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The relationship between population growth and living standards:

the evidence from Japan and Singapore

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Abstract

The problem of increasing population is quite an old topic. The main aim of the study is to investigate the relationship between population and economic growth in Japan and Singapore in the period between the 1960s and 2000s. This is to be done using theoretical framework involving theories of economic growth, as well as structural and demographic change theories. The study indicates a positive relationship for the selected cases but it is not straightforward as the direction of causality is controversial. The key factors in terms of the above mentioned theories are present in order to explain the causality direction and the impact mechanism itself.

Keywords: economic growth, structural change, population growth, demographic change, living conditions

Contents

1. Introduction

1.1 Background

Economic growth has been the primary focus for the developing countries and every developed country has its own preconditions and history of meeting the ends. The view on the role of population in this process was rather pessimistic since the emergence of Malthusian theory which was challenged a century ago by Warren Thompson and his Demographic change theory. These changes in the view of the impact of the demographic situation help to widen the understanding of the complex economic growth processes.

Since the end of WWII, Japan and Singapore have been experiencing high and relatively steady rates of economic growth. However, data shows that both Singapore's economy and population have grown faster in comparison to those of Japan, and thus raise interest in the relationship between indicators related to GDP and population in order to investigate the particular difference between the cases.

What makes these cases interesting is that, in addition to the above-mentioned information, since the 1960s, Japan has had very low population growth rates while Singapore has been enjoying robust population growth given that the economic growth has been robust in both cases. To phrase it more simply, when in Singapore both economy and population showed robust growth, the Japanese economy had robust growth as well while its population growth was lagging behind.

1.2 Problems

It is still questionable whether slow population growth can be considered as the only problem while having robust economic growth, as in case of Japan. However, on average, economic growth rates were higher in Singapore if compared to Japan, given that the population growth rate was higher in the former. One could estimate Singapore's population in 2010 to be roughly three times that recorded for 1961, with 5 million persons in 2010 against 1,7 million in 1961. For the same period real GDP increased by roughly 40 times . For Japan, the same period was marked with real GDP growth by 6 times and a 35% increase in population with a base year of 1960. It can be admitted that the GDP of Singapore grew at much higher rates than the GDP of Japan (Booth, 1999)

This situation creates a problem of understanding the real processes behind economic and population growth. Investing available resources and endowments in economic growth has been a tough challenge due to the amount of limited choices and resources in addition to the fact that there could be more opportunities to grow while maintaining a population boom. Furthermore, it could also be problematic to find out if there is a straightforward causality between population and economic growth and which way the direction of causation could go.

1.3 Significanceand purpose

Determination of the significance of a topic related with economic and demographic issues is complex as it involves terms that can be used within these fields of study. However, a thorough understanding of the above-mentioned processes would shed a light on the keys to a sustainable demographic model combined with well-planned healthy economic growth. Such knowledge could be very useful for officials to plan long-term growth policies that take into account the demographic and economic situation or to influence the current policies in order to reach a sustainable model of development; furthermore, to avoid discordances between the dynamically changing economic potential of a country and its human capital. Thus, it could also be useful to alleviate certain types of poverty, optimise resource and human capital management etc.

In addition, both aging and the decline of birthrates can have a negative impact on long-term growth for Japan in the upcoming decades starting from 2020 through 2050 (Takao Komine and Shigesaburo Kabe, 2009). A study by Fehr et al. continues to explain why population aging has a negative impact by implying that it can lead to capital shortage as a consequence of increases in payroll and wage tax rates (Fehr et al., 2008).

An important lesson from these results might be that when analyzing population structure, demographic transition should be taken into account as a factor that can influence economic growth.

1.4 Research question

The primary question then is, "how and to what extent can population growth influence GDP per capita and vice versa?" since there is a possibility of having a mutual causality relationship. Another complementary and no less important question is, "what kind of patterns can we observe for these cases?".

1.5 The outline of thesis

Answering these questions will require a particular framework and methodological approach. Chapter 2 (*Methodology*) shall discuss suitable methods to investigate the problem and to answer the research question. Simultaneously, the same chapter covers data sources and the statistical method used to analyse data. Chapter 3 (*Key concepts and theoretical framework*) discusses key concepts of the problem and outlines a theoretical framework. The theory of demographic transition shall be linked to the theories of economic growth and structural change as a cornerstone of the framework. Chapter 4 (*Analysis and concluding discussion*) follows the

theoretical approach and builds up a dataset to be expressed in the form of empirical findings. Consequently, analysis and interpretation of data and empirical findings shall be discussed in the same chapter according to the chosen theoretical approach. Chapter 5 sums up the thesis and discusses related topics for future research that were not fully brought up but represent considerable interest to some extent.

2. Methodology

2.1 Research methods

The research method used is primarily quantitative statistical analysis backed up by review and discussion of preliminary studies, which serve as a qualitative part of the methodological approach. For the qualitative part of the research, content analysis could be intensively used in order to extract a bit of potentially useful information by keywords. Content analysis being mentioned as a flexible method (Bryman, 2008, p. 289), gives a certain advantage in the process of review of the relevant material as it can also save time, which is a luxury for the research process. Doing meta-analysis could help to summarize and compare all the outcomes of a large number of quantitative studies and check if the variables have an effect (Bryman, 2008, p.88)

The design of the research is exploratory since the research objectives consist of finding patterns between variables of population growth and economic growth that could shed light on either the process of increasing living standards or intensive growth based on human capital.

The research is designed to use a mix of inductive and deductive methods where possible since it is expected that beside mainstream ideas, a set of ideas that were not captured before will be derived (Bryman, 2008, p.22)and tested from data rather than being attached to existing ones and vice versa. As a powerful tool for revealing patterns and implications, the application of correlation and regression models with available quantitative data will be intensively used in order to establish the level of influence and correlation between economic and demographic indicators.

Primary economic indicators used for the study are the ones that show wellness or living conditions and for this reason GDP per capita is most suitable. Furthermore, population growth represents the most suitable indicator from the set of demographic indicators. The study aims to cover the period from 1960 until the first decade of 21st century. Thus, research design falls into longitudinal design since it covers more than one year (Bryman, 2008, p.49). Theoretically, such approach reduces flexibility since it requires conformation to the single standard and makes it hard to use data generated by different standards of dataset designs. However, if data is abundant within one dataset standard, then it is not too complex.

Given that the design is longitudinal and uses retrospective data expected to be collected at various points in time in the past, the challenge is then to obtain the data without missing values; missing values could make it hard to calculate and predict trends between certain points. However, the data set is provided by Development Indicators Database and does not have many missing values.

2.2 Data analysis

All the data will be tested for statistical significance in order to ensure that statistically significant data is obtained and in order to reduce the risks of getting a coefficient by chance (Bryman, 2008, p.335). It should be mentioned that the manipulation of data will include descriptive statistics methods and also correlation pairs and regression models. Furthermore, in order to carry it out efficiently with the awareness of the above mentioned tests, the following set-up will be used in the SPSS statistical software: entries and sets of variables with $p<0,05$ granting 95% confidence level, and samples with a higher coefficient of determination, also known as R square. When creating correlation and regression models perhaps it could be reasonable to find out causation by shifting one set of variables one step back in time since the independent variable most likely required time to affect the dependent.

Given that more than two variables will be used, a multivariate analysis method will be performed (Bryman, 2008, p.331). Secondary analysis will be performed since mainly secondary data will be used, and apart from the fact that it can save costs and time, it provides us with high-quality data and more importantly it allows longitudinal analysis (Bryman, 208, p.297), which totally fits the above-mentioned methods. Besides primary indicators, the following variables could be used : total population, total GDP, total GNI, population by age, GDP PPP, population by age and others that are related to them or derived from them and could be relevant for the research. Furthermore, economic growth in terms of GDP can be mentioned instead of GDP per capita but that does not create a huge distortion.

