

Can Sustained Economic Growth and Declining Population Coexist?

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A majority of the developed countries are expected to face declining populations in the foreseeable future if their fertility rates stay below the replacement rates. Japan is the most prominent example. As a result of five consecutive decades of low birth rates and almost no net immigration, its population fell by 0.01 percent in 2005, followed by zero growth in 2006 and 2007, and a 0.06 percent decline in 2008. Recent population projections of the Ministry of Internal Affairs and Communications in Japan suggest that Japanese population, which is currently around 127 million, will decline steadily during the first half of the 21st century to reach 95 million -- close to its 1960 levels -- in 2050. Similar concerns are raised for many European and Asian nations. The United States has relatively high fertility, but still way below its historical standards.

Among the most significant issues is the impact of declining population on economic growth. In this paper, we ask the following questions. Is there a force that would allow economic growth and declining population to coexist? Is there a mechanism that could reverse the decline in fertility? The literature on fertility and economic growth argues that, along the development path, parents have fewer children each with higher quality. As a result, fertility declines and the stock of human capital grows, which lead to sustained economic growth in per capita terms. This is the main mechanism suggested by many papers including Becker, Murphy, and Tamura (1990) and Galor and Weil (1999, 2000). It explains what happens at the early stages of development quite well. Our research is motivated by the observation that there is no serious theory linking fertility, human capital accumulation, and economic growth once we get to the modern advanced economy with below replacement fertility. There are serious calls for such a contribution [see Galor (2008) and Murphy (2009)]. Unlike the majority of papers in the fertility and growth literature, we do not attempt to model transition from underdevelopment to development. Our goal is to construct a model of fertility and growth in advanced societies rather than to investigate what happens during the process of development.

This paper argues that the degree of increasing returns to human capital in traditional production technologies determines the nature of the long-term relationship between economic growth and population growth in advanced countries. By traditional technologies, we mean labour-oriented production processes prevalent in traditional manufacturing and services sectors. These sectors have benefited largely from increasing returns to human capital generated through agglomeration economies and the formation of cities throughout the second half of the twentieth century [see Moretti (2004a,b)].

Our theoretical structure combines the models developed by Becker and Lewis (1973), Becker and Barro (1988), Becker, Murphy, and Tamura (1990), and Lucas (1988). Like Becker and Lewis (1973) and Becker, Murphy, and Tamura (1990), quantity-quality trade-off at the

aggregate level is an important element in our analysis. Unlike these papers, we generate this trade-off in a novel way: the goods cost of child rearing is an increasing function of the aggregate human capital. This assumption communicates the idea that human capital is a cost element as well as a productivity element for the society; that is, part of the human capital stock is accumulated for the purpose of raising higher quality children. When the population starts declining, this mechanism works in the opposite direction to produce extra resources for the society. We explain this 'efficiency-augmenting mechanism' in greater detail in Section 2. Like Becker and Barro (1988) and Becker, Murphy, and Tamura (1990), our model is based on a dynastic utility structure. Like Becker, Murphy, and Tamura (1990), we use this dynasty structure to construct a growth model based on aggregate human capital. Unlike all other papers in the literature, we insert this structure into an endogenous growth model -- a la Lucas (1988) -- with increasing returns to aggregate human capital in production. We work out a particular balanced growth path and perform our analysis across steady state solutions. Our model produces two main predictions. As the degree of increasing returns to human capital in traditional production technologies falls, (1) the population growth rates decline steadily, whereas the growth rates of per capita consumption display a U-shaped pattern; and (2) negative population growth and positive growth in per capita consumption can coexist.

The first result says that when the increasing returns to human capital in traditional production technologies are large, both the per capita consumption growth rate and population growth rate are fairly high. As the increasing returns move down, the growth rates of per capita consumption follow a U-shaped pattern. It is always positive. However, the population growth rates fall steadily and can record negative numbers after reaching a threshold. The second result follows immediately.