Demographic Dynamics and Economic Take-Off: the Economic Impact of China's Population-Control Policies

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Abstract

This paper has developed and tested a simple theory of demographic dynamics and economic take-off. It is shown that the standard econometric estimation conceals the "take-off effect" and therefore will underestimate the economic impact of demographic changes. Using the developed theory, we show that the key economic impact of China's population-control policies is that they have moved forward by a decade the timing of the economic take-off in China, and their actual impact on China's economic growth could be twice as large as that estimated by the traditional econometric method.

Key Words: China's one-child policy, Demographic dynamics, Economic take-off, Dependency ratio.
JEL Classification: O5, J1

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1. Introduction

Between 1979 and 2003 China achieved on average an annual growth rate of 9.42% in real GDP in a country with a population now estimated to be 1.3 billion. Even on the real GDP per capita basis, its growth reached on average 8.12% per year during the same period. Most people have credited this economic miracle to China's adoption of an open-door policy in the late 1970s and the subsequent pro-market economic reforms. However, economic policy was only one of the two pillars in China's quest for modernization. The other is the population-control policy. The Chinese government at the time believed that modernization would not take place without controlling its fast-growing population. Since the 1970s China has embarked on the most extraordinary attempt to control population in human history, among which the most well-known is the so-called one-child policy (one child per couple, which came out in 1979-80). Western countries have been very critical about China's controversial population-control policies but the Chinese government believes that these policies have contributed to modernization in China. The real impact of this ambitious population-control plan on China's economic growth, however, has received little attention. The purpose of the paper is to conduct some initial inquiries on this important topic.

To investigate the economic impact of China's population-control policy, we have to answer the following two questions: (i) to what extent have China's population-control policies affected the demographic transition in China? and (ii) to what extent has the demographic transition contributed to the economic growth in China?

Before answering these questions, we shall take a look at the literature on the relationship between demographic dynamics and economic growth. Recent progresses in the research on population and economic growth have focused on the demographic/age structure of the population.[1] For example, Bloom and Williamson (1998) have shown that after taking into account the changes in age structure, (i) population growth has a negative impact on economic growth; [2] (ii) the growth of an economically active population has a positive impact on economic growth; (iii) the *dependency ratio*[3] (or its inverse, the ratio of working-age to nonworking-age population) has a strong effect on the economic growth, in and across the sub-regions in Asia. They find that as much as one-third of East Asia's economic miracle between 1965 and 1990 can be explained by the region's population transition in that period (i.e. an increasing working-age relative to nonworking-age population). In general, economic growth is found to be less rapid when this ratio is decreasing, and more rapid when increasing.

If the demographic structure in China would follow the pattern similar to those in East Asia,[4] then how can China justify its drastic population-control policies especially given the huge human cost involved in their implementation? These policies of course have increased the ratio of working-age to nonworking-age population but if the ratio itself was on the course of increasing, the question that one should ask must be this: to

[1] See the early contributions in Brander and Dowrick (1994), Kelley and Schmidt (1995).
[2] Earlier studies about the economic impact of population growth have mixed results because they failed to take into account the structure of population.
[3] The dependency ratio is the ratio of non-working age to working-age population.
[4] See Bloom and Williamson (1998) for a very detailed description of the changing demography in East Asia during the postwar period. In Section 3 I will discuss in detail the population-control policies and demographic transition in China.

what extent have these policies increased the ratio of working-age to nonworking-age population, and the economic growth in China?

According to Greenhalgh (2003), the one-child policy has averted 300 million births since its introduction in 1979-80. That is, on average, 13 million births were averted each year during that period. Suppose the 13 million births were added to the population each year. This would roughly reduce the ratio of the working-age to total population by 0.75% for the years between 1980 and 1995.[5] If we use the estimates from Bloom and Williamson (1998), this would imply on average a 0.78% reduction in the annual growth rate of the real GDP per capita in China. This means that without the one-child policy, China's real GDP per capita in 1995 would have been 13.2% lower.

As will be shown in this paper, however, the standard econometric estimation only captures an "averaging effect" and therefore it will very likely underestimate the true magnitude of the economic impact of China's population-control policies. The standard econometric estimation conceals a very important effect, i.e. the so-called "take-off effect". The take-off effect is well-known to the development economics and is a very important development process of many fast-growing economies. Many emerging economies had experienced an initial period of moderate growth, and then the economy took off and they moved on to a period of rapid growth. The take-off effect has been attributed to the increases in capital inflows, savings, etc. The current paper, however, focuses on the relationship between demographic transition and economic take-off.

[5] Only the dependent and total populations have to be adjusted before 1995 because those who were born during this period still remain part of the dependent population.

Specifically, it will for the first time make the connection between economic take-off and demographic structure.

2. Demographic Dynamics and Economic Take-Off

2.1 A Simple Theory

The logic for the linkage between demographic structure and economic take-off is actually very intuitive, although it has never been formally established in the literature. [6] We can establish the theory by combining the findings from the following three strands of literature:

(i) The Literature on Threshold Externalities in Development Economics. To explain the striking differences in development patterns among nations and between different periods of the development stages in a country, Azariadis and Drazen (1990), for example, have introduced the "threshold externalities" into the production function that permits returns-to-scale to rise very rapidly whenever an economic state variable, such as capital stock (or the quality of labor), take on values in a relatively narrow critical mass range. See Galor and Tsiddon (1991), Futagami and Mino (1993), among many others, for the subsequent literature.

(ii) The Literature on Demographic Structure and Saving Rates. It was suggested a long time ago that birth rates should be inversely related to a country's saving potential. Following this logic, Leff (1969) found early evidence that dependency rates and saving rates were also inversely related. The intuition is that children constitute a heavy charge

[6] Coale and Hoover (1958) provided the earliest intuitive discussion on the linkage between demographic transition and economic growth (but not economic take-off).

for consumption expenditure, resulting in reductions of saving potential.[7] In other words, low dependency ratios should lead to high saving rates.[8]

(iii) The Literature on Savings and Domestic Investment. The high correlation between savings and domestic investment was first found in a very influential study for Japan by Feldstein and Horioka (1980), which was subsequently confirmed by others in numerous empirical studies for many countries. The key message of the finding is that even in an increasingly globalized capital market, investment portfolios are far from being diversified across the countries. Therefore, the higher a country's saving rate, the more its domestic investment.

The linkage is now complete. To summarize briefly, the logic goes as follows. For economic take-off to occur, the economy has to accumulate enough capital. A large amount of capital could come from either an influx of foreign capital, or an increase in domestic investment (which is highly correlated with domestic savings). A low dependency ratio (i.e. a high ratio of working-age to nonworking-age population) increases domestic saving rates. Therefore, if the ratio of working-age to nonworking-age population passes above a certain level, savings (and then the domestic investment) will be high enough and this will contribute to the economic take-off.

Now we can incorporate the above theory into the standard econometric models for demography and economic growth. According to the neoclassical growth model of

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[7] Most studies of macro data confirm this finding. See Higgins and Williamson (1997), among others.

[8] Horioka and Wan (2006) recently found evidence supporting a negative relationship between the dependency ratios and saving rates in China between 1995 and 2004.

conditional convergence, the growth of output per worker depends positively on the difference between the stead-state and the current level of output per worker:

$$g_y = \lambda(y^* - y) \tag{1}$$

where g_y is the growth rate of output per worker, y is the natural logarithm of the initial level of output *per worker*, and y^* is that of the steady-stage level. The latter is determined by a set of factors,

$$y^* = \mathbf{X}\tilde{\boldsymbol{\beta}} \tag{2}$$

where $\tilde{\boldsymbol{\beta}}$ is a vector of parameters, and $\mathbf{X}$ typically includes variables/indexes such as natural resource abundance, human capital, geography, and economic policy (see Bloom and Williamson, 1998).

