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Demographic change and economic growth: Theory and evidence from China

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ABSTRACT

The paper tests the impact of demographic change on China's economic growth by using 1983–2008 provincial panel data. The deducted result of the theoretical model shows that the share of working-age population is positively correlated with economic growth, whereas birth rate has an adverse impact. Empirical results substantiate the finding. Due to the decrease of birth rate and the increase of the share of the working-age population, China's average annual per capita GDP growth rate increased 1.19 and 0.73 percentage points during the sample period. The contribution of these two demographic changes contributed to 19.5% of the economic growth together.

1. Introduction

China's economic growth has attracted worldwide attention over the past 30 years. Its real GDP grew at an average annual rate of 9.9% in 1979–2010, and 8.8% for the per capita GDP. Because China is a huge country with a population of more than one billion, its rapid economic growth has attracted significant interest from domestic and foreign economists and researchers. Scholars have offered various interpretations of China's miracle, from such perspectives as institutional reform (Chen, 1993; Qian, 2003; Qian and Barry, 1996; Woo, 1999), improvement in the trade environment that leads to an increase in FDI (Démurger, 2000; Raiser, 1998; Wei, 2002; Wu, 1999), accumulation of human capital (Wang and Yao, 2003), a rise in total factor productivity (Jefferson et al., 2008; Perkins and Rawski, 2008; Wang et al., 2009) and a demonstrated comparative advantage (Lin et al., 2003). In this paper, we will interpret China's economic growth miracle from the viewpoint of demographic change.

In 1960s, China's total fertility rate peaked at about 6.0. In 1970s, China began to implement the family plan policy, namely "one-child policy", then its fertility rate decreased substantially to about 2.0 in the early 1990s, and the fertility rate decreased further to about 1.3 in 2010. Just as Culter et al. (1990) pointed out that declining fertility is one of the most important sources causing demographic change. With fertility declining and population life expectancy increasing, China is facing an increasingly serious problem of population aging. All of the developed countries, including Japan and Western Europe, where population aging is serious, have experienced an economic slowdown or economic recession to vary degrees. Many researchers have analyzed the economic effect of an aging population, but they have not arrived at a unanimous conclusion. Some researchers believe that population aging causes a rise in the dependency ratio, labor shortages, aging of the labor structure and social security burdens. All of these factors have a negative effect on economic growth (Faruqee and Mühleisen, 2002; Lindh and Malmberg, 1999; MacKellar et al., 2004). Some scholars hold that population aging may stimulate more investment in human capital, which has a positive effect on economic growth (Futagami and Nakajima, 2002). Population aging, in fact, exerts its impact on economic growth through the changing demographic structure, that is changing the share and structure of the working-age population, or dependency ratio. When studying the impacts on economic growth of population aging without taking other demographic structure variables (such as working-age population share and the birth rate) into account, it will often come out with misleading results.

Recently, many researchers have concentrated their studies on the impact of the share of the working-age population or the dependency ratio on economic growth (Bloom et al., 2000; Cai, 2004; Lee and Skinner, 1999; Wang and Mason, 2005; Wei and Hao, 2010). Obviously, the share of the working-age population or the dependency ratio can best describe the population structure because it can accurately reflect the proportional relationship between the working-age population and the dependent population. However, when focusing on the impact of the share of the working-age population or dependency ratio on economic growth, another important problem is easily ignored: such as the influence of the birth rate.

A drop in the birth rate and death rate (an increase in the mean life expectancy) has long been regarded as a driving force for economic growth. However, empirical studies in many countries have not found

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evidence for this theory (Culter et al., 1990; Jones, 2002). Early research, such as Coale (1986), Brander and Dowrick (1994) and Kelley and Schmidt (1995), and several recent studies, including Bloom et al. (2000) and Bloom and Finlay (2009), have found that the birth rate is negatively correlated with economic growth. During the last two decades, China's birth rate has dropped substantially, if the birth rate is really negative for economic growth, it means that the declining birth rate is also one of the driving forces of China's economic growth in the last few decades.

To overcome endogeneity in the growth regression, empirical studies of cross-country data regularly use a lagging birth rate as an explanatory variable (such as Li et al., 2007). Galor and Weil (1996) pointed out that with economic development and a rise in the real wages of women, a higher birth rate means a higher opportunity cost, which compels women to opt for a lower birth rate. Such an endogenous problem cannot be controlled due to the lagging birth rate. Such factors (birth opportunity cost) may be taken into account in the decision to give birth. So, using lagging birth rate as an explanatory variable cannot adequately solve the endogeneity problem.

Although many economists have long noticed the importance of birth rate and share of working-age population on economic growth, they have largely ignored one of the factors on economic growth. In this paper, we shall test the influences of share of working-age population and the birth rate on economic growth. First, we test the impact of share of working-age population and the birth rate on economic growth on the basis of the Cobb–Douglas (C–D) production function. The results of the theoretical model show that the share of the working-age population has a positive impact on economic growth, whereas the birth rate has a negative impact. We therefore go on to collect China's provincial panel data for empirical testing. In the empirical results, both the fixed-effect estimate and instrumental variable estimate show that the share of the working-age population has a positive influence on the growth regression and that the birth rate has a negative impact.