Quantitative data within the mentioned spheres will be provided from official statistics and databases of research institutions and research datasets will be built based on that. All the necessary data can be collected from the Development Indicators Database provided by the World Bank website.

3. Key concepts and theoretical framework

3.1 From Malthus to Demographic transition

The debate over population growth and its significance for human welfare was raised in Malthus studies in the sense that growth of population depended upon the means of subsistence, primarily the food supply (Thompson, 1944, p.2). The pessimism of his theoretical implications was locked within a Malthusian dilemma since the world has a limited amount of land and

resources. Such an approach predicts a fast and steady population growth for countries with an abundance of resources until the point where abundance turns to scarcity since the production growth would be linear and population growth exponential. Thus, sooner or later the exponential function would outrun the linear production function and lead to famine or other disasters. As it turned out, the world's population increased rapidly and the theory was severely questioned. However, it can be admitted that population growth and human welfare are closely related (Thompson, 1944, p.3).

The theory of demographic transition will help to identify the stages of development for each country and to determine the economic patterns to which the former are linked. Having in mind characteristics for a certain stage theory could hint to which changes in economic growth precede growth and change in population structure and vice versa. Demographic transition is a transition in patterns in a country's demographics such as a gradual shift from high birth and high death rates to lower rates simultaneously as a country passes through stages from primarily agricultural and pre-industrial economy into industrial and technologically advanced production. It can also be stated that economic development leads to better and more efficient use of factor endowments. The transition model can be divided into four stages:

- Stage I primary characteristics: high mortality and fertility levels and more or less stable birth and death rates; best examples here are low productive agricultural economies.
- Stage II primary characteristics: decline in mortality, changes related to public health and modernization (Thompson, 1944, p. 39), still high birth rates leading to population boom.
- Stage III primary characteristics: decline in fertility, changes related to urbanization (Thompson, 1944, p.15), higher standards of living, more or less stable mortality level.
- Stage IV primary characteristics: low mortality and fertility levels and more or less stable birth and death rates, developed economy

Since the original transition model was developed in the first half of the 20th century it has consisted of only four stages due to the fact that the last stage was the highest stage on the transition scale achieved until that moment by the most progressive countries. Therefore, it may miss one or more stages that follow thereafter. Primary characteristics of the following stage is that a country establishes a sub-replacement fertility rate which, when accompanied by population aging of the baby-boom generation, leads to population decline. It was later pointed out that countries could be classified as high growth potential countries, those that are in

transitional growth and countries experiencing incipient decline (Notestein in Weeks, 2008, p. 90).

The recent studies claim that demographic transition is not only transition from high death and birth rates to low levels but also a set of transitions each having certain consequences such as transition in health and mortality levels followed by fertility transition, which predicts age transition (Weeks, 2008, p.98). Massive growth of population leads to migration transition followed by urban transition and the family and household transition.There is evidence that at certain stages economic changes precede demographics such as a decline in mortality occurring after a rise in standards of living and improvements in public health. The same can be said about a decline in the birth rate as it can be a lagged reaction on the adaptation to industrial and urban life (Weeks, 2008, p.91). However, there is high possibility for these evidences to be valid only to trigger fertility and mortality transitions. Given that education and economic institutions can provide physical and human capital with a high output activity, population growth can lead to economic growth (Romer in Seligson, 2008, p.53).

3.2 Structural Change theory

Rostow's theory on structural change is similarly divided into stages that could reflect some aspects of demographic transition theory. According to the theory, a country beginning in the Traditional stage is supposed to pass through the Preconditions for Take-off stage, the Take-off and the Drive to Maturity on its way to the Age of High Mass Consumption (Rostow in Seligson, 2008, p.173). The traditional society in this case is distinguished primarily by the limitations on productivity due to the low level of scientific achievements and innovations. Thus agriculture remains the primary sector in the economy. The transition to the second stage of growth, namely the preconditions for the Take-off stage, is believed to be driven by prerequisite such as natural resources, trading possibilities and social and political structure (Rostow in Seligson, 2008, p. 175).

Concerning the cases of Japan and Singapore, the last three stages are of most interest and relevance to the empirical results and analysis. Following the Precondition to Take-off stage, the Take-off is claimed to be driven by the upsurge in technological development in industry and agriculture, while at the same time paving the way for large-scale modernization of the economy. At this point effective investment and savings are expected to rise and fuel expansion in the private and industrial sector (Rostow in Seligson, 2008, p. 177). In addition, technological revolution in the agricultural sector is generally supposed to release labor to new sectors and, consequently, the share of secondary sector increases to the extent that it becomes bigger than the primary agricultural sector. The shift from agricultural to industrial economies can also be explained as a drive to productivity (Frieden, 2006, p.24) since the labor force had to move to

spheres where they could be productive; for example, from farms to factories since farms could be productive with fewer and fewer workers while the growing industrial sector required workers.

The Drive to Maturity stage is primarily described as the stage when the economy moves beyond its original industries to the production of sophisticated goods requiring higher technology and capital input, such as a shift from metal and heavy engineering to the production of machines, chemicals and electrical equipment (Rostow in Seligson, 2008, p. 178).

When the country reaches the Age of High Mass Consumption, the sectoral structure shifts towards production of consumer goods and services at the same time as a shift to high-value consumer goods is observed. In addition, there is a higher proportion of skilled labor in the aggregate labor force and higher real income per capita (Rostow in Seligson, 2008, p. 179), thus population consumption is expected to play an essential role in the aggregate demand. A rising share of the service sector when the economy reaches later stages of development is explained to be the result of an income-elastic demand for services (Gemmell, 1982).

3.3 Economic growth theories

The exogenous economic growth model, a theory of growth within the framework of neoclassical economics also referred to as the "neoclassical theory of growth", was developed by Solow and Swan and asserts that growth occurs as the result of forces that come from outside a system. It claims that higher saving rates would determine capital accumulation, which is crucial for economic growth (Solow, 1956). Thus a high ratio of capital over the labor would mean a decrease in savings, which could then be stimulated by the growth in labor force (Solow, 1956). This model employs TFP as a measurement of technological progress and labor productivity; consequently, it is hard to track growth in technological progress when TFP changes. It is quite crucial since growth in TFP can lead to economic growth (Broadberry, 2010, p. 331). The discontent with the theory was based on the fact that it considers technology as an exogenous factor and leads to the emergence of an explanation of the economic growth from the point of view where economic growth has endogenous factors of growth.

Endogenous growth theory, on the other hand, claims that economic growth is an endogenous outcome of an economic system (Romer, 1994). The model assumes that there are many firms in a market economy, that it is possible to replicate physical activities and that discoveries differ from other inputs (Romer, 1994). Despite that, the theories are somewhat similar in that they focus on behavior on the market and accept above-mentioned conditions, although the latter claims to cover technological and innovational elements. Thus it assumes that technological advance comes from people and that many individuals and firms have their rights to earn monopoly rents on discoveries and market power (Romer, 1994).

3.4 Preliminary studies

According to Rostow's model, Japan had its Take-off stage in the fourth quarter of the 19th century (Rostow in Seligson, 2008, p. 177) and by the time it entered World War II it may have been in the Drive to maturity stage. This is supported by Thompson as he suggests that in the period before WWII, Japan had already passed its high birth rate stage and the trend was on the decline (Thompson, 1944, p.31).

