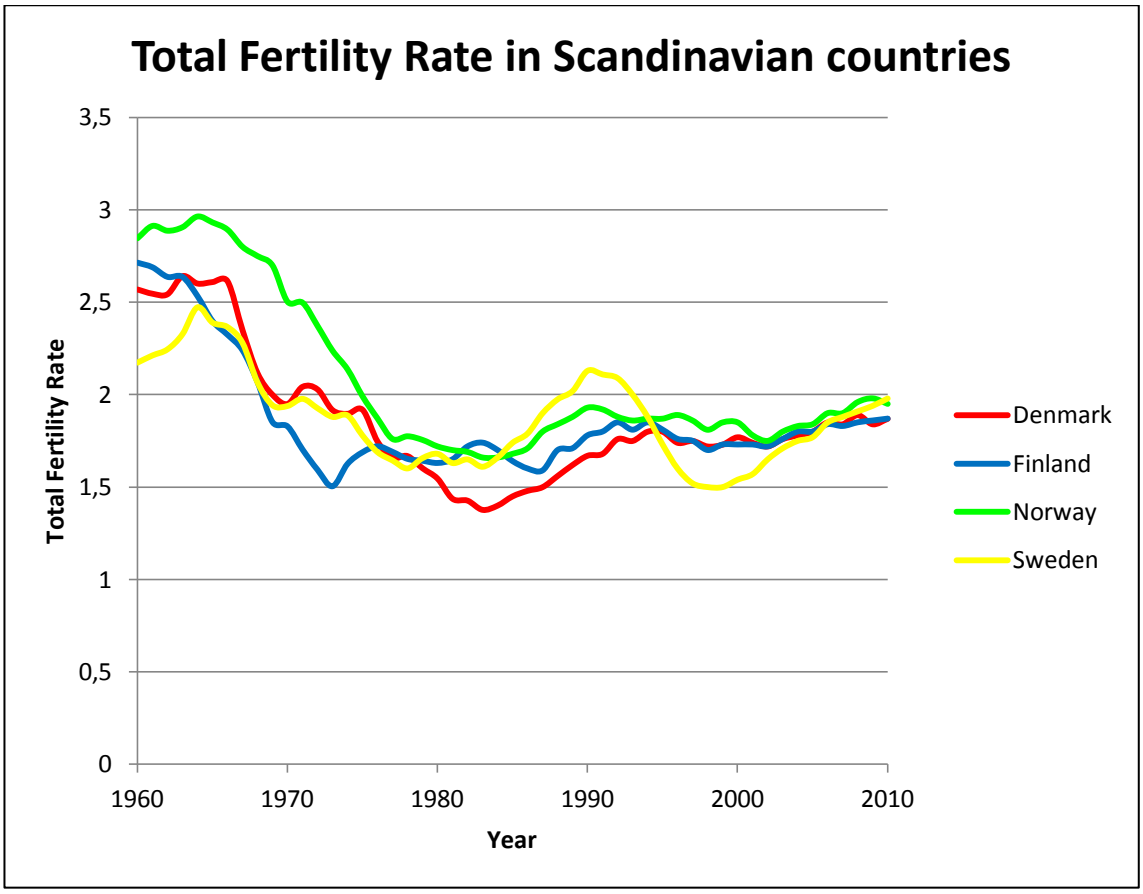

Figure 3.3: Total fertility rate development in Scandinavian countries
Source: World Bank, http://worldbank.org

Figure 3.3 shows development of the total fertility rate in the Scandinavian countries between years 1960 and 2010. It averaged to 2.51 in 1960 and then all Scandinavian countries except Sweden experienced declines in their total fertility rates. Total fertility rates in Denmark, Finland and Norway attained their minimum in 1983, 1973, and 1983, respectively. The total fertility rate development in Sweden was little more complicated than in other Scandinavian countries. Its observed minimum throughout the period 1960-2010 is 1.50 in 1998. Since 1983, the population weighted average fertility rate in Scandinavian countries has been permanently increasing to 1.93 in 2010. This value is below the simple replacement rate necessary to replace population, but allows Scandinavian countries to sustain their population and avoid demographic crisis without excessive immigration.

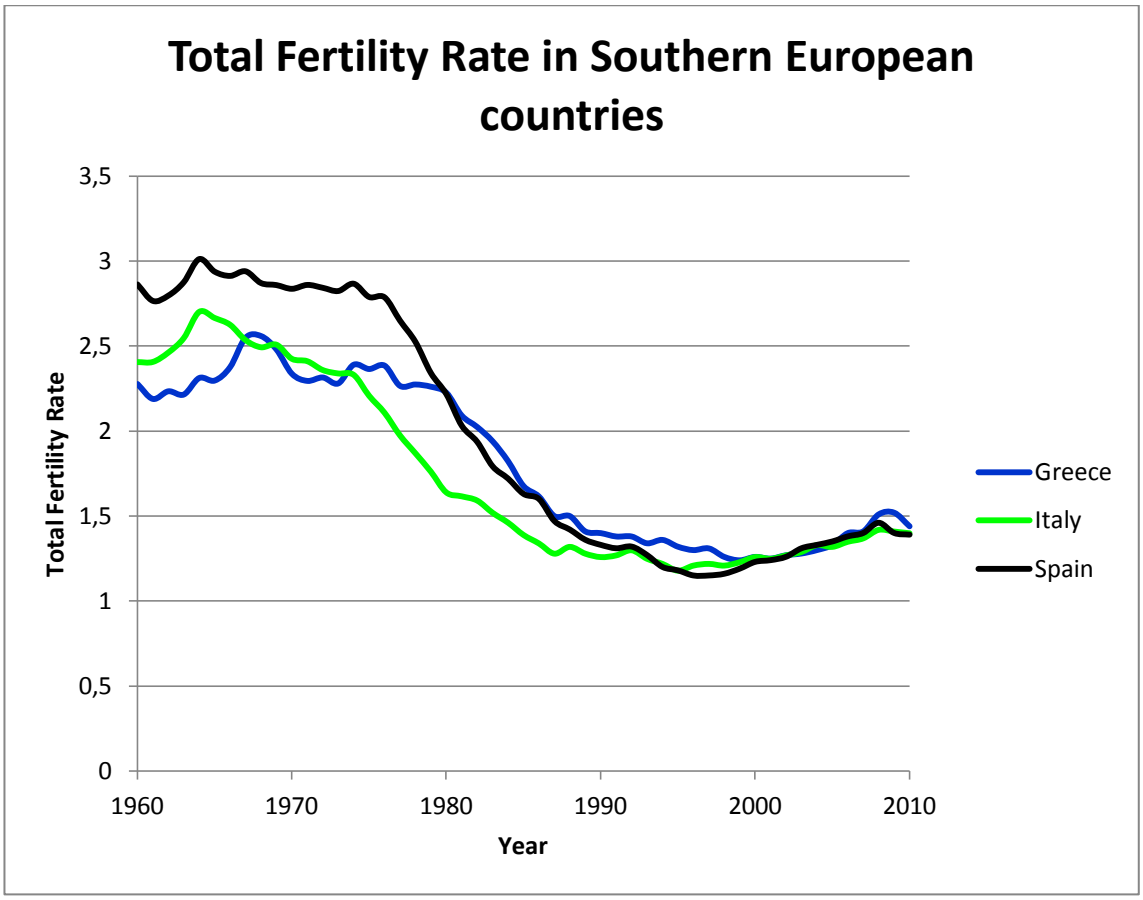

Figure 3.4: Total fertility rate in Southern European countries
Source: World Bank, http://worldbank.org

Figure 3.4 shows development of the total fertility rate in three Southern European countries. Among European countries, Greece, Italy and Spain are those most seriously hit by demographic crisis. In 1960, total fertility rates in all three countries were above the replacement level and experienced increases in late 1960s or in the beginning of 1970s in the case of Greece. These light increases were followed in all three countries decreases that lasted till 1998, when the average total fertility rate in these three Southern European countries was just 1.21.

