Population aging and economic growth: political economy and open economy effects

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Abstract

This paper addresses population aging in the context of both open economy and endogenous fiscal policy response. The analysis explores the role of these modeling features and discusses how this framework differs from closed economy and other open economy models.
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1. Introduction

Population aging has become one of the most significant demographic phenomena facing industrialized countries. While framework for analysis of growth and welfare effects of aging shifted from closed economy to open economy,[1] the domestic political implications of aging have been mainly ignored.[2] Population aging in one region of the world may lead to capital flows by altering saving and consumption behavior. An endogenously changing fiscal policy, in turn, may affect human capital accumulation through a change in government spending for public goods, such as education. In this paper, I examine the roles of both open economy and politically responsive fiscal policy in the growth effects of population aging.

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[1] See Cutler et al. (1990), Börsch-Supan (1996), Kenc and Sayan (2001) and Elmendorf and Sheiner (2000).
[2] Two exceptions to this are studies by Razin et al. (2001) and Holtz-Eakin et al. (2000) in which the authors explicitly address the political economy involved in the connection between aging and tax policy.

2. The model

The model builds on the basic Diamond overlapping generations model,[3] extending it, however, to a two-country world economy model similar to Buiter (1981). The model incorporates the interaction of household behavior, firm behavior, political process, and international capital flows. In a standard OLG framework with individual preferences represented by a lifetime Cobb–Douglas utility function, $U = \ln C_{jt} + (1/1 + \delta)\ln C_{jt+1}$, the optimal saving of an individual j will depend on net labor earnings determined by the wage rate (w_t), effective labor (l_t) and the tax rate (τ_t):

$$S_{jt}(a_j) = \frac{1}{2 + \delta}(1 - \tau_t)w_t l_t(a_j), \tag{1}$$

where effective labor is the product of human capital,[4] which is accumulated from the interaction of ability level (a_j) of the individual and government spending per worker (g_t) on a productivity enhancing public good[5]

$$l_t(a_j) = \Phi[a_j g_t + 1]^{\psi}, \tag{2}$$

where ψ is a parameter indicating the return to human capital from the inputs (a_j and g_t). The form of the human capital function is chosen so that even individuals with the lowest ability ($a_j = 0$) will contribute to the economy in terms of human capital (see Holtz-Eakin et al., 2000). ψ can also be interpreted as human capital elasticity w.r.t. ability and government spending.[6]

2.1. Political process

To make the political process of fiscal policy determination rich, interesting, yet tractable, a median-voter framework with voter heterogeneity is used. Voter heterogeneity is introduced by assuming a distribution of genetic ability levels for the working generation. The ability level of the individual will, in turn, determine the value she receives from the public good. The preferred tax rate

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[3] See Diamond (1965). However, the earliest formalization of an overlapping generations model is due to Allais (1947) and Samuelson (1958).

[4] Here, young supplies one unit of time to the economy. Note that, making the allocation of time between 'schooling' and supplying labor endogenous does not change this analysis.

[5] This model does not consider pressures on government spending coming from such government programs as social security. While social security payments also constitute an important source of conflict between generations, the focus is on a type of government spending that enhances the productivity of working young. One good example to this is government spending on public education. However, any other government program that is directed towards increasing the labor productivity of young could easily be used. Here, the goal is to highlight the strong link between this type of government spending and human capital accumulation. See Meijdam and Verbon (1996) for an example of the literature on the political economy of social security.

[6] If we define an effective government spending function as $g_t^E = a_j g_t + 1$, ψ will in fact be the elasticity of human capital to effective government spending.

of individual j when young will maximize the indirect utility subject to the government budget constraint $(\tau_t y_t = g_t)$.[7] This preferred tax rate is

$$\tau_{jt}(a_j) = \frac{a_j \psi y_t - 1}{(1 + \psi) a_j y_t}. \tag{3}$$

Eq. (3) is the tax rate each individual prefers based on her ability level. This preferred tax rate is increasing in both ability level a_j and in income per young y_t. Because the old do not derive any benefit from the public good,[8] they incur a cost without enjoying any benefits. Therefore, their preferred tax rate will always be zero, regardless of their ability.

With an increase in the dependency ratio,[9] older people will need fewer young voters to form a majority. Since these young voters are at the lower end of the ability distribution, they prefer lower taxes than higher ability people because their return from the public good is lower. Therefore, the median voter becomes a person with lower ability and the preferred tax rate of the median voter is lower.