Let $\tilde{y}$ denote the natural logarithm of output *per capita* and then we have

$$\tilde{y} = y + \ln(L/P) \tag{3}$$

where L is the labor and P is total population. Using (1)-(3), we can express the growth rate of output per capita as

$$g_{\tilde{y}} = \mathbf{X}(\lambda\tilde{\boldsymbol{\beta}}) - \lambda\tilde{y} + (1+\lambda)\ln(L/P) \tag{4}$$

Therefore, we will use the following econometric equation for estimating (4),

$$g_{\tilde{y}} = \alpha_o + \alpha_1\tilde{y} + \alpha_2 \ln(L/P) + \mathbf{X}\boldsymbol{\beta} + \varepsilon \tag{5}$$

According to our theory, we obtain the following hypothesis.

Hypothesis 1: *There is a structural break in parameter,* α_2 *, corresponding to a threshold value in L/P.*

2.2. The Evidence

Table 1 in the appendix provides a list of the 11 Asia-Pacific countries/regions included in the data set we use for our estimation. These countries all have experienced a period of rapid growth since 1960. Our choice of countries is also limited by the lack of data for the entire sample period (e.g. some countries in the region have data only starting from 1980 or 1990). For each of these 11 countries we have obtained annual data between 1960 and 2007 for the variables related to the GDP and population from the World Bank, and the rest of the variables from the other related research papers cited in this paper.

If we estimate equation (5) in a traditional way, the estimated coefficient for **LNL/P** only captures the averaging effect of demographic structure on economic growth.[9] To test **Hypothesis 1** and because the threshold value in L/P is unknown, we use Bai-Perron method (1998) to estimate and test structure breaks in equation (5). The results of our estimation of equation (5) are summarized in Table 2 below.[10]

Table 2: Output from the estimation of the model selected by BIC

The model with 1.0000 breaks has SSR: 10885.9663

The dates of the breaks are: 82.0000

Variable	Estimate	Std. Error	t-value	Prob.
X1 (TropicalArea)	−1.682008	0.497398	−3.381614	0.001
X2 (Openness)	2.884225	0.632916	4.557039	0.000
X3 (Y_o)	−0.326629	0.216829	−1.506387	0.133
X4 (LnL/P)	−1.309286	2.350226	−0.557089	0.578
X5 (LnL/P)’	29.920884	5.246673	5.702830	0.000

[9] Bloom, Canning, and Malaney (2000) try to account for the extra information by adding growth rates of total and working-age populations when estimating equation (5). However, it is very difficult to theoretically justify the use of both growth rates and logarithm of populations in the same equation.

[10] More detailed information of our estimation is reported in the appendix.

The dependent variable for the above estimation is the annual growth rate of real GDP per capita (from the World Bank). The variable of **TropicalAarea** is a country's proportion of land in tropical area (from Gallup, Sachs and Mellinger, 1999) and it has a negative impact on the growth rate. The **Openness** is an index for a country's openness (from Sachs and Warner, 1995) and it has a positive impact on the growth rate. Y_o is the initial level of real GDP per capita in year 1960 (World Bank). It has the correct sign but is very weakly statistically significant (with a p-value of 0.133).

LnL/P is the logarithm of the ratio of a country's working population to its total population (World Bank), which is the variable of our main interest. The Bai-Perron method is capable of identifying multiple structural changes, but it only finds one structural break of **LnL/P** in equation (5). The value of the variable (L/P) associated with the break date 82 (as reported in Table 2) is 0.603. A simple conversion/calculation reveals that 1.52 is the corresponding value for the threshold ratio of working-age to nonworking-age population, or working population to dependent population, [i.e. L/(P-L) or W/D]. The estimated coefficient for X_4 is the effect of **LnL/P** on the growth rate *before* the break, but since it is statistically insignificant (with a large p-value of 0.578), we cannot reject the null hypothesis of zero. The estimated coefficient for X_5, **29.920884,** is the effect of **LnL/P** on the growth rate *after* the break and is very large and statistically significant. The results are very interesting and indicate that the threshold effect is very significant. When the W/D ratio was smaller than 1.52, an increase in the W/D ratio had little effect on the growth rate of real GDP per capita. When it reaches around the threshold value of 1.52, however, an increase in the W/D ratio has a very significant positive effect on growth rate and the economy starts to take off.

Our econometric findings can also be illustrated using Figures 1-4 in the appendix, in which I plot the real GDP per capita and the ratio of working-age to nonworking-age population for Thailand, Malaysia, Indonesia, and South Korea.[11] The figures of real GDP per capita show that these emerging economies have all experienced a similar path from slow to moderate and then rapid economic growth. A further investigation of the real GDP per capita, together with the demography figures (W/D ratio), reveals the intriguing part of our theory. Even during the period in which the ratio of working-age to nonworking-age population is increasing, the pattern of economic growth is very different. They are all characterized by an initial period of moderate growth and then followed by an economic take-off. More interestingly, all these take-off effects started to emerge when the ratio of working-age to nonworking-age population reached a threshold value. They are all around the value of 1.52, confirming our finding by the Bai-Perron method.

[Figures 1-4 Here: See Appendix]

3. An Application: the Economic Impact of China's Population-Control Policies

The relationship between demographic transition and economic take-off is also no exception in China. In Figure 5 in the appendix I plot China's real GDP per capita (in constant 2000 US$) and the ratio of working-age to nonworking-age population. From the figure of per capita GDP, notice that it took almost 30 years, between 1950 and 1980,

[11] The working-age is 15-64, and the nonworking-age includes child (0-14) and old-age (65+).

for China to first double its per capita GDP. Then, the economy took off in the early 1980s and it only took the next 10 years for China to double its GDP per capita once again. More importantly, notice that the ratio of working-age to nonworking-age population had already started to rise from 1970,[12] but the economy was still growing very slowly. It was only when the ratio of working-age to nonworking-age population reached the threshold value in 1981-2, that the economy began to take off.[13]

[Figure 5 Here: See Appendix]

Therefore, to investigate the economic impact of China's population-control policy, first we need to know to what extent China's population-control policies affected its demographic transition and especially the threshold value for the ratio of working-age to nonworking-age population that contributed to the economic take-off.

3.1. China's Population-Control Policies and Demographic Transition

Figure 6 in the appendix has three curves that describe China's population growth (level), crude birth and death rates between 1949 and 1996. Notice that birth rates had been on a steady decrease since 1971 and reached 17.82‰ in 1979, the lowest level since 1949. Then, in late 1979 and early 1980 China introduced the one-child policy, a new and tougher population-control policy that allows only one child for each couple. One might wonder: given that its previous policy worked so well, why did China wanted to switch to a new policy? More interestingly, a casual look at the birthrate curve might

[12] Section 3.1 will discuss the changing demography in China in detail.
[13] Since the retirement age in China is 60 and this Section focuses on China, we have adjusted the working-age to 15-60, and the other age groups accordingly. The two types of curves are very similar, however.

suggest that China's one-child policy failed to reduce the birth rate. The birth rate actually went up in the 80s, the first decade following the implementation of the one-child policy. Indeed some Chinese officials were disturbed by the numbers they saw (see Figure 6: the birth rate went up to 22.28‰ in 1982, and 23.3‰ in 1987).

[Figure 6 Here: See Appendix]

However, the implementation of the one-child policy was considered very successful in almost all urban areas though less successful in rural areas. Therefore, in order to understand the real impact of the one-child policy on China's demographic transition, we need to review China's population policies since 1949, and in particular, the reasons behind the steady decline of the birth rates in the 70s.

During the first few years of the post-1949 period, China's leaders had a view that a large population was an asset (which was influenced by the traditional Chinese culture). But soon China started to become aware of the liabilities of a large and rapidly growing population.[14] When China's first population census of 1953 showed that its population (on the mainland) was already close to 600 million and was increasing at a rate of over 2% a year, many people were caught by surprise. As a result, in the late 1956 China started its first campaign on birth control but it was soon interrupted by the devastating famine caused by the "Great Leap Forward"[15]. To some extent, the 1956 campaign

[14] A fast growing population during this period was not unique to China. Other Asian countries also had a similar experience at the beginning of the postwar period, which was mainly due to rapid reductions in child mortality (Bloom and Williamson, 1998).