Besides the above mentioned factors of growth, strengthening competition was claimed to be conducive to faster productivity growth (Broadberry, 2010, p.332). However it may reflect neoclassical growth ideas as Singapore benefited to quite a high extent from free trade, while at the same time opening opportunities for international competition.

Another point of view is represented by Fawcett as he suggests that the developmental state was aware of the needed changes and held economic development through industrialization in the private sector (Fawcett, 1981). Furthermore, the state established public institutions in order to promote urban economic structure and the devising of population policies; goes without saying that such a government imposed strong administrative and political control (Fawcett, 1981).

It has to be said that education can be an important factor for economic growth as it is partially investment and partially consumption (Arndt, 1987, p.71) As an investment, it helps to promote the accumulation of human capital, thus contributing to capital formation as a prerequisite to growth (Arndt, 1987, p.70), as consumption, it stimulates the supply of goods. In addition, the relation between the level of skills of a husband and the level of schooling of a wife on the size of the family has been indicated in previous researchs.

The tendency is then as follows: the less professionally skilled the husband was or the less schooling the wife has completed, the larger the family would be (Thompson, 1944, p. 34). In addition, it is believed that the increases in standards of living would not be possible without innovations that allow new physical and human capital to be put to work in high return activities (Romer in Seligson, 2008, p.53).

3.5 From Theoretical framework to analysis

If one puts aside either endogenous or exogenous theory of economic growth, the three mentioned theories do not necessarily contradict each other. On the contrary, they have quite a lot in common which enables us to create working theoretical framework. A focal point in both the endogenous growth and neoclassical growth theories is the behavior of the economy as a whole (Romer, 1994).

So does the idea of "the supply-demand framework" within the theory of demographic transition as it considers that people are rational in their choices; it is determined by the individual couples' choices (Weeks, 2008, p.211). Thus couples tend to balance between the potential supply of and demand for children. In any case, education in this case can be the factor that provides more information and thus contributes to rather rational decision making (Weeks, 2008, p.216).

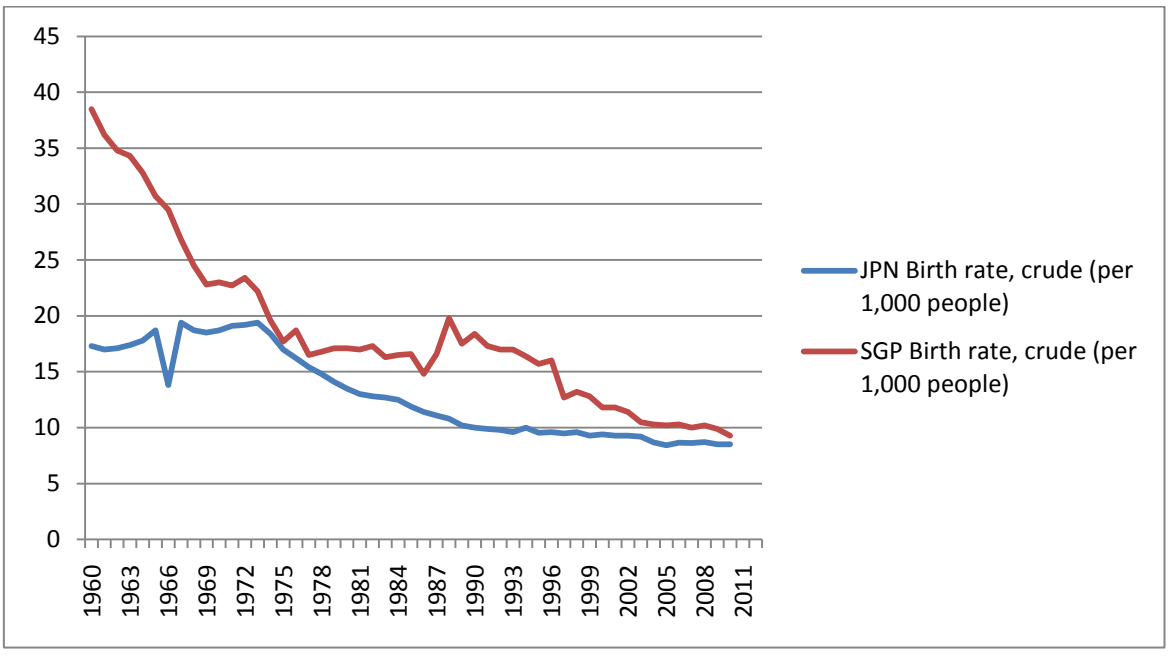
Referring to the mentioned theoretical implications, Japan's and Singapore's demographic and economic indicators will be analysed in order to distinguish the patterns to which these countries belong at certain periods along their path of development. The theoretical framework and implications from preliminary studies give a preliminary understanding of which way a potential causation can go in the correlation between GDP per capita and population growth. In order to give an explanation to the causation direction, an analysis of correlation will be performed.

4. Analysis

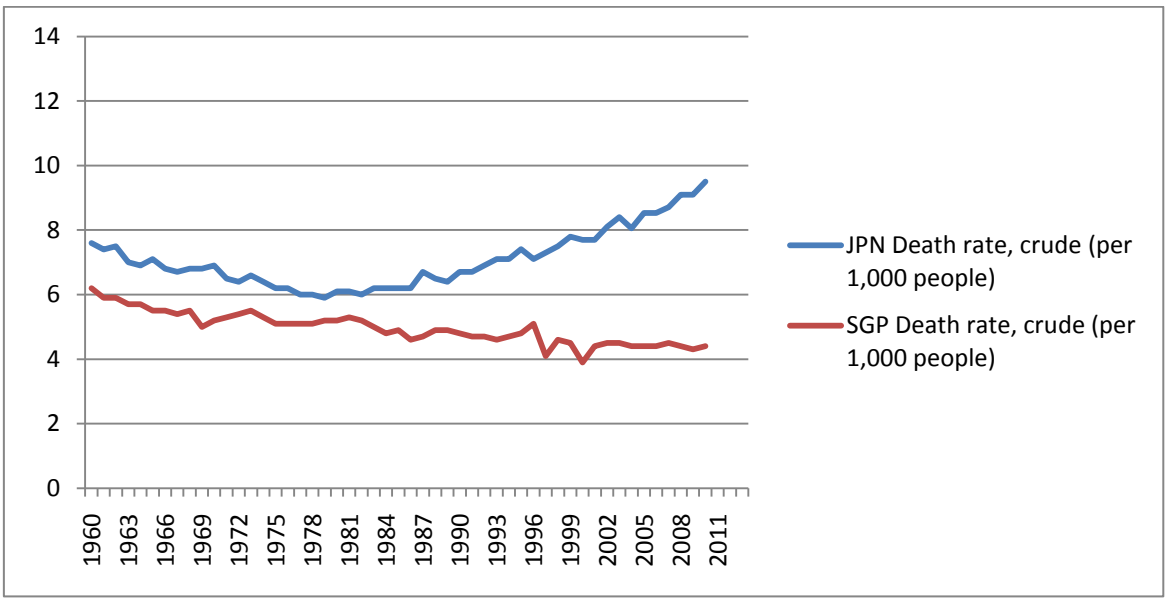
4.1. Graphical analysis of indicators

As can be seen from graphs 1 and 2, initially Japan had a lower birthrate and higher death rate, which could be used as support for the argument that Japan had already been in the third stage of demographic transition and the trending up of the death rate after the 1990s might be linked to a larger portion of older people having been born during previous population booms, as can be seen from graph4. It can also be traced using a pattern of population composition by age, as Japan in the 1960s is similar to Singapore in the second half of the 1970s.