2.2. Producers' behavior and world equilibrium

Each country produces a single good using a Cobb–Douglas production technology

$$Y_t = \Lambda K_t^\alpha H_t^{1-\alpha}, \tag{4}$$

where Λ is the productivity index, K is capital stock and H is aggregate supply of human capital. The aggregate supply of human capital is $H_t = N_t \int_0^1 l(a) f(a) \, da$. Then, human capital per worker, using (2) is

$$h_t = \Phi \int_0^1 (ag_t + 1)^\psi f(a) \, da. \tag{5}$$

Under competitive factor market conditions, factor demand equations are:

$$w_t = (1 - \alpha)\Lambda \left(\frac{k_t}{h_t}\right)^\alpha, r_t = \alpha\Lambda \left(\frac{k_t}{h_t}\right)^{\alpha-1}, \tag{6}$$

where $k_t = K_t/N_t$ and $h_t = H_t/N_t$ are capital stock per worker and human capital per worker, respectively. Using (1) and (5), saving per worker can be expressed as

$$s_t = \left(\frac{1}{2 + \delta}\right)\theta_t w_t \Phi \int_0^1 (ag_t + 1)^\psi f(a) \, da. \tag{7}$$

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[7] It is assumed in each period that government uses the entire tax revenue to finance the public good for all young equally, regardless of their ability level.

[8] This assumption is used to highlight the generational conflict between young and old generations. The key thing here is that the young generation derives considerably greater benefit from spending on the productivity enhancing public good than the old generation.

[9] The dependency ratio is defined as the ratio of elderly to non-elderly persons, $(N_{t-1}/N_t) = (1/1 + \eta_t)$ where an increase in the dependency ratio is simulated by an exogenous decrease in the population growth rate, η_t.

However, the domestic capital stock per worker may be higher or lower than the domestic saving per worker, implying international capital flows. Writing this in per worker terms, international goods market equilibrium implies

$$k_{t+1}^A + k_{t+1}^B = \frac{s_t^A}{1 + \eta_{t+1}^A} + \frac{s_t^B}{1 + \eta_{t+1}^B},$$

(8)

where superscripts A and B denote countries (or regions). I assume that initial population sizes are the same in both countries (i.e. $N_0^A = N_0^B$) and population growth rates of countries are initially equal in all periods. According to a territorial system of capital income taxation, capital income is taxed where income is earned. This implies that net-of-tax interest rates are equalized in equilibrium. Therefore, the international capital flow constraint is

$$r_{t+1}^A\left(1 - \tau_{t+1}^A\right) = r_{t+1}^B\left(-\tau_{t+1}^B\right).$$

(9)

Capital will move between countries until both (8) and (9) hold.

3. Capital mobility and endogenous fiscal policy in capital transitions

In the model explained above, a decrease in the population growth rate can affect capital per worker in two ways. Firstly, it can affect 'directly' by causing fewer workers in the economy, which eventually leads to lower marginal product of capital, and thereby inducing capital outflows, ceteris paribus. Secondly, it can also affect 'indirectly' through endogenous fiscal policy by changing the identity of the median voter. As a result of the political process, aging makes the median voter a lower ability person that votes for a lower preferred tax rate. This is important for an aging country since a lower tax rate implies lower government spending on the productivity enhancing public good, which in turn may produce negative growth effects. These direct and indirect effects can be analyzed by examining the dynamic solution[10] of capital per worker caused by a change in the population growth rate at any period during transition.[11]

For a given ability of the median voter, a decrease in the population growth rate (η_{t+1}^A) in Eq. (8) initially raises capital per worker by spreading the same saving over fewer workers. This is the *direct saving effect*. However, through a *direct net interest rate effect* depicted by a negative coefficient on dk_{t+1}^A in Eq. (10),[12] this initial increase in capital per worker in one country actually depresses the net

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[10] I assume that countries start at an identical initial steady state and population growth rates of countries are constant and equalized in the long run.

[11] Actual derivations of these results are available upon request.