[15] The "Great Leap Forward" was a disastrous economic experiment/experience for China, which significantly reduced industrial and agricultural productions and as the result, the famine occurred.

reduced the birth rate, but it was the famine that really brought down the birth rate between 1958 and 1960. But neither the campaign nor the famine actually had any significant impact on *fertility* since right after the beginning of the 1960s the birth rate jumped back to, and even surpassed in some years, the previous levels in the early 50s.[16] This is a familiar phenomenon after a famine or war during which people often delay their decisions on childbirth.

During the early 1960s China started the second birth-control campaign that emphasized the virtues of late marriage. The second campaign again soon came to a halt when the "Cultural Revolution" began in 1967. However, during the Cultural Revolution many young people from urban areas were sent to the rural areas and as a result, many delayed their marriage and childbirth decisions (which had nothing to do with the birth-control campaign).

In 1971 China started to reenergize its halted campaign on birth control but this time under a new slogan, "later, longer, and fewer", which called for delayed marriage, greater spacing between babies, and fewer children in total. Between 1971 and 1979, the "later, longer, and fewer" campaign reduced the birth rate by as much as 50% and the campaign was very successful (Yang, 1996).

However, neither the birth-control campaigns in the early 60s and between 1971 and 1979, nor the Cultural Revolution, had fundamentally affected the fertility rate in

[16] The birth rate is the actual number of childbirths per 1000 persons per year. The total fertility is the average number of children that would be born to a woman over her lifetime if she were to experience the current age-specific fertility rates through her lifetime.

China. Although to some extent they reduced the fertility rate by delaying marriages and decisions on childbirth, the long-term effect was limited. For instance, in the mid-70s, a married couple could still have two children in cities, and three or four in the country. Without significantly reducing the number of children each couple produces, the delaying strategies can work only in the short-run and remain effective for 10-15 years at most. In 1979 China was exactly at this critical point where the previous delaying strategy on birth control became much less effective. To make the matter worse, the delaying effect on childbirth of the 10-year long Cultural Revolution came to a stop when many who were sent to the rural areas started to move back to their original cities in 1978-79. Furthermore, the previous baby-boomers born after the famine would soon start to produce their children. Therefore, without a new policy, soon the birth rate in China would have jumped back significantly. It is under this background that China started the one-child policy in 1979-80.

As mentioned earlier, however, the birth rate actually went up in the 80s. Some studies have associated the higher birth rate in the 80s with the baby boomers born after the famine. If we take a closer look at the birthrate curve in Figure 6, however, we see that there are actually two peaks during the 1980s, one in 1982 and the other 1987. The first peak should not be related to the baby boomers because the peak of the baby boomers happened in 1963 and the peak age-at-birth for Chinese women is in their 20s. It is actually the bouncing-back effect as a result of the delaying strategies of the previous population-control policies and a decade of Cultural Revolution. The peak birthrate in 1987 matches the peak of the baby boomers of 1963 perfectly, and it is the arrival of the second generation of those baby-boomers. If the one-child policy had not been implemented, the birthrates would have jumped back much higher during the 1980s. The one-child policy significantly curbed the increase of the birthrates in the 1980s and, more importantly, has permanently changed the demographic trend and the total fertility rate in China.

3.2. The Impact on the Demographic Structure and Timing of Economic Take-Off

To evaluate the economic impact of China's population-control policies, first we would like to know their impact on the birthrates and subsequently the ratio of working-age to nonworking-age population. What would have happened to the birthrates in China in the absence of those policies? As discussed earlier, according to Greenhalgh (2003), the one-child policy has averted 300 million births. In Figure 7 in the appendix, I have drawn a trajectory for the birthrates in China between 1949 and 2005. But our focus is on the segment between 1970 and 2005, during which China started the "later, longer, and fewer" campaign, followed by the one-child policy. One can of course draw a slightly different trajectory but the trajectory drawn in Figure 7 is very conservative. It implies that the difference between the actual birthrates and the trajectory avoided 200 million births between 1980 and 2004 (rather than 300 million claimed for the same period), and 300 million for the entire period of 1970-2004. There are two reasons for choosing this trajectory. First, we try to take into account the lower birthrates between 1968 and 1978 as a result of the Cultural Revolution. Second, using the trajectory in Figure 7, we will likely underestimate the impact of China's population-control policies and, as will become clear, strengthen the argument we try to make in this paper.

[Figure 7 Here: See Appendix]

From the birthrate trajectory in Figure 7, we can calculate the new ratio of working-age to nonworking-age population. While the old-age population is not affected by the difference between actual birth rate and the trajectory in this period, both child population and working-age population have to be adjusted. It has to be adjusted for the entire period for the child population but only for the period after 1984 for the working-age population (since the newborns will enter into the working-age population after 15 years).

As in Figure 8a in the appendix, the new adjusted curve for the ratio of working-age to nonworking-age population is lower than the actual curve between 1970 and 2004. That is, in the absence of these policies, the ratio would have gone down even further after 1970 and reached the lowest point around 1978-79 before it starts to climb back. More importantly, this means it would have taken an extra 10 years for the ratio of working-age to nonworking-age population in China, probably in 1992, to reach the threshold value for economic take-off to take place.

[Figures 8a-8b Here: See Appendix]

What would have happened to China’s real GDP per capita if the timing of its economic take-off were delayed by 10 years: that is, if the economic take-off were to take place in 1992, rather than in 1982? Then, the growth of real GDP per capita between

1982 and 1992 would have followed the same pattern as that prior to the economic take-off,[17] and we also assume the growth of real GDP per capita after 1992 would have followed the same patterns/rates as those that actually happened after 1982. According to this principle, Figure 8b has plotted the actual real GDP per capita and the projected real GDP per capita (i.e. without population-control policies). Notice that the initial difference is small but the gap gradually increases. By 1995, for example, the actual level of real GDP per capita reached US$658 but the projected was only US$520. That is, because of China's population-control policies, its real GDP per capita in 1995 was 26.5% higher than otherwise.

However, the purpose of the above analysis is not really trying to estimate the true magnitude of the economic impact of China's population-control policies. To do that, we need a much more accurate Figure 7 and also more variables for our estimation. Rather, our real purpose is to compare the difference in the estimated economic impact of China's population-control policies between the tradition econometric method and our developed theory.

To make such a comparison, we directly estimate equation (5) (i.e. without using Bai-Perron method) and the results are reported in Table 3 in the appendix. We can use the estimated coefficient for **LnL/P** from Table 3 (i.e. only capturing the averaging effect) to examine the economic impact of China's population-control policies. Using the same birthrate trajectory in Figure 7, we first adjust the data for total population, working-age population, and the real GDP per capita for the period after 1982. Then, using equation

[17] We use the average growth rate of the most recent four years prior to the economic take-off.

(5) and the estimated coefficient in Table 3, we adjust the growth rates and calculate the estimated annual GDP per capita for the period between 1982 and 2007. From Figure 9 in the appendix, we can see that the estimated annual per capita GDP (from using the averaging effect) is above the projected (after capturing the take-off effect). That is, using the traditional econometric estimation will underestimate the economic impact of China's population-control policies. For example, in 1995 the estimated level of real GDP per capita is around US$579. According to this calculation, China's population-control policies would have increased real GDP per capita by only 13.4% in 1995, half of the size we have found above.

[Figure 9: See Appendix]

4. Concluding Remarks

The paper has developed a simple theory of demographic dynamics and economic take-off. In addition, we have also found some empirical support for the theory. We show that the standard econometric estimation only captures an "averaging effect" and therefore it underestimates the true magnitude of the economic impact of demographic changes. The standard econometric estimation conceals the so-called "take-off effect" in the development economics.

Using this theory, we show that the key economic impact of China's population-control policies is that they have moved forward the timing of China's economic take-off by a decade. We also find that the economic impact of China's population-control policies identified by using the proposed theory is much larger than that identified by the standard econometric method.

We have also provided an in-depth analysis of China's population-control policies and shown that since 1956 China has launched several campaigns in order to control a large and fast growing population, but it is the one-child policy that has permanently changed the demographic trend and the total fertility rate in China.

