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A Note on Health Insurance and Growth

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A Note on Health Insurance and Growth

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Abstract

This paper compares public health care with private health insurance in an overlapping generations endogenous growth model. It is shown that economic growth is higher when there is a private health insurance.

Keywords: public health care, private health insurance, endogenous growth

JEL Classification: D91, H51, I18, O41

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1 Introduction

Over the last four decades, health expenditures as a percentage of GDP have doubled in all OECD countries. To a large extent, health expenditures are public. In general, the current period's public health expenditures are financed by a tax on the current period's wages. Given that the ratio of old (retired) to young (working) individuals is increasing in all OECD countries, the necessary tax to finance public health care in such a pay-as-you-go system increases. Feldstein (1999) estimates that until 2070 the payroll tax to finance the US Medicare program has to rise by 9 percent. Given that in the US less than 45% of health expenditures are public, while the OECD average is over 70%, the tax increase will be even higher in other countries. Feldstein (1999) suggests that prefunding of Medicare could reduce the future burden and the deadweight loss of the pay-as-you-go system.

This paper will analyze different health insurance schemes in an endogenous growth overlapping generations model. Given the different schemes, we will analyze how growth affects health expenditures and vice versa.¹ In addition, we will consider two demographic shocks: At first, we assume that an increase in life expectancy leads to an increase in the probability of becoming ill. At second, we consider an increase in medical productivity. Johansson (2000, 2001) considers different health insurance schemes in OLG models. However, in Johansson (2000) the capital stock, the population growth rate and interest rate are exogenous, while in our model the capital stock and the growth rate are determined endogenously. Johansson (2001) is based on a neoclassical growth model with an endogenous capital stock. However, as in Bednarek and Pecchenino (2002) the analysis is based on numerical simulations.

2 Firms and Individuals

Firms are using capital K_t and labor defined in efficiency units L_t to produce a homogeneous output Y_t . The production function is assumed to be of the Cobb-Douglas form $Y_t = AK_t^\alpha L_t^{1-\alpha}$ with $0 < \alpha < 1$, $A > 0$. Labor efficiency units depend on the number of workers N_t and on accumulated knowledge B_t . Labor in efficiency units is $L_t = B_t N_t$. Firms are maximizing profits $\Pi_t = AK_t^\alpha L_t^{1-\alpha} - r_t K_t - w_t L_t$, under perfect competition. Here r_t denotes the interest rate, w_t denotes the wage of workers. Profit maximization and

¹To concentrate on the growth effects, problems of intragenerational equity, moral hazard and adverse selection are set aside.

competition imply that factors are paid their marginal product. To capture the basic idea of endogenous growth models in the wake of Romer (1986) and Lucas (1988) we assume that accumulated knowledge corresponds to physical capital per worker $B_t = K_t/N_t$ to obtain:

$$Y_t = AK_t \quad (1)$$

Therefore, the wage and the interest rate are given by:

$$w_t = (1 - \alpha)A (K_t/N_t) \quad \text{and} \quad r_t = \alpha A \quad (2)$$

Individuals live for two periods. In the first period they are healthy and they work. In the second period they are retired and they may become ill. Lifetime utility depends on consumption during the first period c_t , consumption during the second period d_{t+1} and on the health status in the second period. If the individual is healthy the health status is $h_{t+1} = 1$. If the individual is ill the health status is $h_{t+1} < 1$. Let the probability of becoming ill be θ . Then expected utility is $E(U) = (1 - \delta) \log(c_t) + \delta(1 - \theta) \log(d_{t+1}) + \delta\theta \log(d_{t+1}h_{t+1})$. Due to the logarithmic form we are able to separate the health effect:

$$E(U_t) = (1 - \delta) \log(c_t) + \delta \log(d_{t+1}) + \delta\theta \log(h_{t+1}) \quad (3)$$