Graph1. Birth rate in Japan and Singapore

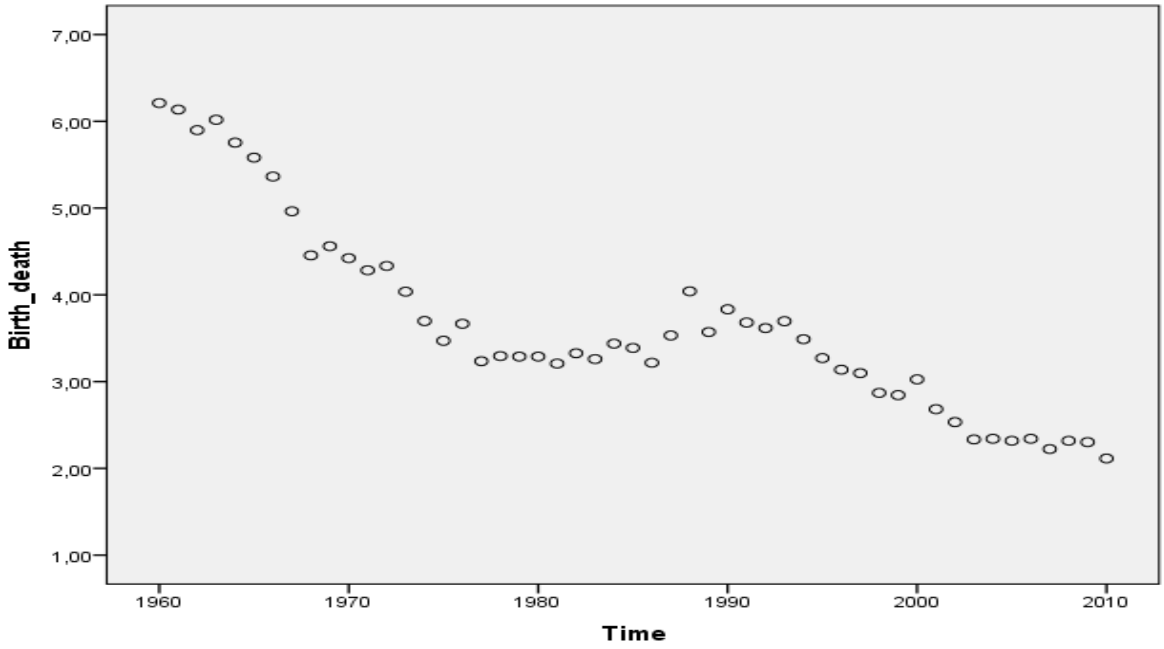


Graph2. Death rate in Japan and Singapore



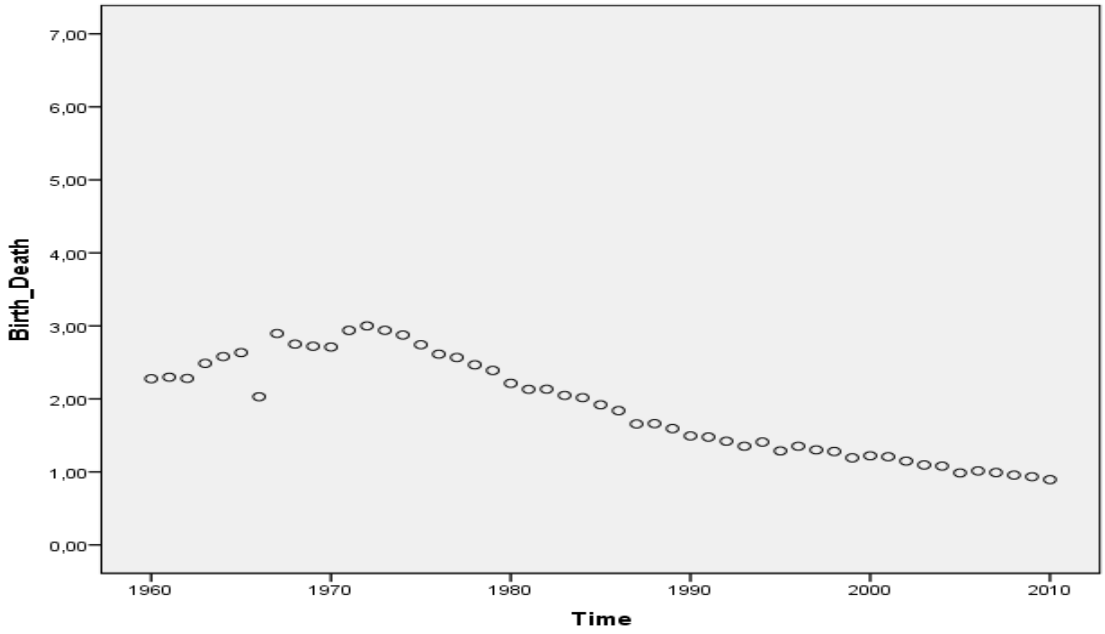
The birth rate was on the decline until it reached a steady state by roughly 1975; this does not necessarily signify that up until this mentioned point Singapore was in the third stage of demographic transition, since the birth rate continued to decline from the second half of the 1980s. This may mean that the Singaporean economy had economic opportunities and institutions in order to keep birth rate floating.

Birth/Death ratio scatter plot Singapore



The birth to death ratio scatter plot gives a more detailed picture of the demographic transition in Singapore. The birth to death ratio is quite high and thus there is almost no doubt that Singapore is in the third stage of transition. As in graph 1 the downward trend is interrupted around the 1980s, but in the scatter plot it can be observed that the trend is delayed by 10-15 years.

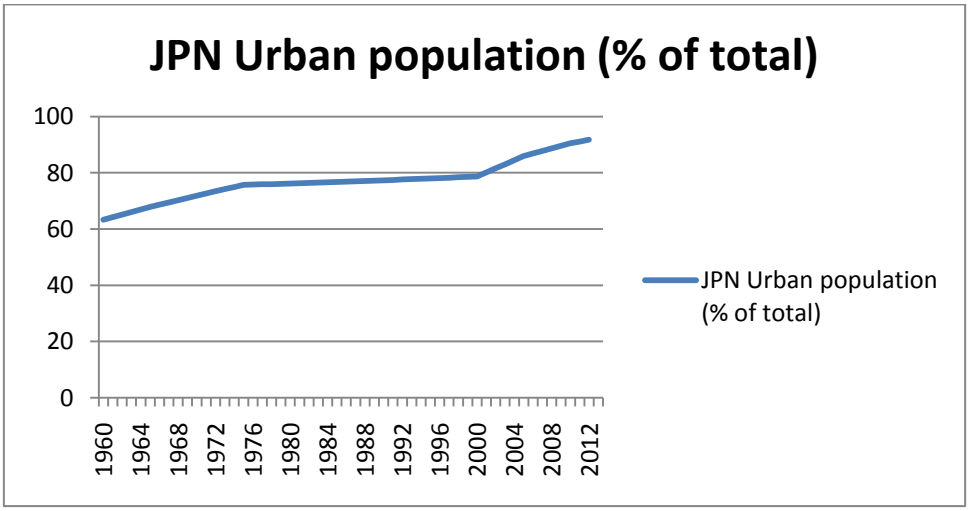
Birth/Death ratio scatter plot Japan



In the scatter plot for Japan there is an upward trend from 1960 until the early 1970s, which is probably a recover mechanism after World War II. Moreover, the striking interest here is the point where the ratio reaches 2 on Birth/Death axis on a long run and the slope of the line tends to 0 as the levels of fertility and mortality are to quite an extent stable and low. Thus, based on theory it can be said that for Japan the entrance point to stage IV is around the 1980s while Singapore entered it in the early 2000s.