Some may think that the real impact of the one-child policy on the total fertility in China cannot be assessed until all women who came of childbearing-age in the early 1980s passed their fertile years. This would be a valid point if China had not had any other measure of population control and the one-child policy was just an isolated policy. Based on the above analysis of China's demographic dynamics, however, we have already seen the fundamental and long-term impact of the one-child policy on total fertility and demographic trends in China. This can also be confirmed by the following two observations. *First*, from Figure 5, notice that the ratio of working-age to nonworking-age population started to increase from the lowest level in 1970 but it was only after 1982, after China started the one-child policy, the ratio began to rise above the threshold value of 1.52 and the economy took off thereafter. *Second*, from Figure 7, notice that after China came out of the period of relatively high birthrate in the 1980s, in 1992 the birth rate reached the lowest level since 1949 and it has continued to decline. More strikingly, the declining trend after 1996 is even faster than the period of 1992-1996. This suggests that there are other factors, in addition to the one-child policy, that contribute to the continuously declining of the birth rates in China.

As is shown in McNicoll (2006), since late 1990s China's total fertility rate and its trajectories have paralleled the decline in Taiwan. This suggests that since late 1990s the income effect on demographic transition has started to play an important role because China has doubled its real GDP per capita every 12 years since 1980. The income effect on demographic transition will become increasingly important in China. As a result, birth rates will continue to decline. But the death rates in China will increase because of its ageing population). It is my view that during the first 15 years of its implementation, China's one-child policy played a significant role in transforming the demographic trend in China, but like its predecessors, its major historical role has probably come to an end.

Research on demographic dynamics and economic growth provides some insight for understanding the future of economic growth and has important implications for a country's population policy. If we believe the important impact of demographic structure on economic growth, China now should replace the one-child policy with a more relaxed population-control policy. From Figure 10 in the appendix, we see that China's "demographic gift" has just reached its peak. The windows of opportunity of the "demographic dividend" will pass through shortly. In 15 years, China will face its major burden of seniors when the baby boomers start to retire from year 2023 (also see Figure 6). The ratio of working-age to nonworking-age population will dip below the threshold value again.

[Figure 10: See Appendix]

Appendix

Table 1: Country List

China, Mainland
Fiji
Hong Kong
Indonesia
Japan
Korea
Malaysia
Papua New Guinea
Philippines
Singapore
Thailand

Table 2: Output from the estimation of the model selected by BIC

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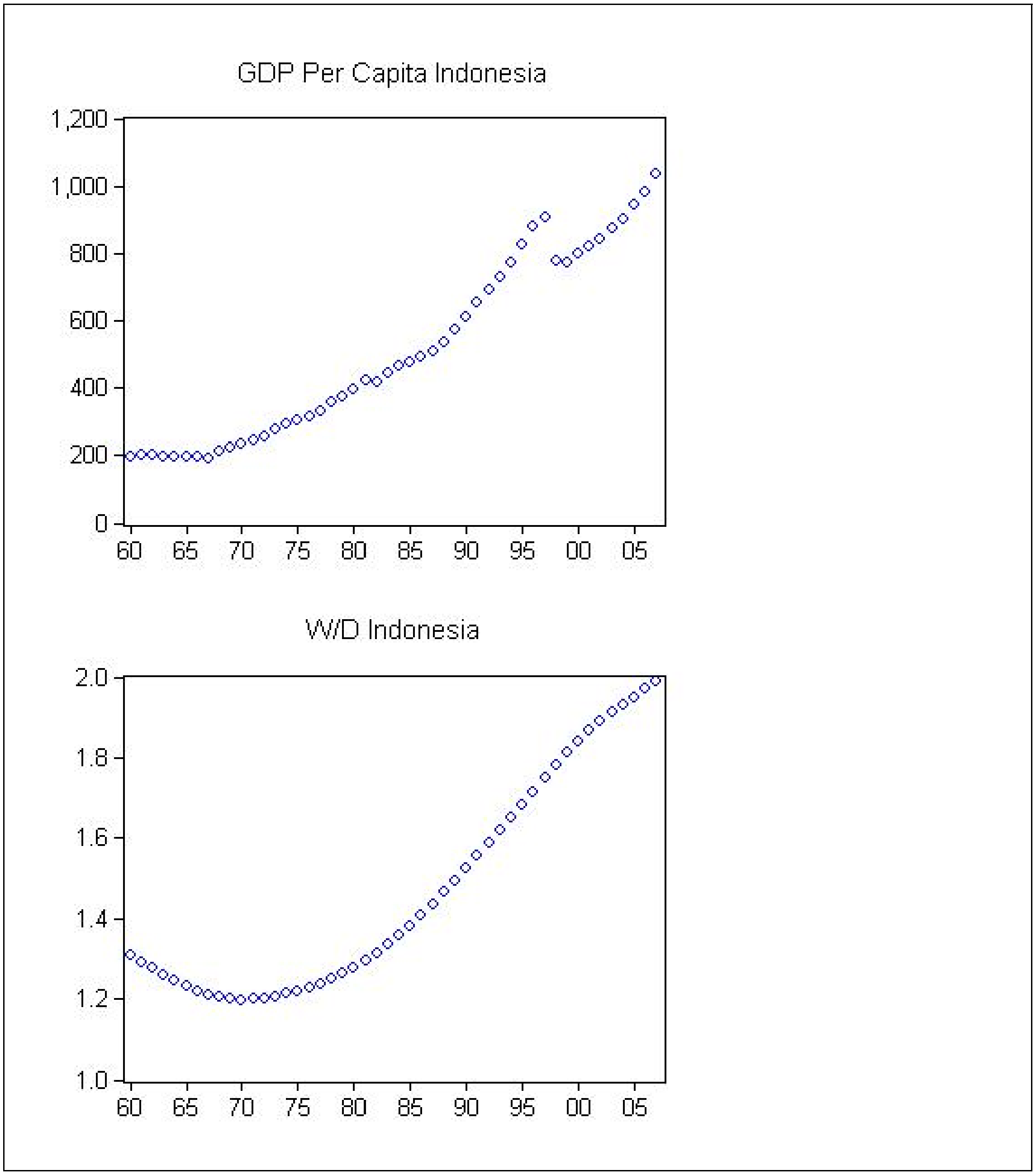
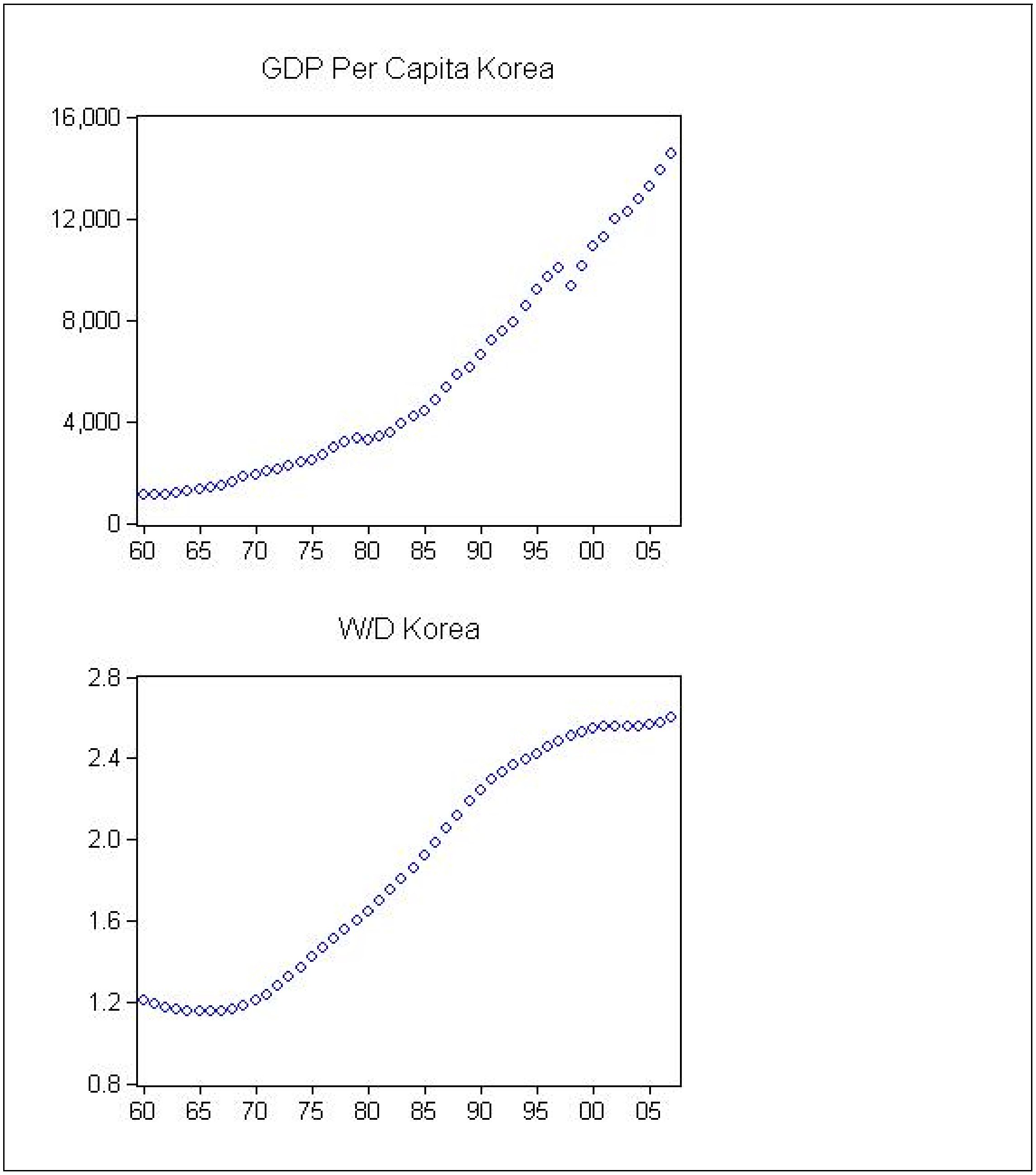
--------------------------------------------------------------
The model with 1.0000 breaks has SSR :  10691.1221
The dates of the breaks are:   88.0000

