



Searching for empirical linkages between demographic structure and economic growth



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ABSTRACT

Demographic structure could affect economic growth through many channels. However, little is known about how demographic structure affects economic growth since no study has examined an extensive collection of channels through which demographic structure could affect economic growth in a single context. This paper overcomes this limitation by examining 45 potential mediating variables between demographic structure and economic growth. A causal search algorithm is used to identify channels through which demographic structure affects economic growth. Our results suggest that demographic structure affects economic growth differently between developed and developing countries. For developed countries, we find that an increase in the share of middle-aged workers has a positive effect on economic growth through institutions, investment and education channels. On the other hand, an increase in the share of the senior population has a negative effect on economic growth through institutions and investment channels. For developing countries, we find (but with weak evidence) that an increase in the share of young workers has a negative effect on economic growth through investment, financial market development and trade channels.

1. Introduction

Several works have shown that demographic structure (or age structure) affects economic growth or its determinants (e.g. Sarel, 1995; Bloom et al., 2001; Persson, 2002; Kögel, 2005; Urdal, 2006; Feyrer, 2007, 2008, 2011; Cuaresma et al., 2014). Demographic structure could affect economic growth through various channels.¹ However, little is known about how demographic structure affects economic growth since no study has examined an extensive collection of channels through which demographic structure could affect economic growth in a single context. This is a serious shortcoming for several reasons.

First, a conclusion drawn (e.g. significant or insignificant effect of a potential determinant of economic growth in a growth regression) for a variable regarding its mediating role between demographic structure and economic growth could be sensitive to the inclusion of another variable. This is analogous to the lack of robustness problem in the growth regression literature (e.g. Levine and Renelt, 1992; Sala-i-

Martin, 1997a, 1997b; Fernandez, Ley and Steel, 2001; Sala-i-Martin, Doppelhofer, and Miller, 2004). This kind of conclusion is sensitive to the inclusion of another variable since it might represent an omission variable or it might represent a more direct cause of economic growth. Second, discovering more variables that mediate the relationship between demographic structure and economic growth would expand our choice of implementable policies. Suppose we have identified that demographic structure in the near future will be unfavorable to economic growth. It is hard to imagine a policy that could effectively and promptly influence demographic structure. However, if we have discovered that the unfavorable effect occurs through some mediating variables (such as government expenditures), it will be more practical to design a policy that can offset this unfavorable effect by influencing the mediating variable instead (e.g. by changing the composition of government expenditures).

In this paper, we present a new methodology for examining the empirical linkages between demographic structure and economic growth. We use a causal search algorithm to aid the identification of

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¹ For example, population ageing could influence the composition of government expenditures which could affect economic growth positively or negatively. The rise of the “youth bulges” (an increase in the share of population aged 15 to 24 years) has been found to be associated with an increased risk of political violence which could in turn affect economic growth (Urdal, 2006). Government expenditures and political violence are two of the many channels that demographic structure could affect economic growth (see Table 1 for a list of channels that demographic structure could affect economic growth considered in this paper). Galor (2005) discussed several mechanisms that trigger the start of demographic transition and their role in the process of economic growth.

Table 1
Channels through which demographic structure could affect economic growth considered in the paper.
Sources: Phiromswad (2014a)