It should also be noted that being a small island gives perfect conditions for Singapore's population to be totally urban, while in Japan urbanisation had to follow migration and an urbanisation transition according to Graph 3.

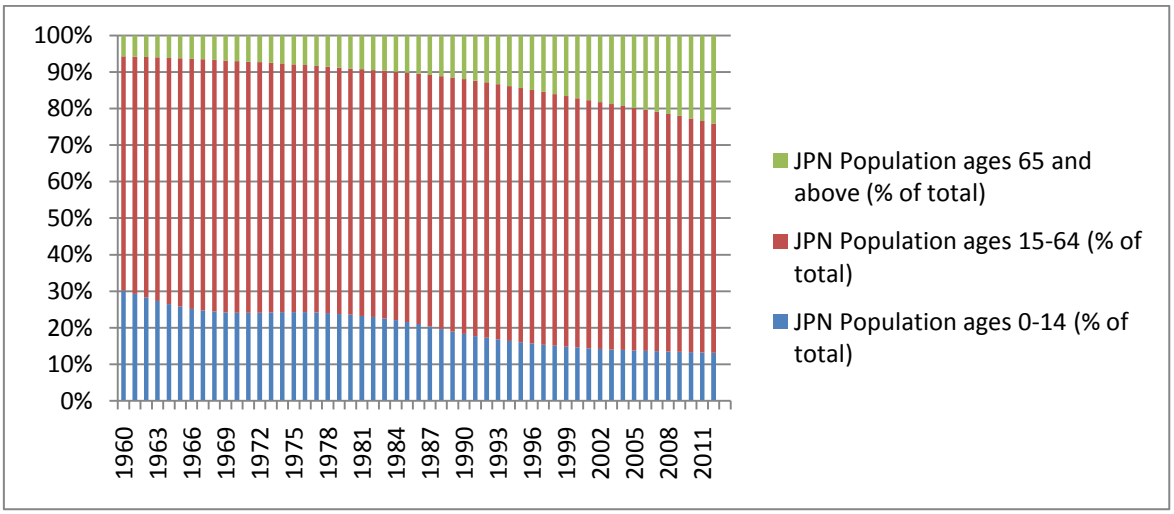
Graph 3. Urban population growth



It can be inferred from a Graph 4 that Japan had its population boom driven by demographic transition before the 1960s as the population with an age distribution of 15-64

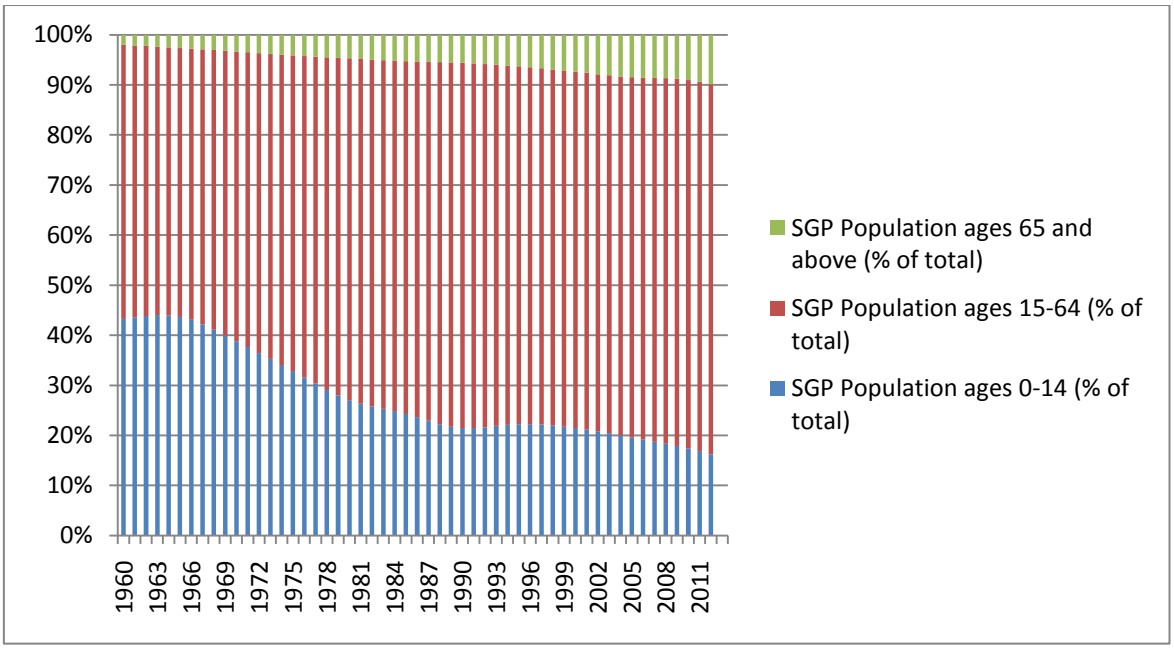
constitutes a high share in the total population. In addition, starting from the 1960s, steady growth in a share of population over 65 continues up until 2012, which, when coupled with more or less stable mortality rates, leads to a conclusion that the level of economic development and public health infrastructure was quite developed; thus, it is likely that Japan by the 1960s was already in the third stage of the demographic transition.

Graph4. Population composition by age in Japan



Singapore on the other hand had its population boom in the 1960s up until roughly the first half of the 1980s. This period can be described as a transition from high to declining birth rates thus this period is rather represented by transition from the second to the third stage in the demographic transition.

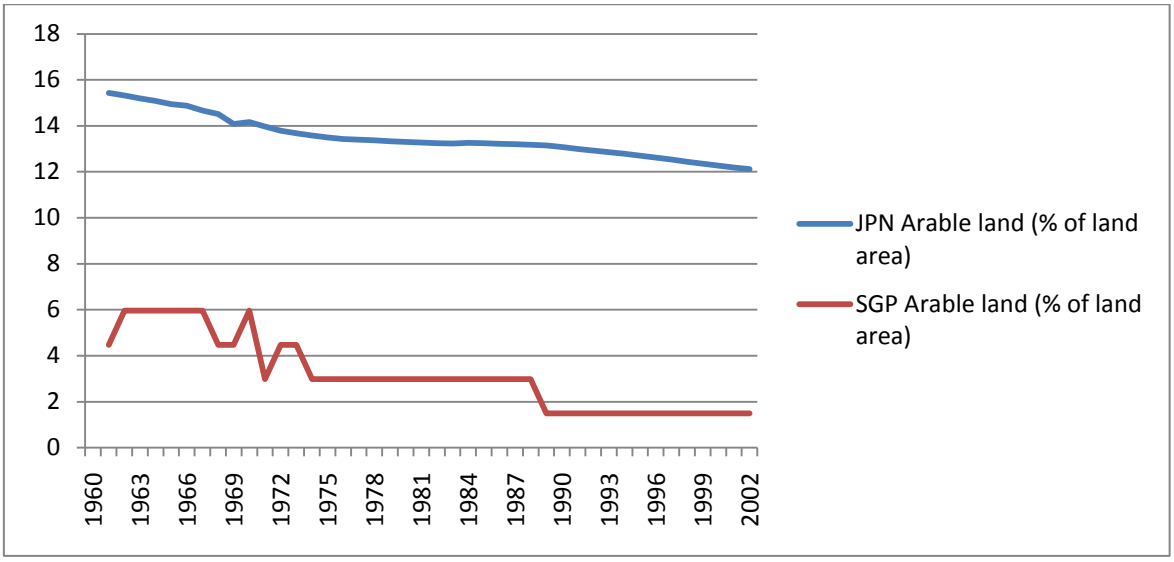
Graph 5. Population composition by age in Singapore