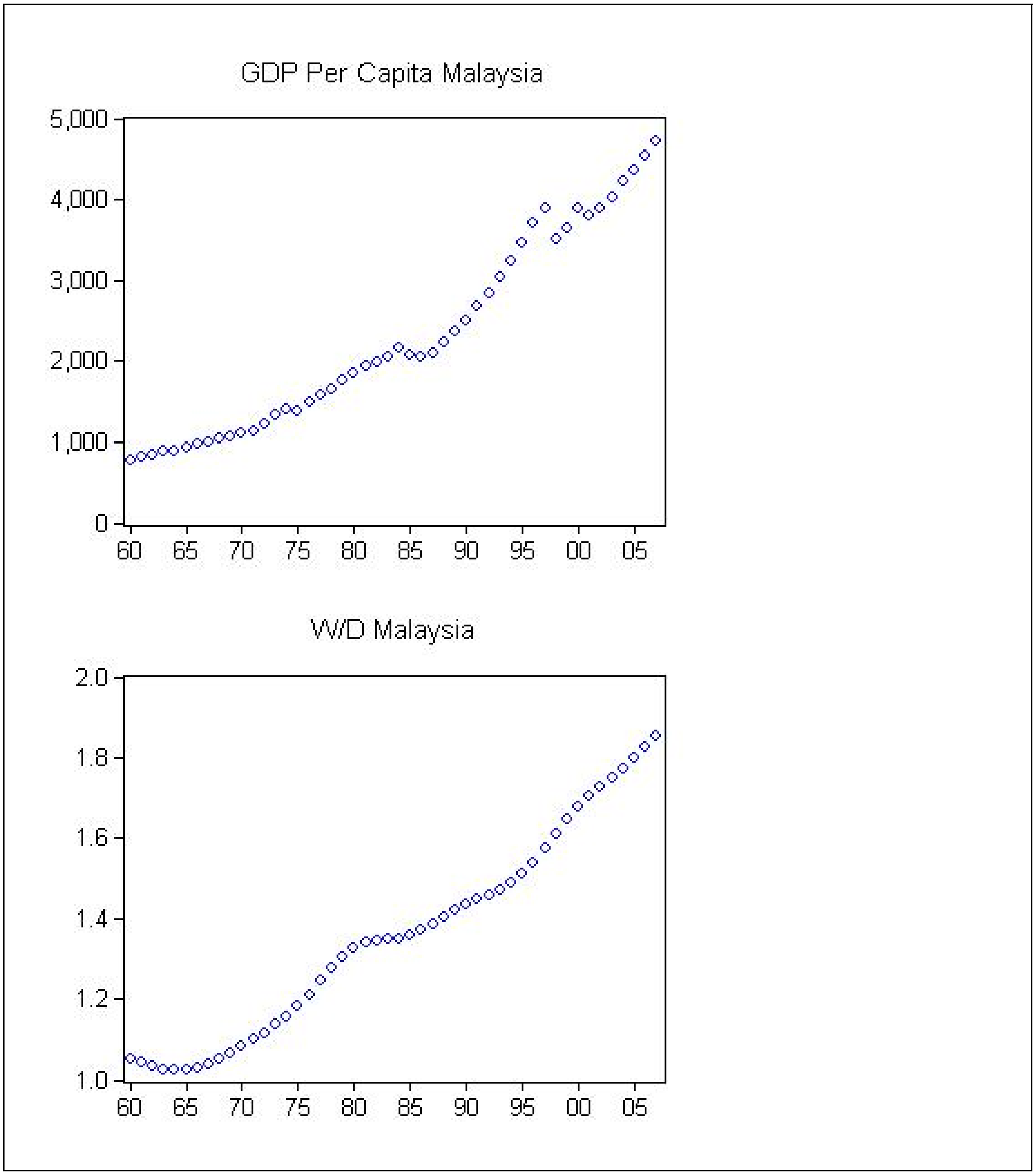
Valid cases:                    528      Dependent variable:              Y
Missing cases:                    0      Deletion method:              None
Total SS:                 12191.002      Degrees of freedom:            522
R-squared:                    0.123      Rbar-squared:                0.115
Residual SS:              10691.122      Std error of est:            4.526
F(6,522):                    12.205      Probability of F:            0.000
Durbin-Watson:                1.155
```

Variable	Estimate	Std. Error	t-value	Prob.
X1 (TropicalArea)	-1.682008	0.497398	-3.381614	0.001
X2 (Openness)	2.884225	0.632916	4.557039	0.000
X3 (Y_o)	-0.326629	0.216829	-1.506387	0.133
X4 (LnL/P)	-1.309286	2.350226	-0.557089	0.578
X5 (LnL/P)'	29.920884	5.246673	5.702830	0.000

Figures 1-4: Indonesia, Korea, Malaysia, and Thailand




GDP Per Capita Korea