Note that there had been large differences in total fertility rates among these Southern European countries in 1960, but then the total fertility rates started to converge to each other. Finally at the end of the sample period each country experienced increase in total fertility rate. However, the average total fertility rate in 2010 was 1.41, which is still much below the simple replacement rate.

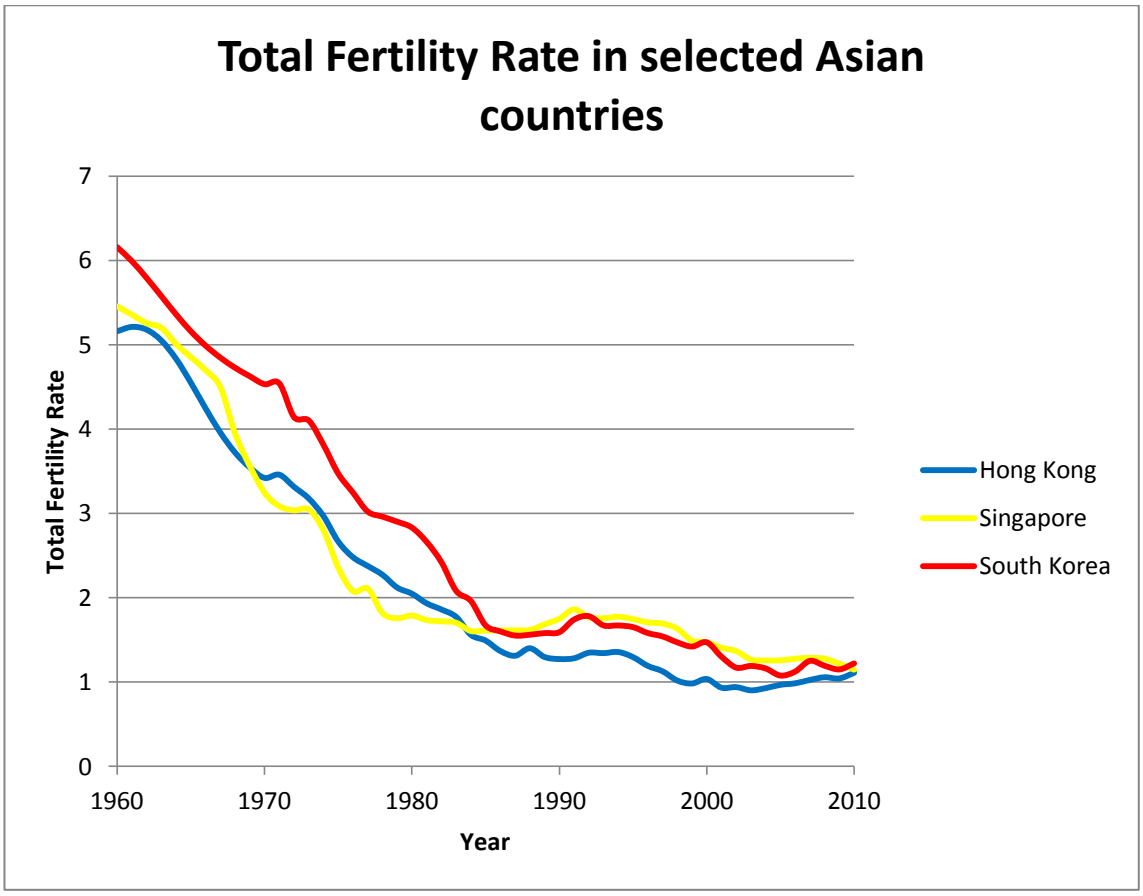

Figure 3.5: Total fertility rate development in selected Asian countries[14]
Source: World Bank, http://worldbank.org

Developed Asian countries, however, did not experience the same development of the total fertility rate as the Scandinavian countries. Figure 3.5 shows the development of the total fertility rate in Hong Kong, Singapore and South Korea between years 1960 and 2010. In 1960, total fertility rates in Hong Kong, Singapore and South Korea had been higher very high, but then they started to fall rapidly, which suggests that demographic transition appeared in Southeast Asia, and ended much below the rate needed to replace population. Currently, Hong Kong has the lowest total fertility rate in the world – only 1.108 births per woman. In 1999 and throughout the period 2001-2006 its total fertility rate was lower than one.

[14] All of these countries are so called Asian Tigers. The remaining Asian Tiger that is not listed is Taiwan.

4 Methodology

4.1 Cluster analysis

Cluster analysis is one of many methods of multivariate statistical analysis. This method creates clusters of multivariate data objects with similar properties. The resulting clusters should be different, but objects within one particular cluster are required to be similar to each other. The whole process of building clusters from multivariate data objects can be divided into two basic steps. In the first step we need to choose suitable proximity measure to measure similarity homogeneity of particular data objects. In the second step we need to choose clustering algorithm to form clusters from objects from our sample.

The similarity or dissimilarity among particular data objects is described by matrix *D*. Elements of this matrix may be distances that measure dissimilarity or proximity measures that measure similarity. The choice of the right proximity (distance) measure depends heavily on the nature of the data objects we work with. We can have two basic types of data objects. The first ones are multivariate data objects consisting of binary variables, the second ones are multivariate data objects consisting of continuous variables. Since we work with the second type of data we do not present here description of proximity measures suitable for data objects with binary variables.

Matrix *D*, whose elements d_{ij} measure the distance between objects x_i and x_j , can be generated by so called L_r norms, $r \geq 1$, where

$$d_{ij} = \|x_i - x_j\|_r = \left\{ \sum_{k=1}^{n} |x_{ik} - x_{jk}|^r \right\}^{1/r}$$

There is one condition, which we need to fulfil to be able to work with distances generated by L_r norms. This condition requires us to work with variables that are measured on the same scale. Of course, this is not our, case since we will work with variables such us total fertility rate (measured in births per women), statutory

retirement age (years) or labour force participation (ratio of those who are working to the whole population) and hence we need to apply standardization before we compute particular distances. For $r = 1$, we obtain so called Manhattan distance or Manhattan length, which we use in this work. This distance measure is basically the sum of absolute values of differences between x_{ik} and x_{jk} for $j \in \{1,...,n\}$.