As Li and Zhang (2007) has done, China's population policy has enabled us to find the instrumental variable of the birth rate in the growth regression. China began to implement the family planning policy in the early 1970s. Beginning in 1980, China began to encourage "one couple, one child". However, this policy was implemented only among the majority Han people in urban areas. In the rural areas, however, the second birth is allowed when the first birth is a girl. This is tantamount to a "1.5-birth policy". Until the end of the 1980s, the family planning policy has not been implemented in areas inhabited by minority people (Anderson and Silver, 1995; Park and Han, 1990; Qian, 1997). Although the policy became applicable in areas inhabited by minority people from the mid-1980s, it was not as strictly enforced as it was by the Han majority. It is mainly directed at the Manchu and Zhuang minorities, whose populations exceed 10 million each (Deng, 1995). Policy ("one couple, one child" or 1.5 children) is not rigorously enforced for the more than 50 other minority nationalities, which, in fact, still implement the multiple-birth policy. That means that the areas with higher proportions of rural and minority populations have a higher birth rate. When the variables (such as investment and human capital) associated with rural population, minority population and economic growth are controlled for, the proportion of the rural and minority population in a province may be used as an instrumental variable to reveal the impact of the birth rate on economic growth (Li and Zhang, 2007).

In Section 2 of the paper, we build a simple theoretical model to reveal the impact of the share of the working-age population and the birth rate on economic growth. Section 3 of the paper covers an empirical model and the data. Section 4 shows the empirical conclusions. Section 5 is a summary of the paper.

2. A simple theoretical model

We proceed with our theoretical analysis as follows: (1) With social and economic development, a dropping birth rate and an aging population would bring about changes in the population structure, which, in turn, would impact the labor supply and economic growth. (2) Suppose only the working-age population has bank savings, and the dependency population (aging people and children) only consumes but not saves; the higher rate of the dependency population means the need for more output to sustain the consumption of these people, and this will reduce the total savings rate and investment capital. Accordingly, the change in population structure may influence economic growth by influencing the savings rate.

We use C–D and the Solow growth theory to analyze the impact of the changes in the population structure of per capita output and the growth rate of per capita output.

We use N to denote total population, u to denote the percentage of total population aged 65 and above (e.g., the aging population), and h to denote the proportion of children aged 0–14 in the total population. Therefore, the ratio of working-age population to the total population aged 15–64 is $1-u-h$, and the working-age population in total is $N(1-u-h)$. The production function is:

$$Y = AK^{\alpha}((1-u-h)N)^{\beta}A>0,\quad 0<\alpha<1,\quad 0<p\le 1 \tag{1}$$

where Y = total output; A = technical level; K = total material capital; and $(1-u-h)N$ = working-age population. Assume that the return to scale of the production function is constant, e.g., $\alpha+\beta=1$.

$$\text{Let}: k=\frac{K}{(1-u-h)N} \tag{2}$$

$$\text{Then},\quad y=\frac{Y}{N}=Ak^{\alpha}(1-u-h). \tag{3}$$

Eqs. (2) and (3) denote per labor capital and per capita output. The analysis of Eqs. (2) and (3) shows that when the child dependency ratio remains constant, population aging raises per labor capital, favorable for raising per labor output. However, this means that the aging population reduces the percentage of the working-age population in the total population, thus reducing the per capita output. By simple calculation, we obtain $\frac{\partial y}{\partial(1-u-h)}=Ak^{\alpha}>0$, and thus, we can observe that the share of the working-age population has an overall positive impact on per capita output.

We use $k(t)$ and $N(t)$ to denote the function of capital and total population at time t, expressed as $\dot{k}=dk(t)/dt$, and $\dot{N}=\frac{dN(t)}{dt}$. Based on the growth of the global population over the past centuries, we have learned that the population growth conforms to a exponent model, that is, $N(t)=e^{nt+c}$, where c is constant. We denote that $\dot{N}=nN(t)$. To make the deduction simple, the paper assumes that $n>0$, where s is the savings rate and ρ is the capital depreciation rate. Based on the Solow growth theory, we have

$$\dot{K}=sY-\rho K,\quad \rho>0. \tag{4}$$

By simple calculation of Eqs. (2), (3) and (4), we obtain:

$$\dot{k}=\frac{sy}{(1-u-h)}-(n+\rho)k. \tag{5}$$

When the economy reaches an equilibrium growth path, satisfying $\dot{k}=0$, Eq. (3) and (5) yield:

$$k^{*}=\left(\frac{As}{n+\rho}\right)^{1/\beta},\quad y^{*}=(1-u-h)A^{1/\beta}\left(\frac{s}{n+\rho}\right)^{\alpha/\beta}. \tag{6}$$

Eq. (6) shows that when the economy reaches an equilibrium growth path, the savings rate is positively correlated with per capita effective capital, and the share of the working-age population has a positive impact on per capita output.