16,000
12,000
8,000
4,000
0
60
65
70
75
80
85
90
95
00
05
W/D Korea
2.8
2.4
2.0
1.6
1.2
0.8
60
65
70
75
80
85
90
95
00
05


GDP Per Capita Malaysia
5,000
4,000
3,000
2,000
1,000
0
60 65 70 75 80 85 90 95 00 05
VVD Malaysia
2.0
1.8
1.6
1.4
1.2
1.0
60 65 70 75 80 85 90 95 00 05

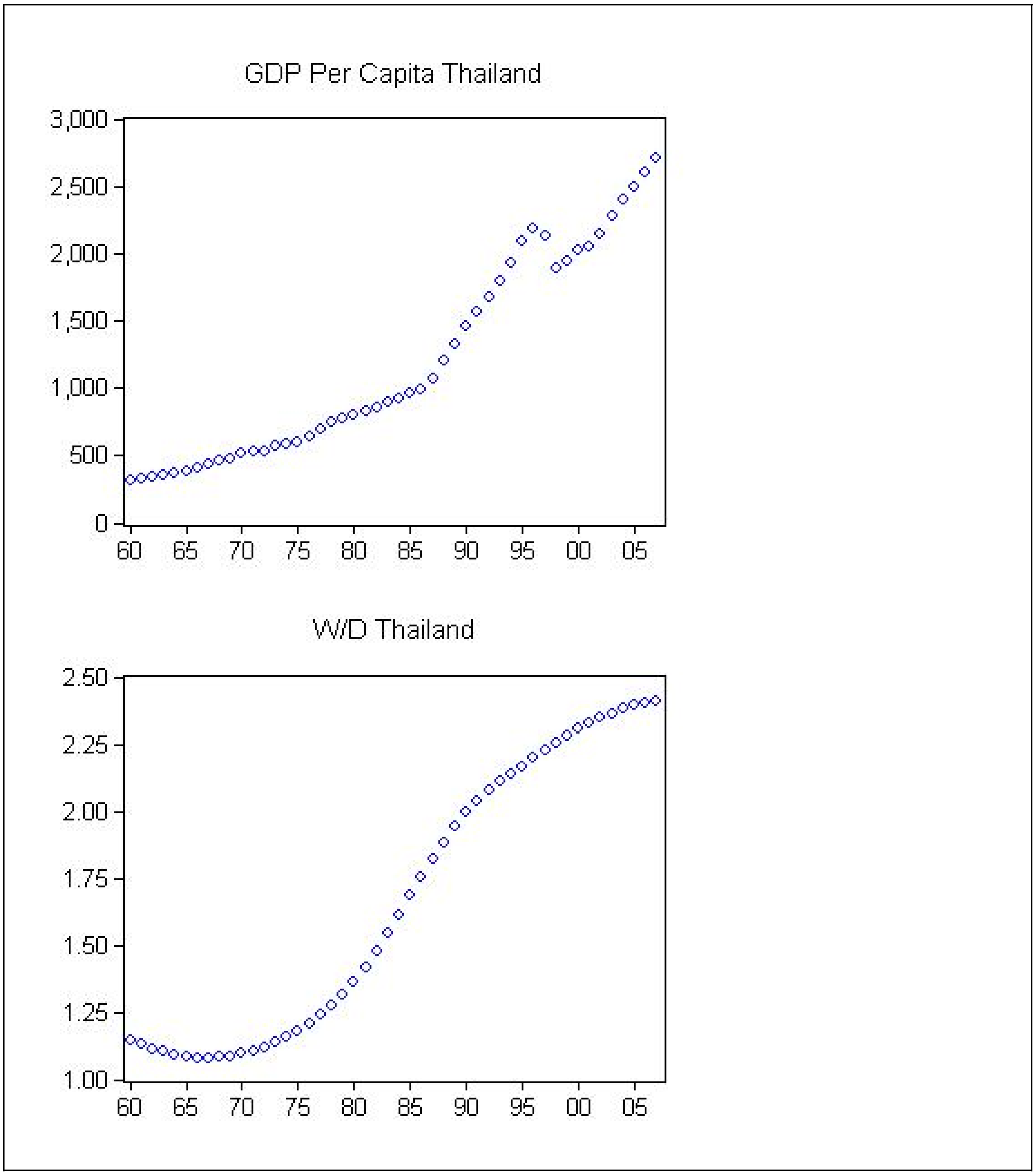

GDP Per Capita Thailand
3,000
2,500
2,000
1,500
1,000
500
0
60 65 70 75 80 85 90 95 00 05
W/D Thailand
2.50
2.25
2.00
1.75
1.50
1.25
1.00
60 65 70 75 80 85 90 95 00 05

Figure 5: China

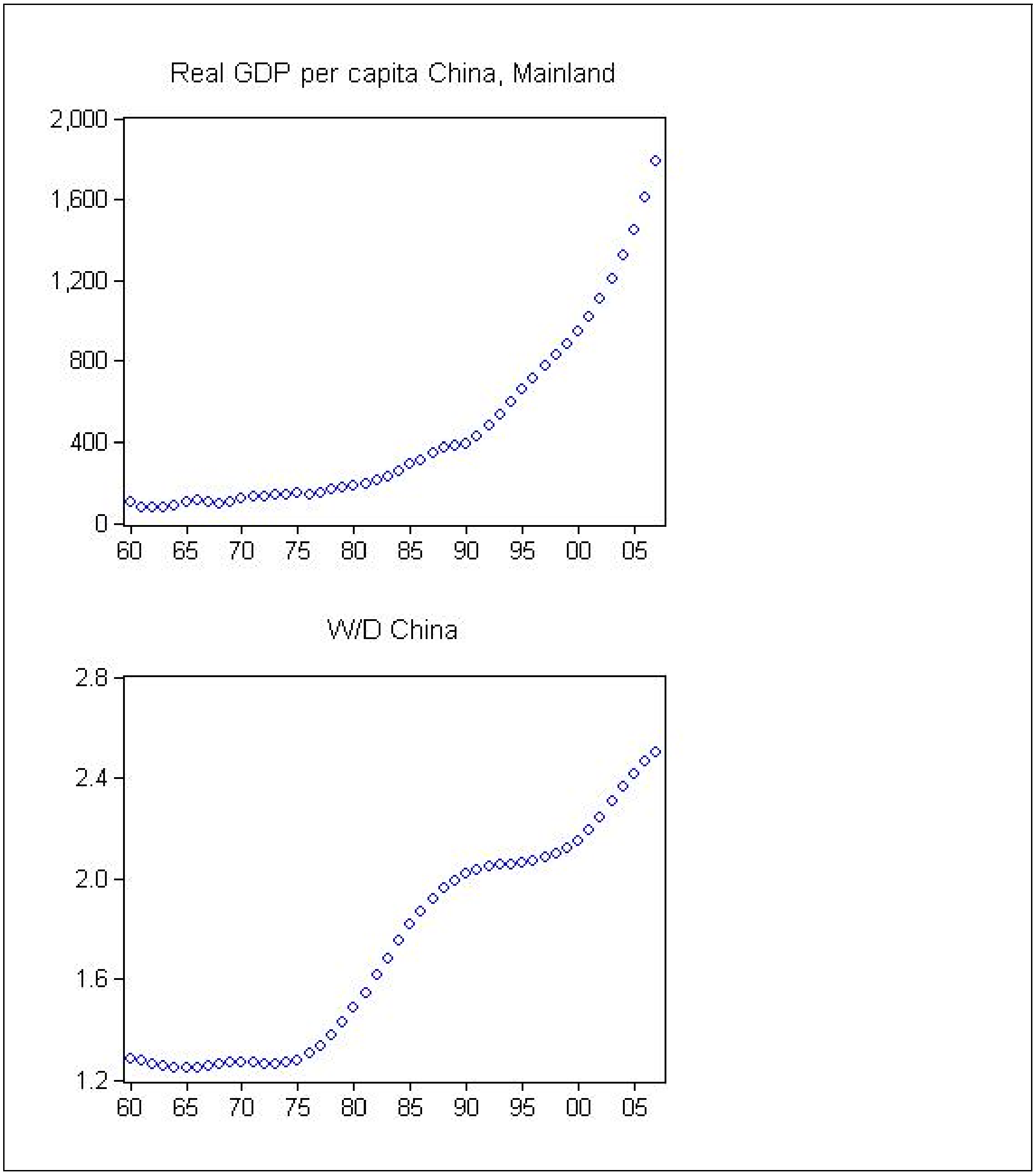
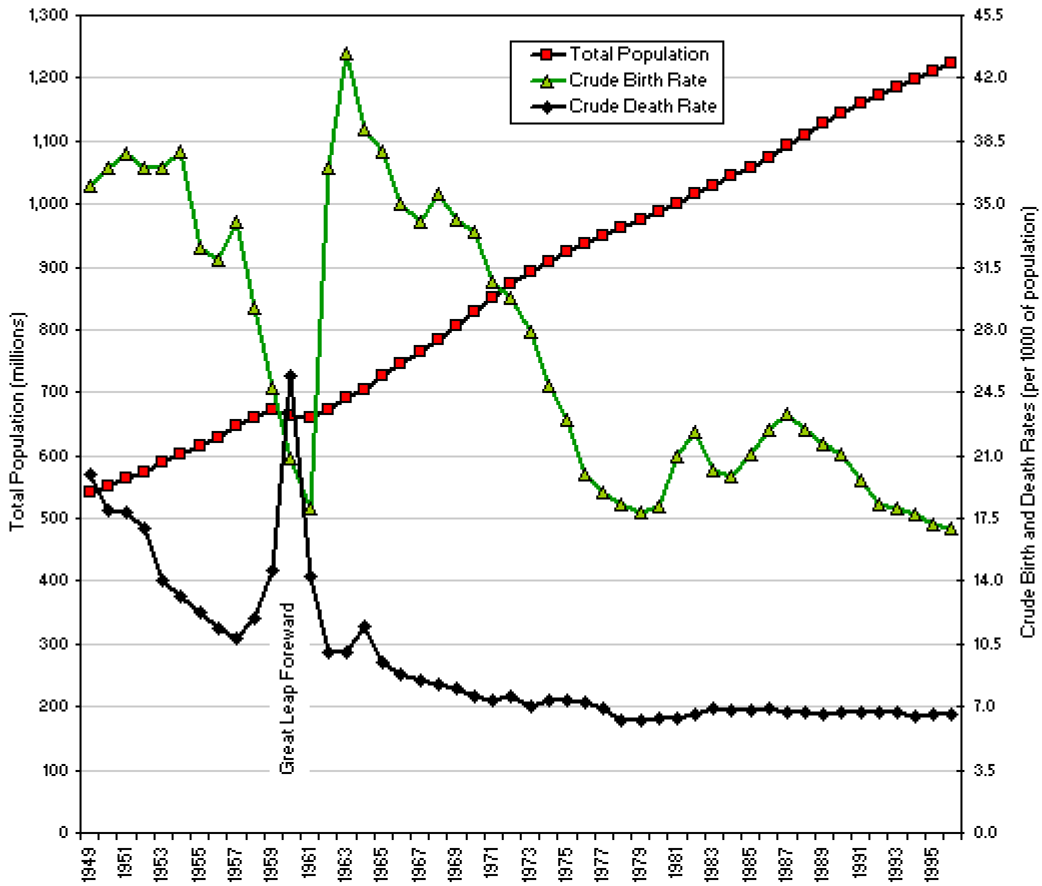


Figure 6: Population growth, crude birth and death rates, 1949 - 1996



Source: China Statistical Yearbook (various years), Beijing

The increase in the crude death rate and the short-term decline of the crude birth rate between 1959 and 1961 where the result of famine during the Great