Once we decide which distance measure to use, we need to decide how to form clusters. There are two basic clustering algorithms. The first one is so called hierarchical algorithm, the second one is so called partioning algorithm. In this work we work with hierarchical algorithm and hence we do not introduce here the second clustering technique. Hierarchical clustering can be done either by agglomerative procedure or splitting procedure.

Agglomerative procedure starts in the situation, where each object represents one cluster, and then forms groups from these small clusters and continues until just one large cluster, that contains all objects, remains. The splitting procedure does clustering exactly in the opposite way. It starts in the situation, where there is just one large cluster that contains all objects, which is the situation, where the previous method finishes, and then splits this cluster into smaller ones and continues until each cluster contains just one object.

In this work we utilize the agglomerative procedure. Thus, we start in situation where each country forms cluster and then form larger clusters from these countries. It remains two answer two questions. How we link already existing clusters and how we determine the right number of clusters (i.e. where we stop forming larger and larger clusters). There are many methods to link existing clusters and form larger ones. Here we use the Ward method which aims at minimizing variance within the newly formed cluster. It is more difficult to answer the second question, since there is no clear rule that determines right or wrong number of clusters.

To guess the right number of clusters we will start with the visual inspection of resulting dendrograms and cut these dendrograms at some reasonable (based on the visual inspection) level. Then we will provide the basic descriptive statistics of resulting clusters characteristics and economic interpretation of differences among adjacent clusters. If the descriptive statistics of the neighbouring clusters are similar to each other or if we do not find easily any clear characteristic that distinguishes two neighbouring clusters we will use two sample t-test to test whether there is statistically significant difference between these two clusters.

4.2 Conceptual framework

We start with study of social environments and then we follow World Bank (2008) and Pallares-Miralles, M., Romero, C. and Whitehouse, E. (2012), who described pension conceptual framework. Social environment imposes restrictions on feasible family policies that may undertaken by government. Developed Southern European welfare states and also developed Asian countries will prove to be very conservative and will not accept family policies breaking the autonomy of the institution of family. On the other hand, this will not be truth in countries with liberal social environments, where extensive family policies reducing child rearing costs are feasible.

These family policies include not only tax deductions and various child allowances, but also obligation for men to leave a job and spend some time at home with children or high wage replacement rates, which reduce women's opportunity costs connected with rearing children. Here we need to notice that it is not likely that men in conservative countries such as Italy or Singapore[15] will leave their jobs and spend their time at home with children. Moreover, for some cultures or religious groups childcare services and other arrangements of extrafamilial welfare institutions breaking the autonomy of the institution of family are considered to be immoral. Hence we conclude that the set of feasible family policies is determined by the nature of the social environment in particular country.

After we show that we can recognize several statistically significantly different social environments among developed countries we move to the analysis of three sets of indicators defined by the World Bank. The first set of indicators describes enabling environment, in which pension system operates. The enabling environment is characterized by set of demographic, labour market and fiscal indicators. In this work we focus on demographic and labour market indicators only.

Decreasing total fertility rates lead to lower number of people entering labour market and contribute to pension system scheme, while increasing live expectancies increase periods, for which pensions are paid. Combination of low and further decreasing fertility rates and increasing live expectancies suggests that old

[15] Here we can name any Southern European or developed Asian country.

dependency ration will not decrease in the future unless the retirement statutory ages are increased. All pension systems based on the contribution schemes paid by working age population are exposed to this demographic risk and will face substantial fiscal problems challenging their fiscal sustainability unless the unfavourable demographic development changes.

The second set of indicators describes pension system design. Pension system design may be very complex, thus we make few simplificantions and focus only on some key characteristics. World Bank recognizes five pension system pillars. These are the zero non contributory pillar, the first mandatory pillar based on contribution paid by working population, mandatory second pillar based on saving and voluntary third and fourth pillars, where the first one is based on voluntary saving and the later one on non financial assets such as children providing old age support.

Another classification of pension systems may be based on the form of the benefit promise, benefit financing or pension system management. Considering the form of the benefit promise, we can have either defined benefit, defined contribution or hybrid system, benefit financing can be based on Pay-As-You-Go basis or can be fully funded and pension system can be managed either by private or public institutions.

Indicators we are especially interested in are contribution rates and qualifying parametres. Qualifying parameters basically set the age, at which one become eligible for retirement. Contribution rates define the portion of earnings that are used to finance pension system. Usually these contributions are paid by both, employee and employer, and represent the basic pension system revenue. For the purposes of the cluster analysis we sum all social security programs contributions paid by employee and all social security programs contributions paid by employer.

The third set of indicators describes pension system performance. Here we focus on coverage, fiscal sustainability and net replacement rates. We work with two active coverage measures. The first active coverage ratio is given as the ratio of total number of current contributors to total number of labour force and the second active coverage ratio is given as the ratio of total number of current contributors to size of working age population. As the old age dependency ratio increases fiscal sustainability of pension systems became serious economic challenge.

We use pension spending as a share of GDP to measure the financial burden imposed by pension systems. Developed countries are those spending by far the

largest share of their GDP on pensions. We need to note that the system, where the number of workers who pay contribution to pension schemes grows at rate lower than the rate of growth of total number of pension system beneficiaries system will not be financially sustainable. This means that even systems, which make surpluses now, can be financially unsustainable, since they will face problems resulting from unfavourable demographic development in the future and will not be able to pay benefits for long periods without making deficits in the future.

5 Data

Data describing enabling environments, pension system designs and pension system performances are acquired from Pallares-Miralles, M., Romero, C. and Whitehouse, E. (2012) International patterns of pension provision II: a worldwide overview of facts and figures. To analyze the social environment we constructed dataset using World Bank data, OECD family database, Eurostat, United Nations data and also data provided by Singapore Department of Statistics and Hong Kong Census and Statistics Department. These data can be found in Table 5.1, for data describing enabling environments, pension system designs and pension system performances please see Pallares-Miralles, M., Romero, C. and Whitehouse, E. (2012).

If there were no data available or if the World Bank methodology was not applicable for some country we excluded this country from our analysis. Development of the total fertility rate was described in the previous chapter, hence here we do not present any descriptive statistics of this variable. Female labour force participation ratio differs significantly across countries. There are eleven countries with female labour force participation ratio at least 70.0, ten within the interval 60.0 – 69.9 and seven within the interval 50.0 – 59.9. Note, that in our sample there is no country with female labour force participation ratio below 50.0. The arithmetic mean is 66.4. Also the proportion of extra marrital births differs significantly across countries.