When it comes to indicators of economic transition and structural change, it is quite notable that Singapore has quite a low contribution to GDP and employment in the agricultural sector in comparison with the more developed Japan. It is a factor that creates dissimilarity and

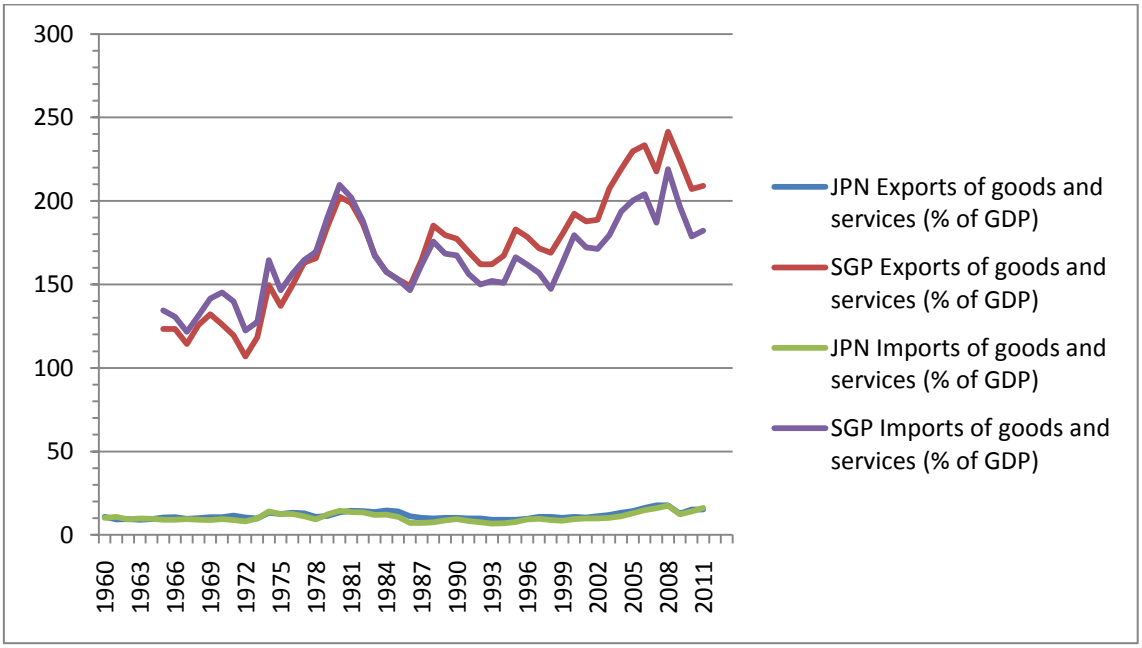
perhaps it can be explained by the geographical condition of having less arable land (as it can be seen on graph 6).

Graph 6. Arable land in Singapore and Japan



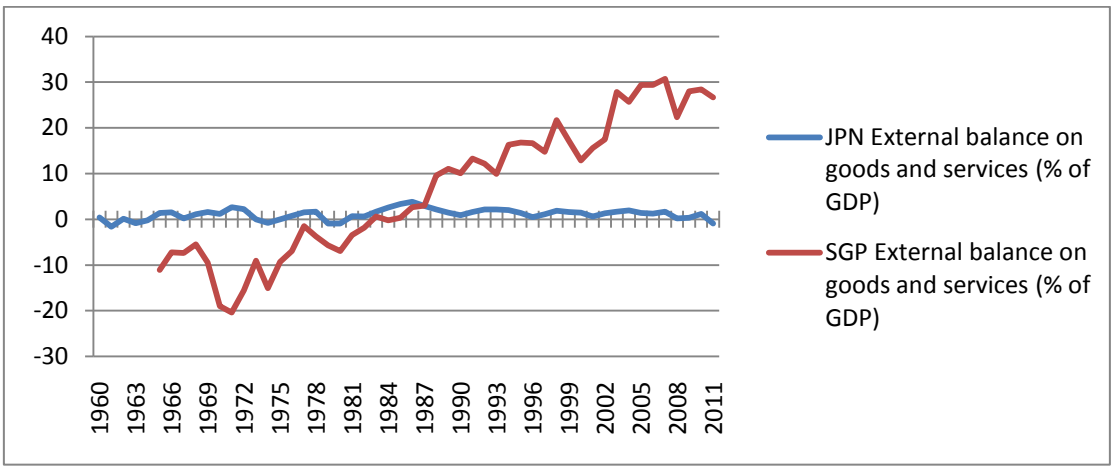
From these figures, it can be seen that Singapore's economy is open and export-oriented and large import shares could consist of imported raw materials or simple technology goods, which were processed and transformed into more complex technology and high-cost goods as well as service for export aims.

Graph 7. Export and import in percentage of GDP in Japan and Singapore



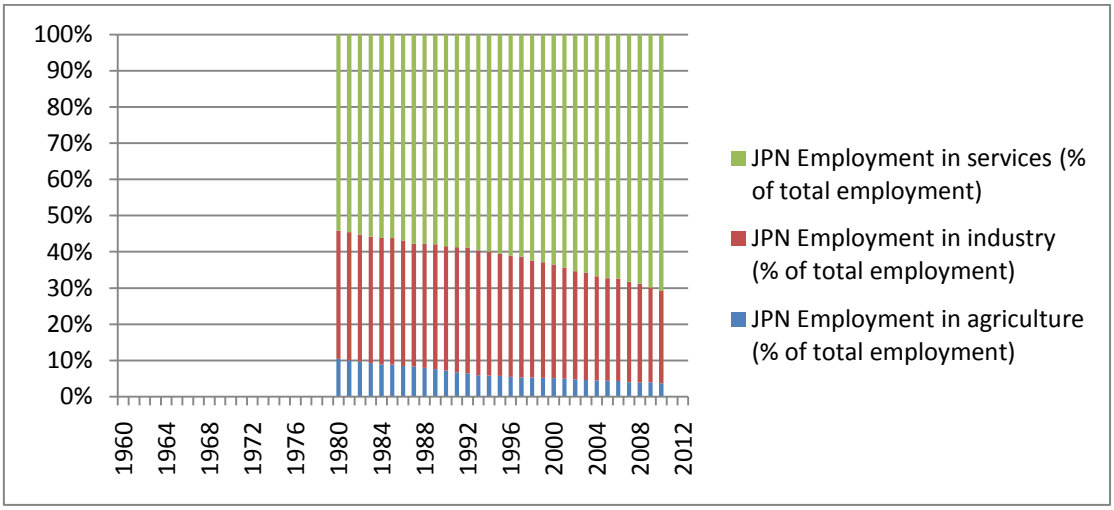
Moreover, it can be seen that this strategy started to pay off as Singapore's external balance becomes positive and shows positive trends (Graph 7a). The fact that Japan is not that open and its external balance fluctuates on the zero level implies that domestic consumption is probably of primary focus and that the revenues of exported goods is just enough to cover import costs.