[12] This coefficient is negative by stability conditions for the political and intertemporal equilibria. Eq. (10) is the reduced form of the left hand side of Eq. (9).

interest rate by putting a downward pressure on the marginal product of capital. This in turn has a negative effect on capital accumulation in that country through capital outflows, ceteris paribus

$$\left(1 - \tau^{A*}\right)\mathrm{d}r_{t+1}^A - r^{A*}\mathrm{d}\tau_{t+1}^A = \frac{r^{A*}\left(1 - \tau^{A*}\right)\left[\alpha\left(1 - \varepsilon_{\tau y}\frac{\tau^{A*}}{1-\tau^{A*}}\right) - P\right]}{k^{A*}P}\mathrm{d}k_{t+1}^A$$

$$+ \frac{r^{A*}\varepsilon_{\tau a}\left[(1-\alpha)\varepsilon_{hg} - \tau^{A*}\right]}{a^{mv}P}\mathrm{d}a_{t+1}^A \tag{10}$$

where $P = 1 - \left[(1-\alpha)\varepsilon_{hg}\left(1 + \varepsilon_{\tau y}\right)\right] > 0$ (by the stability of the political equilibrium), superscript '*' indicates steady state values, a^{mv} is the ability level of the median voter and $\varepsilon_{\tau y}, \varepsilon_{\tau a}$, and ε_{hg} are the elasticity of the tax rate with respect to income, elasticity of the tax rate with respect to ability level and the elasticity of human capital with respect to government spending, respectively.

There are also indirect saving and net interest rate effects. Firstly, capital per worker in period $t + 1$ is affected by saving in period t as can be seen in (8). This is the *indirect saving effect* of a change in the ability of the median voter on capital per worker. For a given level of capital per worker, a decrease in median voter's ability decreases the tax rate, thereby increasing the net-of-tax labor income ($w_t h_t(1 - \tau_t)$) and saving per worker. At the same time, the lower tax rate also lowers government spending, human capital per worker, labor income, and consequently saving per worker, ceteris paribus. The sign of this effect depends on the relative magnitudes of these two counteracting impacts.

Finally, there is an *indirect net interest rate effect* through a change in median voter's ability, which is shown as the last term on the right hand side of Eq. (10). The sign of this term is indeterminate. For a given level of capital per worker, a decrease in median voter's ability decreases the tax rate and thereby government spending and human capital per worker. This in turn would put a downward pressure on income per worker (y) and through this on the marginal product of capital, thus creating a negative effect on the net interest rate. However, since it decreases the tax rate, it creates a counter-positive effect on the net interest rate. Notice that when the elasticity of the preferred tax rate with respect to median voter's ability ($\varepsilon_{\tau a}$) equals zero, the coefficient on $\mathrm{d}a_{t+1}^A$ in Eq. (10) is also equal to zero, which drives the *indirect net interest rate effect* to zero. This is because zero elasticity eliminates completely the feedback effect from an endogenously changing tax rate and government spending. As an example of the impact of this effect, a decrease in the population growth rate in only country A at any point in time will decrease the net interest rate in country A as long as the decrease in the tax rate is outweighed by the decrease in the interest rate. This, in turn will cause country A capital to flow to country B until the net interest rates are equalized. It is found that only the *indirect net interest rate effect* creates asymmetry between countries despite the capital mobility.

In order to explore the significance of open economy and endogenous fiscal policy effects, I compare the effects explained above with the ones from a closed economy model with endogenous fiscal policy and open economy model with exogenous fiscal policy. In the exogenous policy model, I assume that government spending for a productivity-enhancing public good (g) is fixed. Firstly, comparison with a closed economy model shows that both the *direct* and the *indirect* saving effects are shared equally (therefore the magnitudes are halved) between the two countries when these economies are open. Internationally mobile capital partially offsets the effect of population aging that comes from its effects (direct and indirect) on saving by spreading the effects of aging between countries. Secondly, the *indirect*

net interest rate effect is unique to the model used in this paper, making this a combined effect of capital mobility and endogenous fiscal policy. Since this effect changes capital per worker in country A and country B in opposite directions, it is a major factor in creating an asymmetry between the two countries throughout the demographic transition. Through this effect, the pattern as well as the magnitude of the effect of aging on growth may change.

4. Conclusion

This paper identifies both political economy and open economy effects of population aging. International capital mobility works like a shock absorber, spreading the growth effects of aging globally. On the other hand, endogenous fiscal policy drives countries apart in their transitions by creating asymmetries between their fiscal policies. Together these two features may account for a change in the pattern, beyond a change in the magnitude, of the effects of population aging on growth, compared to closed economy and exogenous fiscal policy models. However, the exact magnitude and direction of these effects require an empirical examination.

Acknowledgements

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