In our sample there are six countries with proportion of extra marrital births above 50.0. On the other side, there are seven countries with proportion of extra marrital births below 10.0. Remaining countries are distributed within interval 10.0 – 50.0. The arithmetic mean is 32.3. Mean age of women at the birth of the first child increased significantly. In our sample there are three countries with the mean age of women at the birth of the first child at least 30.0 years. On the other side of the sample there are three countries with the mean age of women at the birth of the first child within the interval 25.0 – 25.9. Remaining countries are quite equally distributed within the interval 26.0 – 29.9. The arithmetic mean is 28.2 years.

Country	Total fertility rate	Female labour force participation	Proportion of extra marrital births	Mean age of women at the first child birth
Norway	1.95	77.4	55.0	27.6
Australia	1.92	67.8	33.4	27.6
Netherlands	1.79	70.1	41.2	28.9
United States	2.10	70.1	38.5	25.0
New Zealand	2.10	71.8	46.5	27.8
Canada	1.68	73.2	24.5	27.6
Ireland	2.07	63.3	32.8	28.4
Germany	1.39	79.4	32.1	30.0
Sweden	1.98	74.7	54.7	28.4
Switzerland	1.50	76.0	17.1	29.6
Japan	1.39	60.6	2.0	29.1
Hong Kong	1.11	62.6	5.0	29.7
Iceland	2.20	82.9	64.1	25.9
Korea	1.22	54.3	1.5	29.1
Denmark	1.87	74.4	46.2	28.4
Israel	3.03	59.1	6.0	27.0
Belgium	1.84	57.8	43.2	27.7
Austria	1.44	64.5	38.8	27.6
France	2.00	62.4	52.6	28.6
Slovenia	1.57	67.0	52.8	28.2
Finland	1.87	72.8	40.7	27.7
Spain	1.39	57.8	31.7	29.7
Italy	1.40	51.0	17.7	29.9
Singapore	1.15	56.7	2.0	30.1
Czech	1.49	64.4	36.3	27.3
United	1.94	69.5	45.4	30.0
Greece	1.44	56.9	5.9	28.8
Cyprus	1.47	63.9	8.9	27.6
Estonia	1.63	64.6	59.0	25.1

Table 5.1: Selected family characteristics in developed countries in 2011 (or latest data available)

Source: World Bank, Eurostat, OECD Family Database, United Nations, National Statistical Offices[16]

[16] Department of Statistics, Singapore, available at http://singstat.gov.sg. Census and Statistics Department, Hong Kong, available at http://censtatd.gov.hk

6 Results

6.1 Total fertility rate and social environment

We start with the analysis of social environment. Based on cluster analysis we identify six different groups of countries. Let us repeat once again that we use Manhattan distance to measure distance between countries and Ward method to form clusters. Manhattan distance between a and b is defined as $\|a-b\| = \sum_i |a_i - b_i|$. Ward's method minimizes total variance within clusters. For each cluster we present list of countries and simple arithmetic averages of particular dimension.

Cluster 1.1	**Cluster 1.2**	**Cluster 1.3**	**Cluster 1.4**	**Cluster 1.5**	**Cluster 1.6**
Spain	Israel	Iceland	Norway	Netherlands	Germany
Italy		United States	Sweden	United Kingdom	Switzerland
Japan		Estonia	Denmark	Slovenia	Cyprus
Greece			Canada	Belgium	Austria
Hong Kong			Australia	Ireland	Czech Republic
Korea			New Zealand	France	
Singapore			Finland		

Table 6.1: Country and social environment classification by cluster

Cluster	**Total fertility**	**Female labour force participation**	**Proportion of extra marrital births**	**Mean age of women at the birth of the first child**
Cluster 1.1	1.36	57.13	9.40	29.49
Cluster 1.2	3.03	59.10	6.00	27.00
Cluster 1.3	1.98	72.53	53.86	25.33
Cluster 1.4	1.91	73.16	43.00	27.87
Cluster 1.5	1.86	65.01	44.66	28.63
Cluster 1.6	1.46	69.64	26.64	28.42

Table 6.2: Total fertility rate and social environment cluster analysis results

Cluster 1.1 consists of three Southern European countries and four Asian countries. This observation suggests that there are important similarities between

these two geographically distant groups of countries. This cluster is characterized by very low total fertility rate, low female labour force participation and very low proportion of extra marrital births. On the other hand, it has the second highest mean age of women at the first birth.

Israel, which is the only country forming Cluster 1.2, is very specific and thus it does not merge into one cluster with any other country or group of countries. From the sample of 29 most developed country, it has by far the highest total fertility rate, which is the key distinguishing characterstic that does not allow Israel to join any other cluster. Values of female labour force participation and proportion of extra marrital births are low or even exceptionally low in the case of proportion of extra marrital births. These values are similar to those for Cluster 1.1. Mean age of women at the birth of the first child belongs to the lowest in the sample of 29 most developed countries.

Cluster 1.3 consists of three countries, which are geographically quite heterogenous. There are significant differences between population weighted and simple arithmetic averages, since populations of Iceland and Estonia combine for less then 0.5 % of the United States population. United States and Iceland enjoyed total fertility rate above two, while Estonia recorded much lower total fertility rate. The key characteristic forcing these three countries to form one cluster is very low mean age of women at the birth of the first child. In the sample of 29 most developed countries the three lowest values of mean age of women at the birth of the first child were recorded for United States (25), Estonia (25.1) and Iceland (25.9).

Cluster 1.4 consists of all Scandinavian countries, Canada, Australia and New Zealand. This cluster is characterized by relatively high total fertility rate and female labour force participation. Let us note that there is significant difference between population weighted average and simple arithmetic average of proportion of extra marrital births. This is due to the fact Canada and Australia characterized by low proportion of extra marrital births are two most populous countries in this cluster. Distinguishing characteristic of this cluster is combination of relatively high total fertility rate with high female labour force participation and relatively low mean age of women at the birth of the first child.

This is apparent especially in the comparison with the next cluster, which has similarly high total fertility rate but lower female labour force participation and higher mean age of women at the birth of the first child. Cluster 1.5 total fertility rate

is relatively high, but there are differences in female labour force participation, proportion of extra marrital births and mean age of women at the birth of the first child. Let us use Welch two sample t-test to evaluate the statistical significance of differences between clusters 1.4 and 1.5. The zero hypothesis is that true difference in sample means is equal to zero.

Variable	**p-value**
Total fertility rate	0.6493
Female labour force participation	0.00629
Proportion of extra marrital births	0.7555
Mean age of women at the birth of the first child	0.0657

Table 6.3: Comparison of clusters 1.4 and 1.5, computed in R.

Now, it is apparent that characteristic that distinguishes Cluster 1.4 from Cluster 1.5 is the combination of female labour force participation (higher in Cluster 1.4) and mean age of women at the birth of the first child (higher in Cluster 1.5).

Cluster 1.6 is characterized by low total fertility, high female labour force participation, high, moderate proportion of extra marrital births and high mean age of women at the birth of the first child, which is the highest among all clusters. While values of female labour force participation and proportion of extra marrital births are similar to those in Cluster 1.5 and Cluster 1.4, respectively, mean age of women at the birth of the first child and the total fertility rate are quite close to those in Cluster 1.1. Finally, let us illustrate the relationship between total fertility rate and other variables in all our sample of developed countries (excluding Israel).