During the first period individuals work and receive the wage w_t . A proportion τ_t of the wage has to be used to finance health care. The net wage $(1 - \tau_t)w_t$ is used for current consumption and for savings s_t . Savings earn the interest rate r_{t+1} and so consumption in the second period of life is $d_{t+1} = (1 + r_{t+1})s_t$. The health status of those becoming ill depends on the medical care they obtain. We measure medical care in terms of time spend by the medical staff on an ill individual l_{t+1} . In the following we call this medical care for short. The health status is an increasing concave function of medical care with an upper limit at $\bar{h}_{t+1} < 1$, which implies that an ill individual cannot be better off than a healthy individual. So we assume

$$h_{t+1} = \min(al_{t+1}^\mu, \bar{h}_{t+1}) \quad (4)$$

where μ is determined by medical productivity. In the following, we assume that a is sufficiently small so that the constraint $\bar{h}_{t+1}$ does not become binding. Then we will derive the optimal time devoted to an ill individual given different health care financing methods.

2.1 Public Health Insurance

We assume a pay-as-you-go public health care system. In this system, the health care costs in each period are financed by a tax on the wage income of the working generation. Health care costs and, therefore, the necessary tax depend on the cost of an ill individual and on the number of ill people. The cost of an ill individual depends on time of medical care and on the wage rate, so it is $w_t l_t$. The size of the old generation is N_{t-1} , and the probability of becoming ill is θ , so that there are θN_{t-1} ill individuals. Hence total medical care costs are $w_t l_t \theta N_{t-1}$. These costs have to be financed by the tax on wage income of the working generation. So the public health insurance budget constraint is $\tau_t w_t N_t = \theta w_t l_t N_{t-1}$. Note that the relative size of generations is given by the constant population growth factor $n = N_t/N_{t-1}$ and solve for the tax rate:

$$\tau_t = \theta l_t / n \quad (5)$$

We assume that individuals maximize their expected lifetime utility. Since the working generation has the majority in the population, they can decide on the health insurance tax. We assume that individuals rely on the assumption that the parameters remain stable, and so the level of health care that the working generation finances for the currently old will be the same as the level that they obtain when they are old $l_t = l_{t+1}$. Their maximization problem can be stated as:

$$\max_{s_t, l_t} [E(u)] = (1 - \delta) \log((1 - \theta l_t / n) w_t - s_t) + \delta \log((1 + r_{t+1}) s_t) + \delta \theta \log(al_t^\mu) \quad (6)$$

Maximization gives optimal medical care and optimal savings under public health care:

$$l_t = \frac{\delta \mu n}{1 + \delta \mu \theta} \quad \text{and} \quad s_t = \frac{\delta w_t}{1 + \delta \mu \theta} \quad (7)$$

As a result, medical care is constant and independent of the wage. Savings are proportional to wages. Now insert medical care from (7) into (5) to obtain $\tau_t = \delta \theta \mu / (1 + \delta \theta \mu)$. An increase in population growth leads to an increase in medical care and has no effect on the tax and therefore no effect on savings. Most interestingly, an increase in the probability of illness θ leads to a decline in medical care. The reason clearly is that health care costs also increase and therefore an increase in θ leads to a decline in savings. An increase in medical productivity μ leads to an increase in medical care. This increases the tax rate and therefore savings decline.

2.2 Private Insurance

In a private insurance system individuals pay contributions while they work to finance health care during the old age. Health care costs of an ill individual during the old age, i.e. in the next period, depend on time of medical care l_{t+1} and on the next period's wage rate, so it is $l_{t+1}w_{t+1}$. The size of the own generation is N_t and the probability of becoming ill is θ , so the number of the ill in the next period is θN_t . So health care costs are $\theta l_{t+1}w_{t+1}N_t$. These costs have to be financed by contributions during the working period. To obtain a better comparison to the public health insurance system, we assume that contributions are fixed in proportion to the wage. These contributions are used to finance health care in the next period. Until they are needed, insurance companies will invest the contributions on the capital market where they earn the interest rate r_{t+1} . So the health insurance budget constraint is $\tau_t w_t N_t (1 + r_{t+1}) = \theta l_{t+1} w_{t+1} N_t$. Denote wage growth as $g_t = w_{t+1}/w_t$ to obtain the actuary fair insurance premium:

$$\tau = \frac{g_t \theta l_{t+1}}{1 + r_{t+1}} \quad (8)$$

As in (6) individuals maximize their expected lifetime utility:

$$\max_{s_t, l_{t+1}} [E(u)] = (1 - \delta) \log \left(\left(1 - \frac{g_t \theta l_{t+1}}{1 + r_{t+1}} \right) w_t - s_t \right) + \delta \log ((1 + r_{t+1}) s_t) + \delta \theta \log (a l_{t+1}^\mu) \quad (9)$$