| Channels | Variables in the channels considered in the paper |
|---|--|
| Government revenues and expenditures | Government “consumption” expenditure net off spending on defense and education in nominal GDP Government expenditure on defense to nominal GDP. Government deficit to nominal GDP Government expenditure on education to nominal GDP Government investment (fix capital formation) to nominal GDP “Social security contribution” to nominal GDP Share of tax revenue to nominal GDP |
| Institutions | Index of civil liberty Index of political rights Index of bureaucratic quality Index of corruption Index of ethnic tension Index of rule of law Index of investment profile Number of revolutions and coups per year Number of political assassinations |
| Trade | The black market exchange rate premium The standard deviation of the black market exchange rate premium The openness dummy variable according to the criterion in Sachs and Warner (1995) The real exchange rate distortion index (or “real overvaluation”) The ratio of trade (export plus import) to GDP |
| Investment | Investment share to real GDP with PPP adjusted Average investment price on purchasing power parity |
| Inflation | Annual inflation rate calculated from GDP deflator Standard deviation of annual inflation rate calculated from GDP deflator |
| Human capital (education and health) | Adult literacy rate Average years of higher schooling in the total population over the age of 25 Average years of primary schooling in the total population over the age of 25 Average years of secondary schooling in the total population over the age of 25 Average years of education of total population over the age of 25 Total gross enrollment rate for higher education Total gross enrollment rate for primary education Total gross enrollment rate for secondary education |
| Demography (beyond demographic structure) | Life expectancy at birth Population density Population growth rate Total fertility rate (number of births per woman) Fraction of population living in cities (urbanization) |
| Natural resource dependency | Hydrocarbon deposits Proportion of mining and quarrying in GDP (in current price of national currency) Proportion of fuel exports in the total merchandized exports Non-fuel primary product export share of total merchandized exports |
| Financial market development | The ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets The ratio of liquid liabilities to GDP or “Financial depth” The ratio of claims on the non-financial private sector to GDP |

channels through which demographic structure affects economic growth. Our causal search algorithm is the PC algorithm of Spirtes et al. (2000). Beyond its ability to identify causal structure, another major advantage of the PC algorithm is its speed which allows us to study an extensive collection of potential mediating variables between demographic structure and economic growth in a single context. Our dataset is a panel data of 122 countries for 5-years period from 1960 to 2010. Appendix A presents a list of countries considered in this paper. We consider 52 variables (two measures of economic growth, five measures of demographic structure and 45 potential mediating variables between demographic structure and economic growth). Table 1 provides a list of the potential mediating variables between demographic structure and economic growth considered in this paper.

We find that there are differences in how demographic structure affects economic growth between developed and developing countries. For developed countries (OECD countries), we find that the index of investment profile from the international country risk guide (ICRG), the share of investment to GDP and the average years of education of the total population over the age of 25 from Barro and Lee (2013) mediate the relationship between demographic structure and economic growth. For developing countries (non-OECD countries), we find (but with weak evidence) that the average investment price on purchasing power parity, the ratio of claims on the non-financial private sector to GDP and the openness dummy from Sachs and Warner (1995) mediate the relationship between demographic structure and economic growth.

This paper is organized as follows. Section 2 provides a literature review. Section 3 discusses the dataset used in this paper. Section 4 discusses econometric methodology. Section 5 presents results. Section 6 provides conclusions and directions for future study. Next, we present literature review.

2. Literature review

2.1. Population growth and economic growth

Early works that examine the impact of demography on economic growth focused on population growth. Based on Bucci (2008), there are three views about the impact of population growth on the economy. According to the pessimistic view, population growth impedes economic growth.² As noted first by Malthus (1798), population growth exerts higher pressure on fixed economic resources (especially land) used in the production process. With low or absent technological progress, population growth would outpace food supply and create famine which would reduce both economic and population growth. Kelley (1988) and Kelley and Schmidt (1994, 1995) documented a negative relationship between population growth and economic growth for less developed countries. Kelley (1988) argued that the negative effect of population growth on economic growth is likely to occur among countries where natural resources are not abundant (especially land and water), property rights are weak, and markets as well as other institutions are inefficient. Kelley and Schmidt (1995) examined the relationship between crude birth rate and crude death rate on economic growth (which are two important components of population growth).³ They found that both had large but offsetting effects on

² Theoretically, it can either be optimal or suboptimal to have an increasing population size. Under the total utilitarianism, it is optimal to have an increasing population size even when consumption per person reduces toward zero (see Boucekine and Fabbri, 2013 for more discussion). This is the so-called Parfit’s repugnant conclusion which holds true in the static equilibrium. However, Marsiglio (2014) examined this conclusion in the dynamic setting and concluded that this conclusion does not always hold as it depends on certain parameter values.

³ They argued that each of them can be growth promoting as well as growth impeding. An increase in the contemporaneous crude birth rate can slow down economic growth as it reduces savings (from higher consumption of the younger population). However, the past crude birth rate can be growth promoting as it increases the labor force. The effects of an increase in the contemporaneous crude death rate on economic growth depend on

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