Figure 6.1: Relationship between total fertility rate and female labour force participation in developed countries in 2010.
Source: author's graph based on data in Table 5.1

Figure 6.1 illustrates the relationship between total fertility rate and female labour force participation ratio in developed countries in 2010. Cluster 1.1 countries are denoted by black circle. These countries are characterized by combination of low fertility and low female labour force participation ratio. On the other side of Figure 6 (top right corner), there is Iceland that is characterized by the highest female labour force participation and also by the highest total fertility rate. This observation suggests that there might be positive cross-country relationship between total fertility and female labour force participation. Brewster, K. L. and Rindfuss, R. R. (2000) argue that this relationship had been still negative during 1970s, but then it reversed. Sample correlation coefficient between total fertility rate and female labour force participation is 0.31.

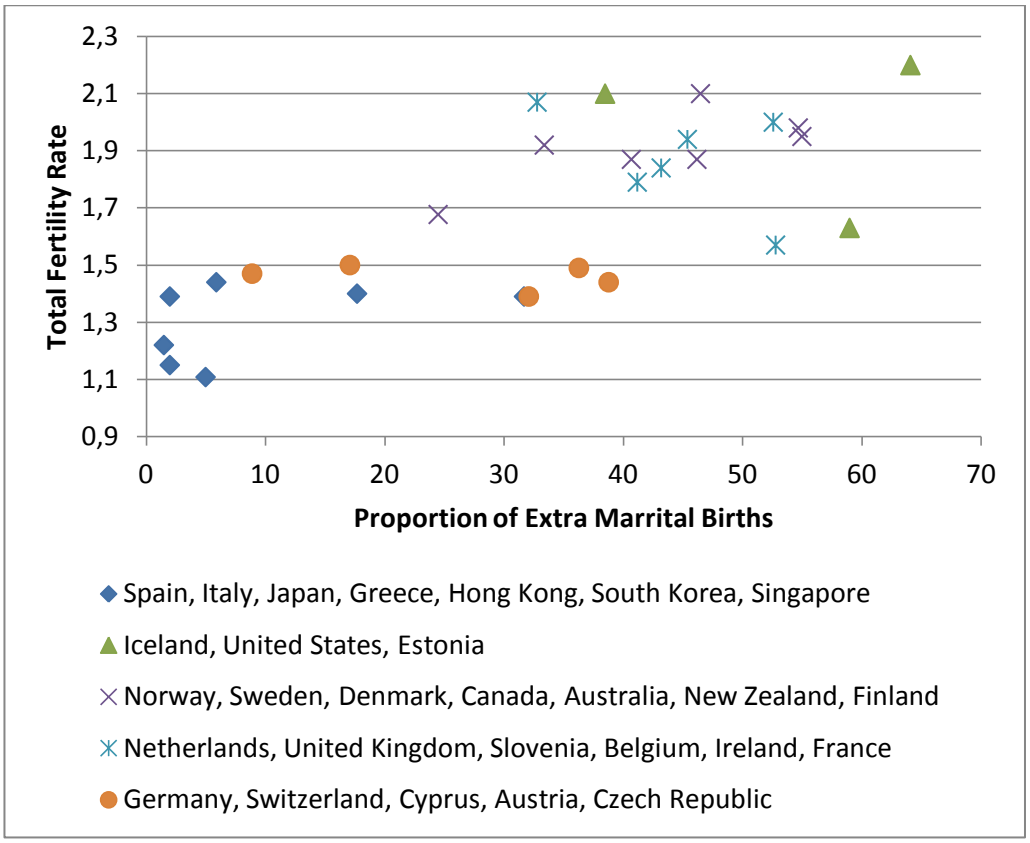

Figure 6.2: Relationship between total fertility rate and proportion of extra marrital births in developed countries in 2010.
Source: author's graph based on data in Table 5.1

Figure 6.2 illustrates the relationship between total fertility rate and proportion of extra marrital births in developed countries in 2010. Cluster 1.1 countries do not form separate group, since the proportion of extra marrital births in Italy (17.7) and Spain (31.7) is relatively high. In general, countries with low levels of proportions of extra marrital births are characterized by low levels of total fertility rates. The highest proportion of extra marrital births was recorded in Iceland (64.1) that is characterized also by highest total fertility. Sample correlation coefficient between total fertility rate and proportion of extra marrital births is 0.40.

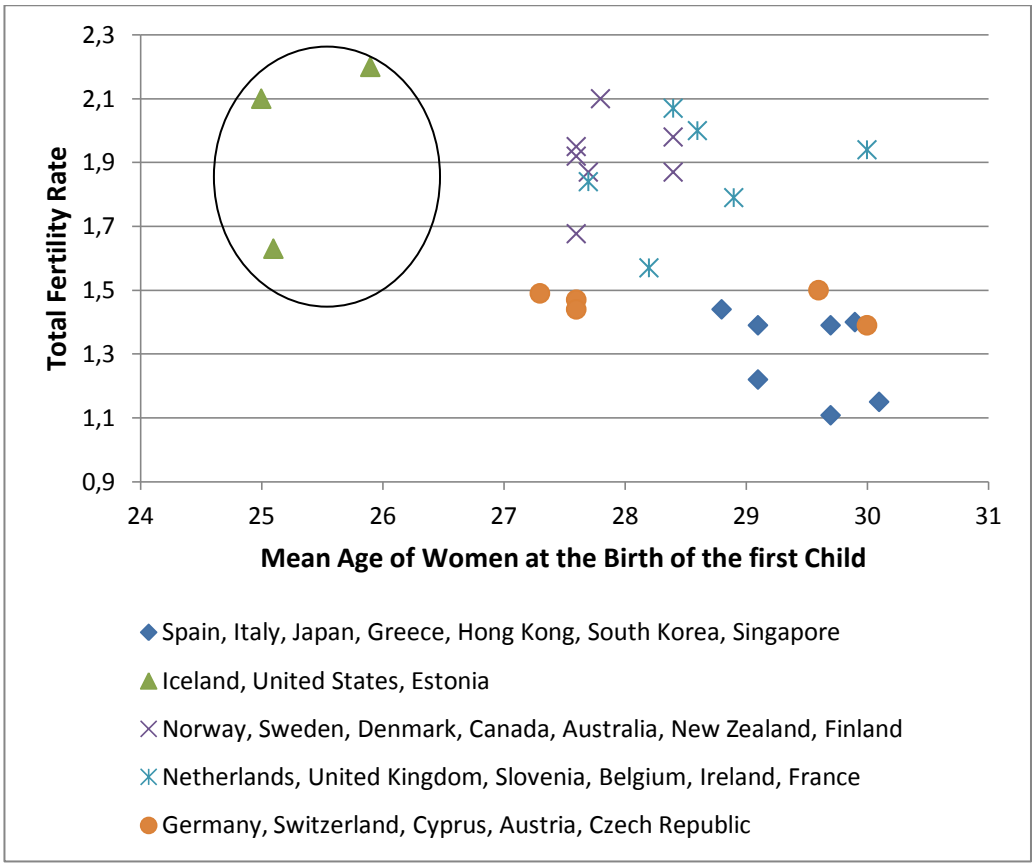

Figure 6.3: Relationship between total fertility rate and mean age of women at the birth of the first child in developed countries in 2010.
Source: author's graph based on data in Table 5.1

Figure 6.3 illustrates the relationship between total fertility rate and mean age of women at the birth of the first child. Black circle denotes Cluster 1.3 countries that are characterized by low mean ages of women at the birth of the first child. Sample correlation coefficient between total fertility rate and mean age of women at the birth of the first child is -0.51.