Maximization gives optimal medical care and optimal savings under private health insurance:

$$l_{t+1} = \frac{\delta \mu (1 + r_{t+1})}{g_t (1 + \delta \mu \theta)} \quad \text{and} \quad s_t = \frac{\delta w_t}{1 + \delta \mu \theta} \quad (10)$$

As a result, medical care is constant, independent of the wage but negatively related to wage growth. Savings are proportional to wages and they are the same as with public health care. Now insert optimal medical care from (10) into (8) and use $r_{t+1} = r_t$ to obtain: $\tau_t = \delta \mu \theta / (1 + \delta \mu \theta)$. Hence, contributions are the same as with public health care. This is why savings are the same. An increase in population growth has neither an effect on health care l_{t+1} nor on contributions and savings. An increase in the probability of illness θ leads to a decline in medical care. The reason is that health care costs rise. This leads to a decline in savings. An increase in medical productivity μ leads to an increase in medical care. This increases contributions and therefore savings decline. Finally, an

increase in the wage growth factor reduces medical care, but has no effect on contributions and savings.

3 Growth

Now consider growth. From the production function it follows immediately that output growth corresponds to capital growth. With public health care, capital in the next period is financed by the savings of the young $K_{t+1} = s_t N_t$. Use the savings function (7) and insert the wage from (2) to obtain: $K_{t+1} = \delta(1-\alpha)AK_t / (1 + \delta\mu\theta)$. This gives the capital growth factor under public health care as:

$$g_t = \frac{K_{t+1}}{K_t} = \frac{(1-\alpha)\delta A}{1 + \delta\mu\theta} \quad (11)$$

As a result, the growth rate is constant. It depends on the rate of thrift, on the labour share, on the scale parameter, on productivity in health care and on the probability of becoming ill. An increase in life expectancy, that increase the probability of becoming ill, leads to a decline in the growth rate. An increase in medical productivity also leads to a decline in the growth rate. The reason for these effects is, that both shocks increase the tax rate and therefore reduce savings.

Now consider the private health insurance. Capital in the next period is financed by savings of the working generation and by health insurance funds. These insurance funds cover health insurance contributions $\tau_t w_t$ and so capital in the next period is $K_{t+1} = s_t N_t + \tau_t w_t N_t$. Insert the savings function and the wage from (2) to obtain: $K_{t+1} = (1 + \mu\theta) \delta(1-\alpha)AK_t / (1 + \delta\mu\theta)$. This gives the capital growth factor under private health insurance:

$$g_t = \frac{K_{t+1}}{K_t} = \frac{(1 + \mu\theta)(1-\alpha)\delta A}{1 + \delta\mu\theta} \quad (12)$$

The growth factor under private insurance is constant and depends on the same parameters as the growth factor under public health care. However, an increase in life expectancy that goes along with an increase in the probability of becoming ill, now leads to an increase in the growth rate. And the same applies to an increase in medical productivity.

Comparison of (11) and (12) shows that the growth factor with private health insurance exceeds the growth factor with public health care by the factor $(1 + \theta\mu)$. This is due to the fact that contributions to private health insurance are put on the capital market.

4 Conclusion

With a funded private health insurance economic growth is higher than with a pay-as-you-go financed public health care system. Two shocks have been analyzed: First, an increase in life expectancy, that increase the probability of becoming ill, and second, an increase in medical productivity. With public health care both shocks lead to a decline in the growth rate. In contrast, with private health insurance both shocks increase the growth rate.

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