Leap Forward. There was even a slight population decline during these crisis years. Please note that this figure shows national averages - in the most severely affected provinces the increase in mortality and the decline in births was much higher. With these and other statistics demographers could reconstruct the number of famine-related deaths. Their estimates range from 25 to more than 40 million *premature* deaths due to famine and famine-related diseases.

Figure 7: A Birthrate Trajectory (China)

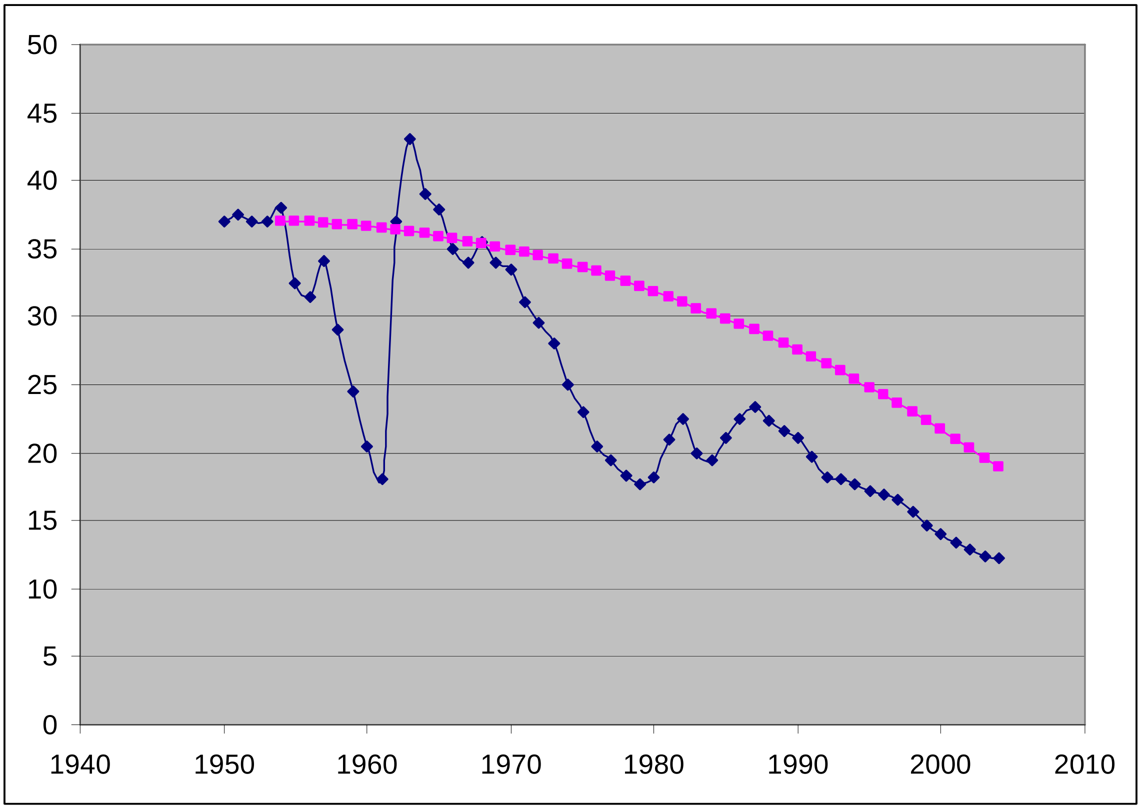


Figure 8a: China's W/D Ratio: actual vs. hypothetical (without population-control policies.)

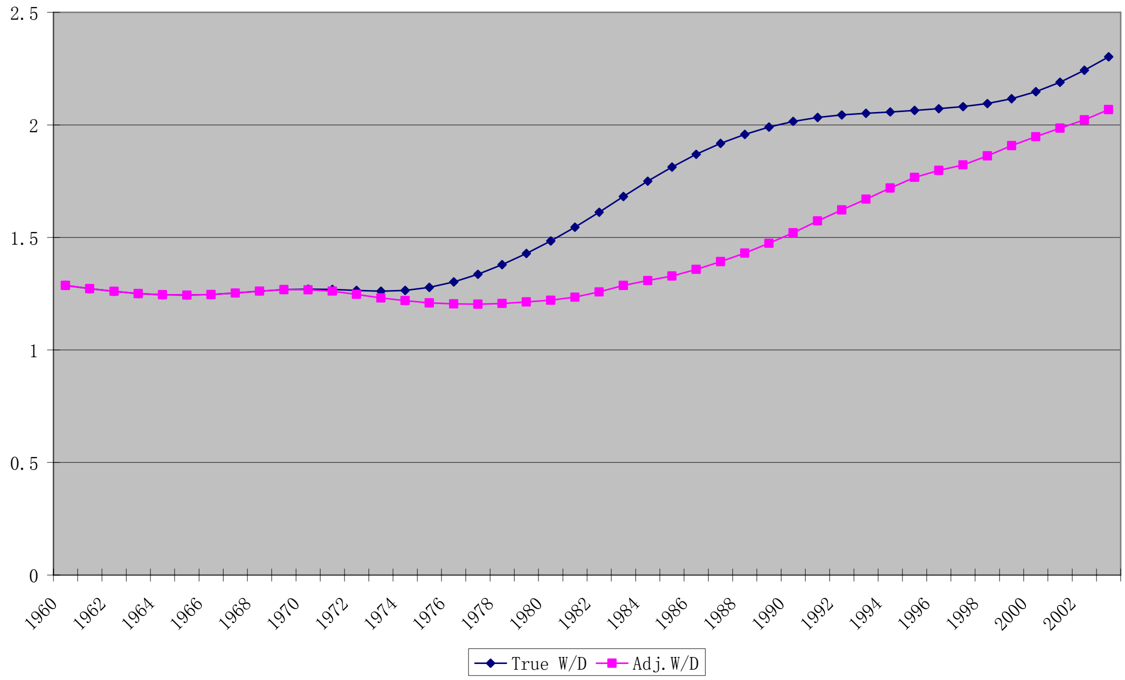


Figure 8b: China's real GDP per capita: actual vs. hypothetical (without population-control policies

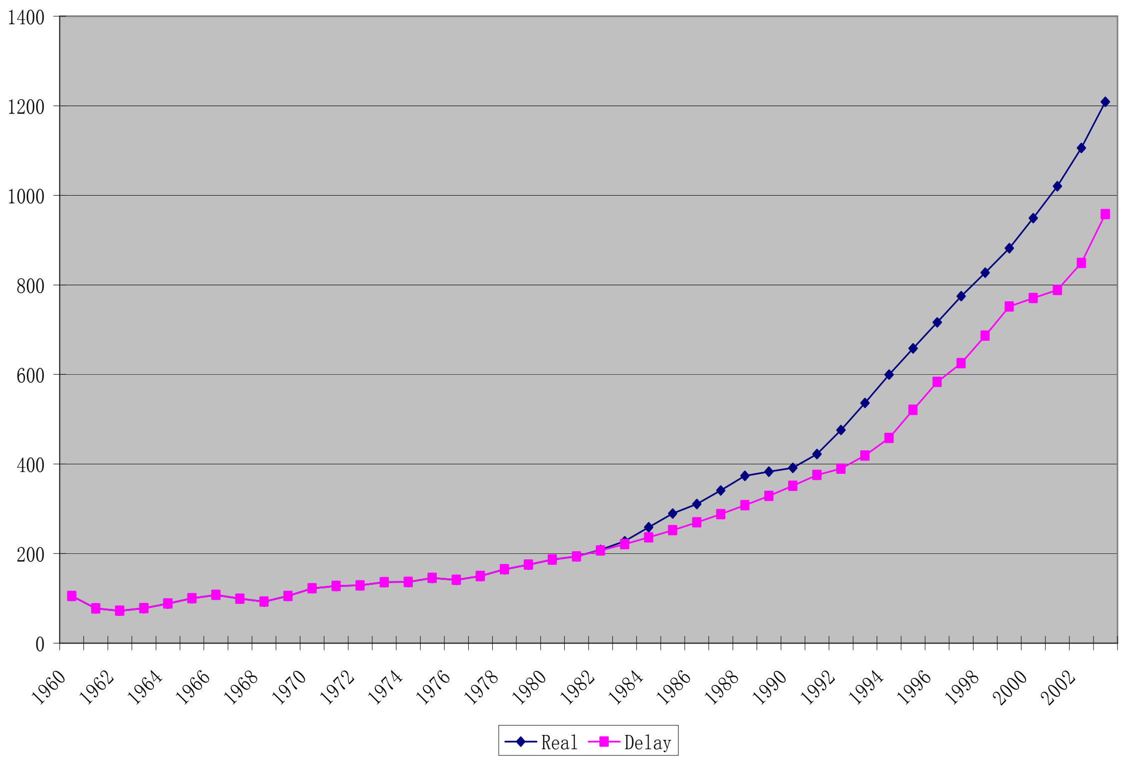


Table 3: Estimation of (5) by the traditional method