6.2 Enabling environment

Cluster analysis of the enabling environments identified six different clusters[17]. Clusters 2.1 and 2.2 are characterized by similar social environment. The first two clusters include all developed Asian and South European countries. Clusters

[17] Due to data availability we excluded Cyprus.

2.3 and 2.4 cover the rest of European countries represented in our sample, Canada, Australia and New Zealand. Cluster 2.5 consists of three postcommunist countries. Countries in Cluster 2.6 are different from social, geographical and also historical point of view.

Cluster 2.1	**Cluster 2.2**	**Cluster 2.3**	**Cluster 2.4**	**Cluster 2.5**	**Cluster 2.6**
Japan Korea	Hong Kong Singapore Italy Greece Germany Austria Spain	France Denmark Belgium Netherlands United Kingdom	Finland Iceland Switzerland Australia Canada Sweden Norway New Zealand	Estonia Slovenia Czech Republic	United Arab Emirates Israel United States Ireland

Table 6.4: Enabling environment and country classification by cluster

Cluster	**Population over 65**		**Total fertility rate**	**Life expectancy at 65 years**		**Labour force participation ratio**	
	2012	**2035 est.**		**Male**	**Female**	**Total**	**Over 65 years**
Cluster 2.1	16.9	27.8	1.30	18.3	23.1	69.5	20.0
Cluster 2.2	16.5	26.4	1.33	17.1	20.5	71.1	4.8
Cluster 2.3	16.6	23.4	1.88	16.3	20.0	74.3	2.3
Cluster 2.4	14.6	21.0	1.9	17.5	20.8	79.3	7.9
Cluster 2.5	16.2	22.2	1.56	13.9	18.3	71.7	10.7
Cluster 2.6	8.9	14.1	2.2	16.5	19.5	71.5	10.0

Table 6.5: Enabling environment cluster analysis results

The first cluster (Cluster 2.1) consists of two countries only – Japan and Korea. These countries are characterized by low total fertility rate. Korea has the third lowest total fertility rate in our sample. However, total fertility rate developments in these countries were quite different. Total fertility rate in Japan was relatively low during whole twentieth century, while total fertility rate in Korea experienced sharp decline in the second half of the twentieth century. Thus the population structure in Japan is different from the one in Korea. The ratio of those

aged at least 65 to whole population in Korea is just 11.1, while in Japan this number amounts to 22.7.

Current projections for 2035 – 26.1 for Korea and 29.5 for Japan - are pretty much similar for both countries. Life expectancies at 65 years are very high in both countries and belong to the highest in the world. Labour force participation ratio amounts to 69.5, which is relatively low in comparison with other countries and clusters. By contrast, labour force participation ratio of those aged at least 65 is the highest among all clusters.

Cluster 2.2 consists of seven countries. Note that this cluster includes two Asian Tigers. Namely Hong Kong and Singapore. Then there are all developed South European countries and two German speaking countries. Moreover, clusters 2.1 and 2.2 combine for a larger one that includes all developed Asian countries covered in our sample. Let us note that the social environment in all countries belonging to Cluster 1.2 or Cluster 2.2 is quite conservative. It is characterized by low proportion of extra-marrital births and relatively high age at birth of the first child.

Part of population aged at least 65 is less than 0.4 percentage point below the respective value for Cluster 2.1. Population projection for this cluster is also slightly more favourable than that for Cluster 2.2, total fertility rate is almost the same as that for Cluster 2.1 and life expectancies at 65 are by 1.2 and 2.6 years lower respectively, while the labour force participation ratio is 71.1, which is 1.6 percentage points difference in comparison with Cluster 2.1. On the other hand, labour force participation of those aged at least 65 is just 4.8. This seems to be the main characteristic, which distinguished Cluster 2.2 from Cluster 2.1.

Cluster 2.3 includes five European countries. Ratio of those aged at least 65 years is somewhere in the middle. Population projection for 2035 is more favourable for this cluster than for the two preceding clusters. Total fertility rate is relatively high, but no country in this cluster attains the replacement level total fertility rate. The highest total fertility was recorded in France. Life expectancies are even lower than in Cluster 2.2. Total labour force participation ratio is 74.3, while labour force participation ratio of those aged at least 65 is only 2.3.

Countries that form Cluster 2.4 are geographically quite heterogeneous. This cluster consists of five European countries, Canada, Australia and New Zealand. It is characterized by favourable demographic environment and has the second highest total fertility rate amounting to 1.9 and relatively favourable population projection.

This cluster is characterized by highest labour force participation. Iceland exhibit labour force participation amounting to 84 % and labour force participation of people aged at least 65 years amounting to 25 %, which are by far the highest recorded values.

Cluster 2.5 consists of three European postcommunist countries. This cluster is characterized by relatively low portion of population aged at least 65 years and relatively favourable population projection. However, the total fertility rate is relatively low. Life expectancies for both males and females are the lowest among all clusters, which distinguish this cluster from the other clusters.

The sixth cluster is the only one with total fertility rate averaging to value above simple replacement rate (2.10). The population structure and population projections are also the most favourable ones among clusters. Life expectancies are the second lowest. Labour force participation ratio is relatively low, while labour force participation ratio of people aged at least 65 is the second highest among all clusters. This cluster has by far the most favourable enabling environment.

6.3 Pension system design

Here we identified only four different clusters[18], while previous analysis revealed six different clusters. All clusters consist of geographically heterogeneously located countries. The main finding is that composition of these four clusters does not follow the results obtained from the cluster analysis of the social environment and the cluster analysis of the enabling environment. Unlike in the previous cases, developed Asian countries do not form one or two similar clusters. The same applies for Scandinavian countries, which are divided into three clusters.

[18] Due to data availability we excluded United Arab Emirates, Cyprus, New Zealand and Denmark.