Graph 7a. External balance in Japan and Singapore

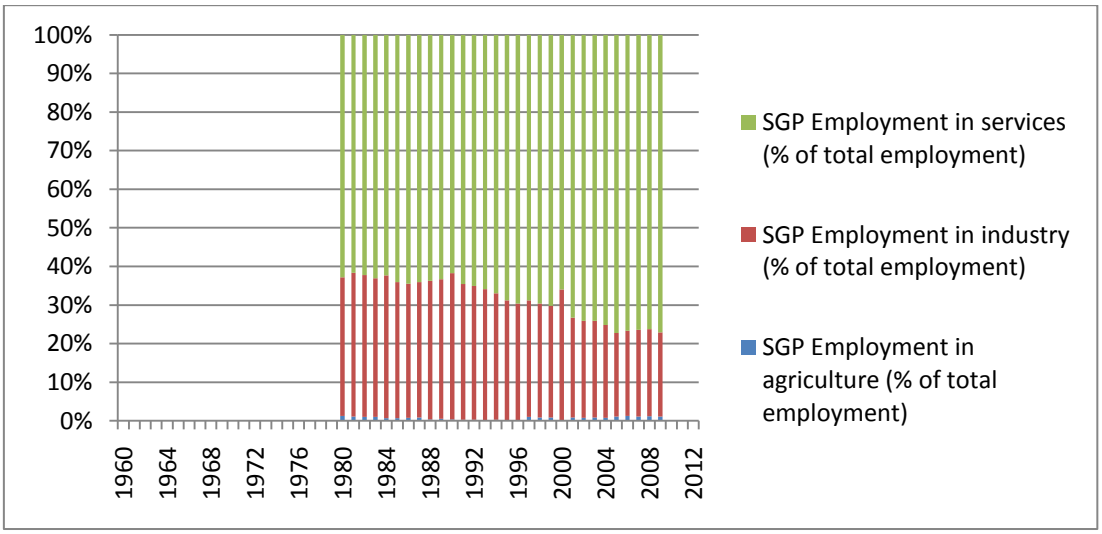


When it comes to labor composition by sectors, it could be said that except for agriculture, the patterns are quite similar, and in Singapore the service sector employs around 10-11% more of population than in Japan. The latter is explained by the geographical conditions and the utilisation of the neighbors' agricultural revolution.

Graph 8. Employment by sectors in Japan

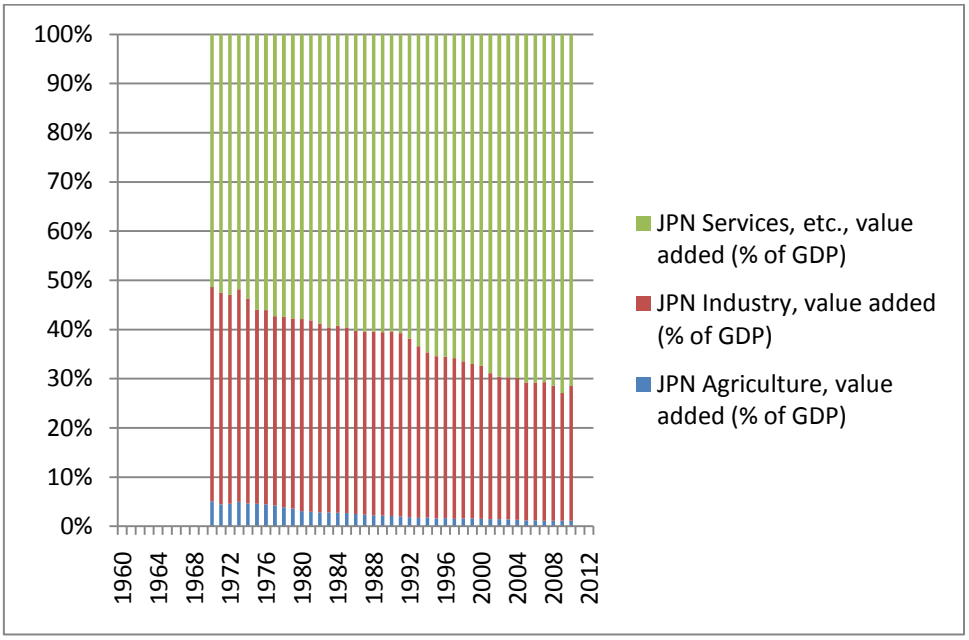


Graph 9. Employment by sectors in Singapore

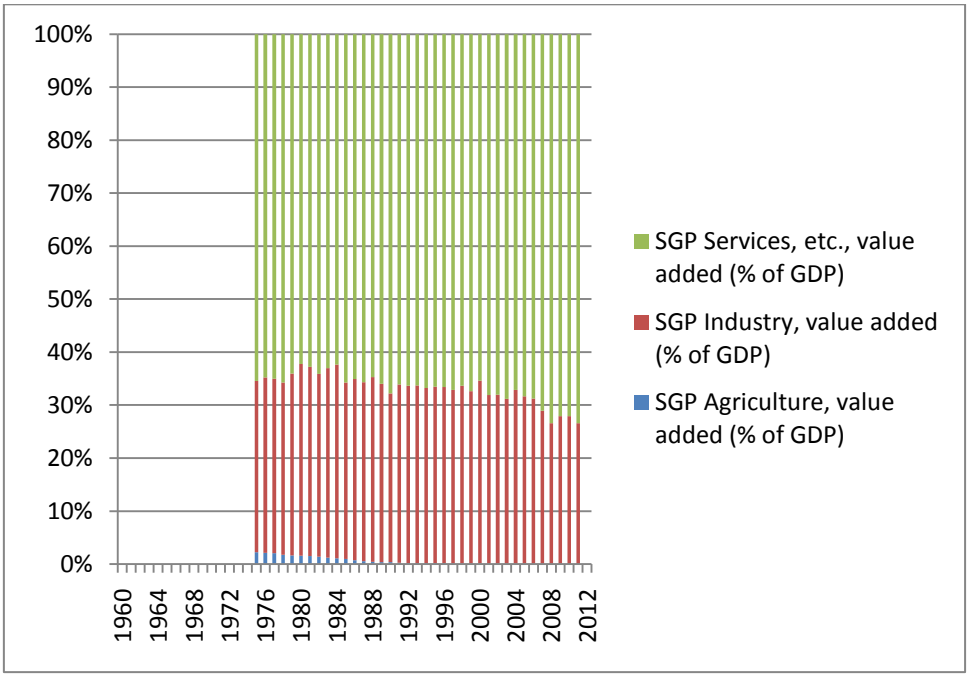


Changes in market prices might have been an important factor for the economy to transform in both cases, but Japan replaced a greater share of value added by the Industry sector to gains from the Service sector (graph 10). As for Singapore that process is going at a steadier pace (graph 11).

Graph 10. Structure of GDP in Japan



Graph11. Structure of GDP in Singapore



4.2 Empirical findings

Correlation and regression results: Japan

Correlations

		GDP_per_capita__constant_2000_US$_	GDP_per_capita__constant_LCU_	Population_total	GDP_per_capita__current_US$_
GDP_per_capita__constant_2000_US$_	Pearson Correlation	1	1,000**	,974**	,955**
	Sig. (2-tailed)		,000	,000	,000
	N	52	52	52	52
GDP_per_capita__constant_LCU_	Pearson Correlation	1,000**	1	,974**	,955**
	Sig. (2-tailed)	,000		,000	,000
	N	52	52	52	52
Population_total	Pearson Correlation	**,974****	**,974****	1	**,891****
	Sig. (2-tailed)	,000	,000		,000
	N	52	52	52	52
GDP_per_capita__current_US$_	Pearson Correlation	,955**	,955**	,891**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	52	52	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,983[a]	,966	,965	2102407,27545

a. Predictors: (Constant), GDP_per_capita__current_US$_, GDP_per_capita__constant_LCU_

Three measures of GDP per capita were used for the correlation matrix GDP per capita (constant 2000 US$), GDP per capita (constant LCU), GDP per capita (current US$) and total population. Initially, the idea was to use periods of development such as 1960-1980, 1980-2010, in order to get strong correlations but for the purposes of overview the whole period of 1960-2011 was taken.