```
==========================================================================
                 GAUSS OLS Estimation Output
==========================================================================
Valid cases:            528     Dependent variable:           Y
Missing cases:            0     Deletion method:           None
Total SS:         12191.002     Degrees of freedom:         524
R-squared:            0.058     Rbar-squared:             0.053
Residual SS:      11478.225     Std error of est:         4.680
F(4,524):             8.135     Probability of F:         0.000
```

Variable	Estimate	Std. Error	t-value	Prob.
X1(TropiclArea)	-1.659618	0.510244	-3.252599	0.001
X2(Openness)	2.127714	0.632775	3.362514	0.001
X3(Y_o)	-0.502684	0.219845	-2.286538	0.023
X4(LnL/P)	**4.281741**	2.157964	1.984158	0.048

Figure 9

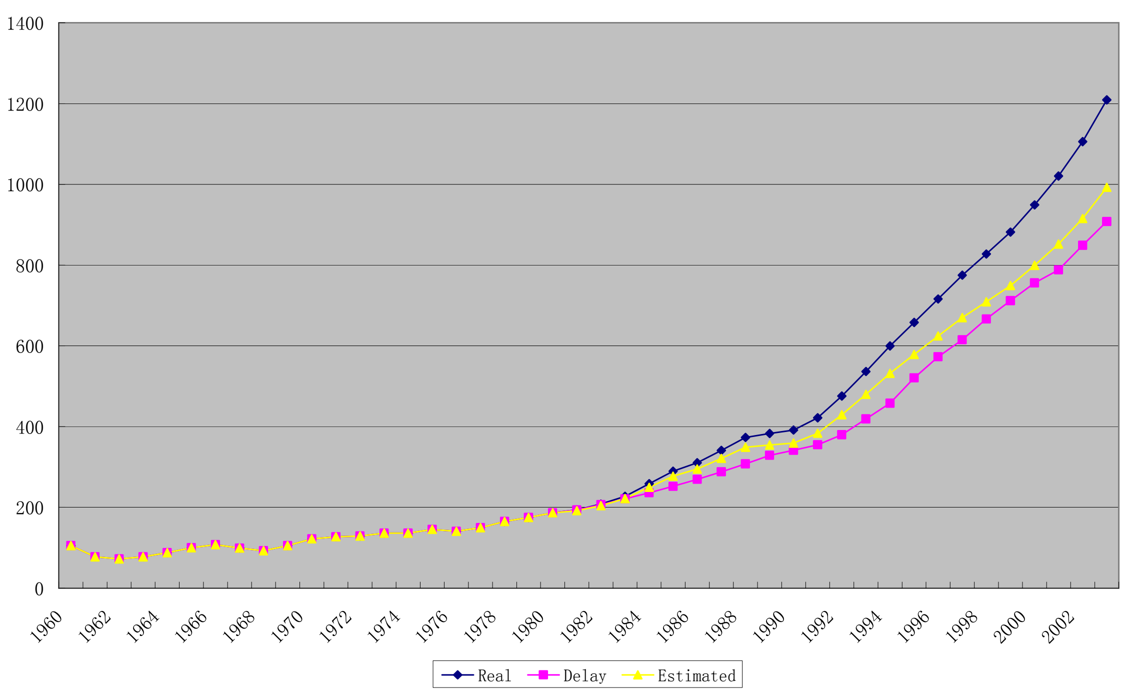
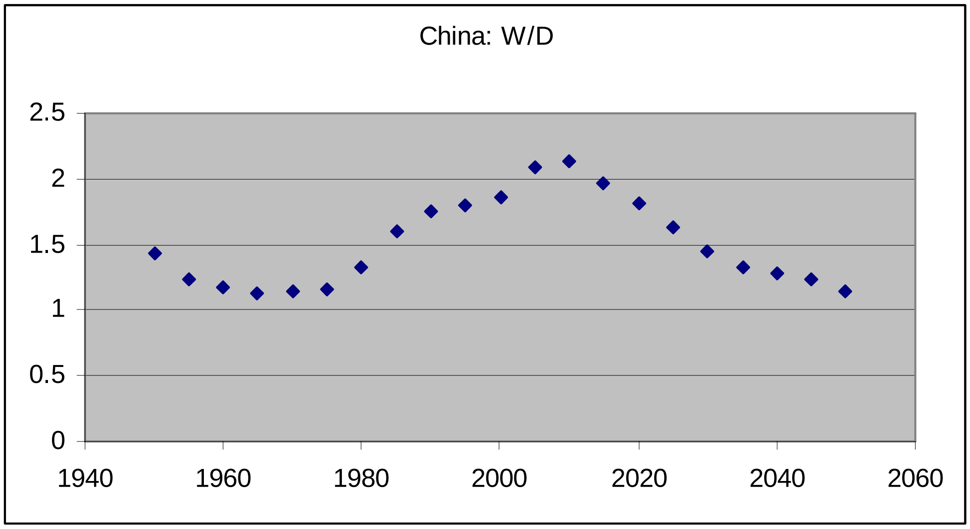


Figure 10: China's Demographic Trend and Implications for Future Economic Growth



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