Cluster 3.1	Cluster 3.2	Cluster 3.3	Cluster 3.4
Ireland	Israel	Netherlands	Slovenia
Hong Kong	United Kingdom	Germany	Czech Republic
Canada	Australia	Greece	Italy
Korea	Iceland	Switzerland	Sweden
Singapore	Norway	Japan	Estonia
	United States	Belgium	
		Austria	
		Finland	
		France	
		Spain	

Table 6.6: Pension system design and country classification by cluster

Cluster	Statutory retirement age		Social security contribution rate	
	Men	Women	Employee	Employer
Cluster 3.1	65.3	65	5.7	7.6
Cluster 3.2	67.2	67.2	7.1	11.4
Cluster 3.3	65.2	65.1	13.2	21.6
Cluster 3.4	65.1	63.1	11.2	21.5

Table 6.7: Pension system design cluster analysis results

Cluster 3.1 consists of four countries only. Two of them are developed Asian countries, then there is one North American country and one European country. This cluster is characterized by very low social security contribution rates, which are the lowest among all four clusters. The combination of low social security contribution rates paid by both employee and employer and relatively low statutory retirement ages of men and women is characteristics that distinguished Cluster 3.1 from Cluster 3.2. Cluster 3.2 consists of six countries. The geographical distribution of these countries is again quite heterogeneous.

Clusters 3.3 and 3.4 contain respectively 10 and 6 countries. Both clusters are characterized by high social security contribution rates. This characteristic distinguish them from the two previous clusters. Unlike Cluster 3.4, Cluster 3.3 exhibits very similar statutory retirement ages for both men and women. Let us note that Cluster 3.4 contains Italy, Singapore, Sweden and three postcommunist countries. In the previous analysis, Italy and Singapore were characterized by conservative social environment and relatively unfavourable enabling environment, while Sweden was identified as socially liberal and enjoying one of the most favourable enabling

environments among studied countries. There are three basic ways how to explain this observation.

The first possible explanation requires one important simplification. For the sake of simplicity we assume that politicians start with the analysis of the enabling environment. Then, based on this analysis, politicians set the parameters of the pension system. If this all is true, we must conclude that politicians either do not react properly to conditions arising from different enabling environments or that social security contribution rates and statutory retiremtn ages do not allow politicians to react sensitively to different enabling environments. Let us explain what happen if we relax our assumption. The other possible explanation is that there is no causality direction going from enabling environment to pension system design and that politicians do not take into account the enabling environment at all.

Both explanations suggest that the behaviour of politicians is not socially and economically rational[19]. In the first case, politicians do not react properly or sufficiently to the enabling environment, since clusters formed by cluster analysis of the enabling environment do not correspond to clusters formed by cluster analysis of the pension system design[20]. In the second case they do not take into account the enabling environment at all, since we assume that there is no causality direction going from the enabling environment to pension system design.

The last possible explanation lies probably in data and clustering itself. We need to notice that there are only small differences between statutory retirement ages for men and women across clusters. Thus the only distinguishing characteristics and policy instrument are social security contribution rates. Hence, if there are no large differences in social security contribution rates across countries belonging to different clusters, the pension system designs might be also quite similar even if these countries belong to different clusters.

However, even if we accepted this, we still would have to conclude that enabling environment has great impact on pension system performance, because settings of particular systems are quite similar, while pension system performance corresponds to conditions imposed by the enabling environment and that setting arranged by politicians is not robust to these conditions.

[19] This might be economically rational for politicians, if they set the parameters of the pension system to attract some group of voters.

[20] Note that we do not require to have identical clusters. The main finding is that Scandinavian and Asian countries, which formed clusters in the two previous cases, do not form clusters now.

To test statistical differences between particular clusters we employ two sample t-test. The null hypothesis is that true difference in means is equal to zero. We leave statutory retirement ages, since 20 out of 26 values for men statutory retirement age and 18 out of 26 for women statutory retirement age lie in the narrow band 65 – 67, and focus only on social security contribution rates. Let us start with comparison of Cluster 3.1 with Cluster 3.2.

Variable	**p-value**
Social security contribution rate paid by employee	0.5001
Social security contribution rate paid by employer	0.06778

Table 6.8: Comparison of clusters 3.1 and 3.2, computed in R.

Obtained p-values are high, especially the one for social security contribution rate paid by employee. This suggests that there is no statistically significant difference between clusters 3.1 and 3.2. We will arrive at very similar result, if we compare Cluster 3.3 with Cluster 3.4.

Variable	**p-value**
Social security contribution rate paid by employee	0.6078
Social security contribution rate paid by employer	0.5032

Table 6.9: Comparison of clusters 3.3 and 3.4, computed in R.

High p-values suggest that there is no statistically significant difference between clusters 3.3 and 3.4. Let us combine both findings together and merge Cluster 3.1 with Cluster 3.2 and Cluster 3.3 with Cluster 3.4. We obtain two large clusters. The first one contains ten countries characterized by low social security contribution rates. The second one contains sixteen countries characterized by high social security contribution rates. But if we do this and merge clusters, the difference between clusters formed by cluster analysis of enabling environment and clusters formed by cluster analysis of pension system design will become even more obvious. Cluster analysis of enabling environment formed six clusters, but now we would have

just two, which suggests that there is no or little causality direction going from enabling environment to pension system design.

6.4 Performance

We identified 5 clusters of countries[21]. These clusters correspond quite well to those identified by the cluster analysis of both social environment and enabling environment. This means that countries that form clusters in previous cases form clusters also now or form at least neighbouring clusters Clusters 4.2 and 4.3 are also geographically quite homogeneous. The Asian Tigers, Singapore, Korea and Hong Kong are in one cluster now. This applies also for Spain, Greece and Italy, which are characterized by conservative social environment and low total fertility rate. Also Norway, Sweden and Finland, which are characterized by liberal social environment and relatively high total fertility rate are in just one cluster now.

Cluster 4.1	**Cluster 4.2**	**Cluster 4.3**	**Cluster 4.4**	**Cluster 4.5**
Denmark	Spain	Singapore	Australia	Estonia
Netherlands	Greece	Korea	Switzerland	Germany
Iceland	Austria	Canada	Japan	France
	Italy	Hong Kong	Ireland	Belgium
			United States	Czech Republic
			United Kingdom	Norway
				Sweden
				Finland

Table 6.10: Pension system performance and country classification by cluster

[21] Due to data availability we excluded Cyprus, Israel, Slovenia, New Zealand and United Arab Emirates.

Cluster	Pension spending (% GDP)	Active coverage		Net replacement rate of individual earnings		
		First	Second	50 % of average	100 % of average	150 % of average
Cluster 4.1	4.1	90.1	78.9	118.1	98.1	93.2
Cluster 4.2	12.0	84.8	58.2	90.2	90.1	89.3
Cluster 4.3	2.8	64.3	47.0	53.0	40.8	32.7
Cluster 4.4	5.6	92.6	71.7	68.1	45.9	35.8
Cluster 4.5	9.0	90.9	67.5	76.4	64.3	60.1

Table 6.11: Pension system performance cluster analysis results

Cluster 4.1 contains three countries only. Cluster 4.1 countries – Denmark, Netherlands and Iceland – spend relatively small amount on pensions, but have the highest net replacement rates of individual earnings. Combination of the highest net replacement rates, relatively low pension spending and the highest second active coverage uniquely identifies this cluster.