As one can see, the correlation is very strong and the regression shows high R square which means that the variables included explain the model in most of the cases. But a potential limitation might be that the element of Total population is included in the GDP per capita measures, thus to test it another correlation was run.

Correlations

		Population_total	GDP__constant_2000_US$_	GDP__constant_LCU_	GDP__current_LCU_	GDP__current_US$_
Population_total	Pearson Correlation	1	,971**	,971**	,969**	,886**
	Sig. (2-tailed)		,000	,000	,000	,000
	N	52	52	52	52	52
GDP__constant_2000_US$_	Pearson Correlation	,971**	1	1,000**	,988**	,959**
	Sig. (2-tailed)	,000		,000	,000	,000
	N	52	52	52	52	52
GDP__constant_LCU_	Pearson Correlation	,971**	1,000**	1	,988**	,959**
	Sig. (2-tailed)	,000	,000		,000	,000
	N	52	52	52	52	52
GDP__current_LCU_	Pearson Correlation	,969**	,988**	,988**	1	,951**
	Sig. (2-tailed)	,000	,000	,000		,000
	N	52	52	52	52	52
GDP__current_US$_	Pearson Correlation	,886**	,959**	,959**	,951**	1
	Sig. (2-tailed)	,000	,000	,000	,000	
	N	52	52	52	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

This time the correlation was run using GDP (constant 2000 US$), GDP (constant LCU), GDP (current LCU), GDP (current US$), as these variables don't have any elements of Total population, but still present an evidently strong positive correlation.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,987[a]	,974	,973	1844261,92454

a. Predictors: (Constant), GDP__current_US$_, GDP__current_LCU_, GDP__constant_2000_US$_

The R square in the regression model does not differ much from previous results. All the regressions will use Population total as a dependent variable.

Correlation and regression results: Singapore

Correlations

		GDP_per_capita__constant_2000_US$_	GDP_per_capita__constant_LCU_	GDP_per_capita__current_US$_	Population_total
GDP_per_capita__constant_2000_US$_	Pearson Correlation	1	1,000**	,978**	,992**
	Sig. (2-tailed)		,000	,000	,000
	N	52	52	52	52
GDP_per_capita__constant_LCU_	Pearson Correlation	1,000**	1	,978**	,992**
	Sig. (2-tailed)	,000		,000	,000
	N	52	52	52	52
GDP_per_capita__current_US$_	Pearson Correlation	,978**	,978**	1	,979**
	Sig. (2-tailed)	,000	,000		,000
	N	52	52	52	52
Population_total	Pearson Correlation	,992**	,992**	,979**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	52	52	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

A similar picture is observed in Singapore with GDP per capita measurements and a similar number on the regression model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,993[a]	,986	,985	123119,16982

a. Predictors: (Constant), GDP_per_capita__current_US$_, GDP_per_capita__constant_LCU_

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,995[a]	,989	,989	108191,70262

a. Predictors: (Constant), GDP__current_US$_, GDP__constant_LCU_, GDP__current_LCU_

Correlations

		Population_total	GDP__constant_2000_US$_	GDP__constant_LCU_	GDP__current_LCU_	GDP__current_US$_
Population_total	Pearson Correlation	1	,987**	,987**	,976**	,959**
	Sig. (2-tailed)		,000	,000	,000	,000
	N	52	52	52	52	52
GDP__constant_2000_US$_	Pearson Correlation	,987**	1	1,000**	,998**	,986**
	Sig. (2-tailed)	,000		,000	,000	,000
	N	52	52	52	52	52
GDP__constant_LCU_	Pearson Correlation	,987**	1,000**	1	,998**	,986**
	Sig. (2-tailed)	,000	,000		,000	,000
	N	52	52	52	52	52
GDP__current_LCU_	Pearson Correlation	,976**	,998**	,998**	1	,993**
	Sig. (2-tailed)	,000	,000	,000		,000
	N	52	52	52	52	52
GDP__current_US$_	Pearson Correlation	,959**	,986**	,986**	,993**	1
	Sig. (2-tailed)	,000	,000	,000	,000	
	N	52	52	52	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Though these results indicate a very strong positive correlation between measures of GDP, GDP per capita and Total population, they do not show the direction of causation. In addition both cases might be successful examples where economic growth goes alongside population growth.

4.3 Analysis

It can be derived from the data that growth in GDP and GDP per capita have a strong positive correlation with growth in population. The data analysis showed that the variables included into the regression model explain most of the cases and that correlations are significant. In addition, according to demographics theory it can be stated that Japan has been in the last stage in demographic transition for the past few decades while Singapore caught-up later. However, this might not necessarily explain why despite having better economic and demographic indicators than Japan, Singapore was able to catch-up with more developed neighbor.

Singapore succeeded in maintaining quite high estimates of TFP of an average of 1,5% per year (Bosworth and Collins, 1996 in Quibria, 2002) and was able to benefit from openness and international competition by establishing a strong export-oriented economy with a positive external balance. This explanation is framed within neoclassical growth theory.

Perhaps no less important of a role was played by human capital, as Singaporean educational institutions combined with access to technologies and a favorable investment environment made it possible to make use of human capital to create high-output. The more people to invent things, the bigger the market for inventions and the greater the rate at which inventions will be discovered (Romero in Obstfeld and Rogoff, 1996, p.492). In that sense a continuous supply of high-skilled labor would lead to growth and boost innovation. Such an explanation reflects the idea of endogenous growth .

A study by Wong Hock Tsen and Fumitaka Furuoka asserts that for Singapore's population, Granger causes economic growth, while for Japan there is bidirectional Granger causality. Granger causality test uses time lag and time series techniques for determining useful information about causality. These results of the Granger causality test imply that for Singapore the rise of population had an effect on economic growth, while for Japan it could be that both population growth and economic growth influenced each other (Wong Hock Tsen & Fumitaka Furuoka, 2005).

5. Concluding remarks

5.1. Conclusion

Determination of the stage of growth according to demographic theory could be useful in the sense that it reflects ideas and consequences of structural change in the economy and this process may not necessarily be one-directional. Japan and Singapore achieved tremendous economic growth and underwent all stages of demographic transition. However, in Singapore economic growth could be caused by processes of population growth while in Japan the process was bidirectional.

It has to be taken into account that these conclusions are drawn for two countries with more or less similar economic and population structures. Even in countries where correlation between economic growth indicators such as GDP, GDP per capita and population is positive and strong, the direction of causality can be controversial. The theory of endogenous economic growth supremely well explains growth in Singapore from a demographic perspective. Nevertheless, the neoclassical economic growth theory explains other factors that were of no less importance but it lacks an explanation as to the changes in technological advancements, innovation and human capital.

To conclude, it has to be said that the importance of the relation between population growth and human welfare has found strong ground since Malthus' era. Its contemporary significance is that understandings of this process will be helpful and conducive to designing economic or demographic policies. Last but not least, there are challenges involved with maintaining a moderate rate of population growth.

5.2 Future research

The demographic perspective on the theories of economic growth becomes an interesting topic especially when the contexts of population aging and potential decline in national savings are brought up. Further theories used the term "migration" within the country or between the sectors; nevertheless, the study involving country-to-country migration variables may provide no less interesting results as there are aging countries with predicted labour shortages and developing countries with growing populations.

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