Cluster 4.2 consists of four European countries. Social environments of these countries, which we identified by cluster analysis of social environment, are pretty much similar. Note that each Cluster 4.2 country can be found in Cluster 2.2 that was obtained by the cluster analysis of enabling environment. This observation suggests that countries with similar enabling environments exhibit similar pension system performances even if their pension system designs are different. Composition of Cluster 4.3 supports this hypothesis. This cluster contains all Asian Tigers. If we look back at the cluster analysis of enabling environment we will find out that two Asian Tigers – namely Hong Kong and Singapore – are in Cluster 2.2, while Korea, the remaining Asian Tiger, is in the adjacent Cluster 2.1.

Cluster 4.2 countries spend by far the largest portion of GDP on pensions and exhibit relatively high both active coverage ratios and net replacement rates. Combination of all above described characteristics determines Cluster 4.2. Cluster 4.3 countries have the lowest pension spending, enjoy relatively low active coverage rates and also low net replacement rates, since they all have young but aging populations. There is no unique characteristic, which distinguishes Cluster 4.3 from the others. This cluster is determined by combination of low pension spending, low active coverage rates and low net replacement rates.

Cluster 4.4 consists of six geographically heterogeneously located countries. There is no unique characteristic defining this cluster but the combination of several characteristics. In this case these characteristics are relatively low pension spending, high active coverage rates and moderate net replacement rates. Cluster 4.5 consists of eight countries and is characterized by high pension spending, high active coverage rates and high net replacement rates. Let us note that 4.5 contains all Scandinavian countries, which were assigned to neighbouring clusters 2.3 and 2.4.

Now, let us focus on Asian Tigers, Southern European and Scandinavian[22] countries only. All Scandinavian countries were assigned to Cluster 1.4, while all Asian Tigers and Southern European countries were assigned to Cluster 1.1. This suggests that social environments within these two groups are similar. Considering the enabling environment, Asian Tigers and Southern European countries should expect tough times, if they do not manage to solve the problem of decreasing total fertility rate. All of them faced rapid decline in total fertility rates in the second half of the twentieth century and thus their population projections are not favourable. This unfavourable demographic development is at least partially offset by high labour force participation of people aged at least 65 years.

On the other hand, Scandinavian countries managed to fix their total fertility level close to simple replacement level and may sustain population without excessive immigration. Cluster analysis of pension system performance arrived at results well corresponding to the cluster analysis of enabling environment or to cluster analysis of social environment, which suggests that the performance of pension systems depends heavily on the enabling environment. By contrast, cluster analysis of pension systém design identified just two statistically significantly different clusters. One containing all Asian tigers and the other containing all Scandinavian countries and all Southern European countries.

[22] Due to data availability we exclude Denmark.

7 Conclusion

7.1 Summary of the results

We used traditional classification of family types t show that total fertility rate and the nature of social environment within particular country are interrelated phenomena. Then we focused on comparison of the liberal Scandinavian welfare state model, which is represented by Finland, Norway and Sweden, with Southern European welfare state model model, which is represented by Greece, Italy and Spain, and with group of three Asian Tigers belonging to the top sixth of the most developed countries.

Choice of these three groups of countries was based on their ability to solve demographic crisis. Then, we performed cluster analysis and analyzed social environment and three sets of indicators issued by the World Bank to study the relevance of the pension motive and the way governments react to different conditions. The main results are:

1. Except two cases - pension system design in Norway was identified as different from those in Sweden and Finland and enabling environment in Korea was identified as different from those in Hong Kong and Singapore, above specified three groups of countries always form clusters.

2. We identified just two statistically significantly different pension system designs present among developed countries.

3. Empirical evidence does not support old age security hypothesis. Asian Tigers have low social security contribution rates and low earnings net replacement rates. In this setting, fourth pillar may have great importance. However, this is not in line with low total fertility rates, which are below 1.3 births per woman.

7.2 Concluding remarks

Using cluster analysis we showed that we can recognize six statistically significantly different enabling environments among developed countries, which follow more or less correspond to those identified by cluster analysis of social environments. Cluster analysis of pension system design identified just two statistically significantly different clusters, where the second one contains two Scandinavian countries and all Southern European countries, while the first one contains all Asian Tigers.

Assuming politicians are economically rational and set pension system design after analysis of enabling environment, we conclude that statutory retirement ages and social security contributions rates do not allow politicians to respond sensitively to different enabling environments. Moreover, increases in statutory retirement ages and social security contributions are just short term solutions, since they try to keep stock of real capital but do not solve the principal problem, which is the lack of human capital.

Let us focus on Cluster 3.1 obtained by cluster analysis of pension system design and Cluster 4.3 obtained by cluster analysis of pension system performance. Both, Cluster 3.1 and Cluster 4.3 contain all the three Asian Tigers. Cluster 3.1 is characterized by very low social security contribution rates and Cluster 4.3 is characterized by low net replacement rates of individual earnings. In this setting people are left with relatively large amount of money. On the other hand, they receive relatively small support in old age.

In such environment, there is great space for familial institutions to provide insurance against poverty in old age, but the observed long term development of total fertility rates does not suggest that familial institutions play an important role. Let us consider the situation in Scandinavian and Southern European countries. Scandinavian and Southern European countries have similar pension system design measured by statutory retirement ages and social security contribution rates and also the net replacement rates of individual earnings are high in Scandinavian and Southern European countries.

In such environment, pension motive for having children plays a minor role. On the other hand, we observe large difference between total fertility rate in Scandinavian countries and total fertility rate in Southern European countries. Since

we conclude that the pension motive for having children plays minor role in these countries, because old age security is provided to a large degree by extrafamilial institutions, we reject the old age security hypothesis and conclude that the pension motive cannot explain the differences in fertility rates among developed countries.

Cluster analysis of pension system performance identified five different clusters. Structure of clusters containing Scandinavian countries, Southern European countries and Asian Tigers corresponds to those obtained by cluster analysis of social environments and enabling environments. To explain this result let us assume that if countries with different enabling environments have similar pension system parameters, performance of their pension systems will be determined exactly by the enabling environment. Let us note that low total fertility rates lead to low labour force coverage rates in long term, since number of potential contributors decreases.

Probably the most interesting result can be obtained by analysis of Cluster 4.3 and Figure 5. We already mentioned that Asian Tigers have low social security contribution rates and low earnings net replacement rates, which may be favourable environment for the existence of the fourth pillar. But once we notice that sharp fall in total fertility rates in Korea and Hong Kong had started before mandatory pension schemes were introduced, we must conclude that people in these countries were given opportunity to rely on financial markets or on their children and familial institutions, and they chose the first option.

We described several conditions, under which pension motive may be strong motive for having children and showed that these conditions are not likely to be satisfied in majority of developed countries. Introduction of mandatory pension schemes cannot be the sole cause of fertility decline in developed countries, since it is only part of erosion of institutional and social framework, under which pension motive for having chidlren is strong.

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