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THE IMPACT OF INCREASING RETIREMENT AGE ON HEALTH SERVICES AND ECONOMIC GROWTH IN BRAZIL

ABSTRACT

This paper uses the Zon and Muysken (2001) model to investigate the effect of increasing the retirement age on health care production, human capital accumulation, and economic growth. All three sectors are interrelated, since the overall level of health affects both workers and the accumulation of human capital, while a higher level of human capital is related to better quality of health. And, finally, health and human capital affect the output of the economy. From the economic growth point of view, the results seem to be positive. Increasing labor availability raises productivity in the health sector, which ultimately improves labor productivity, resulting in increased capital accumulation and economic growth. On the other hand, it is estimated a reduction in the propensity to consume and a smaller portion of the labor force allocated in the health sector.

Keywords: Health Status; Retirement; Economic Growth.

RESUMO

Este artigo utiliza o modelo de Zon e Muysken (2001) para investigar o efeito do aumento da idade da aposentadoria sobre a produção de serviços de saúde, a acumulação de capital humano e o crescimento econômico. Todos os três setores estão inter-relacionados, uma vez que o nível geral da saúde afeta os trabalhadores e a acumulação de capital humano, enquanto que um maior nível de capital humano está relacionado a melhor qualidade da saúde. E, por fim, saúde e capital humano afetam a produção da economia. Do ponto de vista do crescimento econômico os resultados parecem ser positivos. O aumento da disponibilidade de trabalhadores eleva a produtividade do setor de saúde, que acaba por melhorar a produtividade do trabalho resultando em maior acumulação de capital e crescimento econômico. Em contrapartida, estima-se uma redução na propensão a consumir e uma menor parcela da mão de obra alocada no setor de saúde.

Palavras-chave: Saúde; Aposentadoria; Crescimento Econômico.

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INTRODUCTION

The theory of endogenous growth suggests the integration of health production and economic growth through the accumulation of human capital. A drop in growth may be explained by health preference that is positively influenced by rising per capita income or by aging populations. Growth may even disappear in countries with high rates of health deterioration or low productivity in the health sector (ZON and MUYSKEN, 2001).

On the other hand, if the health sector is dynamic, economic growth will be favored both by technological progress in this sector and by better access to the health of the workforce. Health and education are important factors for development as they affect the production capacity of individuals. The more qualified and healthier, the more productive are the workers and consequently the higher the income of the economy.

It is no coincidence, therefore, that education and health expenditures are two of the most representative items of public spending in the developed world. Education expenditure in the Organization for Economic Co-Operation and Development - OECD accounted for 5.2% of Gross Domestic Product - GDP, 4.5% of GDP financed by the public sector, while health costs are approximately 6% of GDP, according to World Bank (2014).

The literature on economic growth has given priority to education because of its more direct correlation with development¹. More recently, however, health has attracted attention because of the rising costs associated with aging. It is not only education, therefore, that is important for economic growth, but health as well.

According to the endogenous growth model of Lucas (1988), education impacts the formation of human capital for growth and development. However, in order for people to provide effective human capital services, they must be healthy. Therefore, the health of the population in general influences the growth and well-being of all. Health contributes to well-being and economic performance because healthy people increase labor productivity.

This paper uses the Zon and Muiyken (2001) model to investigate the effect of increasing the retirement age on health care production, human capital accumulation, and economic growth. The model, therefore, includes a health sector, an education sector, and a production sector. All three sectors are interrelated, since the overall level of health affects workers and the accumulation of human capital, while a higher level of human capital is related to better quality of health. And, finally, health and human capital affect the output of the economy.

Brazil is currently discussing a pension reform to raise the minimum age for retirement. Currently, according to data from the Social Security

¹ Baumol (1967), Lucas (1988), Romer (1990), Barro (1996).

Forum, the average age of retirement in Brazil by contribution time in 2015 was 54.7 years. At the end of 2016, the Brazilian government presented a proposal to increase the minimum age for retirement to 65 years. Hence, this paper investigates how this increase in working time will influence health quality, capital accumulation and long-term economic growth in the country.

The results appear to be positive from the point of view of economic growth. Increasing labor availability raises productivity in the health sector, which ultimately improves labor productivity resulting in increased capital accumulation and economic growth. On the other hand, it is estimated a reduction in the propensity to consume and a smaller portion of the labor force allocated in the health sector.

The article is organized into six sections, including this introduction. The second section presents a literature review on economic growth and health. The third section introduces the endogenous growth model that will be used in the article. The fourth section shows the calibration performed for the model, so as to reflect the Brazilian economy in 2013. The fifth section presents the results and the sixth section, the final considerations and policy suggestions. The fifth section presents the results and the sixth section, the final considerations and policy suggestions.

LITERATURE REVIEW

Health has been a priority in the public and private expenditures of developed countries. According to the OECD (2016), on average the countries of the organization spent 9% of GDP on health in 2015, with the highest spending in the United States (16.9% of GDP), Switzerland (11.5% of GDP) and Japan (11.2% of GDP). Brazilian numbers are very close to the average for rich countries. According to the OECD (2015), Brazil spent 9.1% of GDP in 2013 on health.

However, given income differences, per capita expenditure in US dollars is much higher in the OECD than in Brazil. The average per capita expenditure in the OECD in 2015 reached US\$ 3,815 (OECD, 2016), while in Brazil it was only US\$ 1,471 in 2013 (OECD, 2015).

It is the public sector the main funder of health spending. In the OECD, of the 9% of GDP earmarked for health, 73% comes from governments (6.6% of GDP). In this way, 15% of all OECD public spending goes to the health sector. In Brazil, 46% of health spending was financed by public resources in 2012, so that the health sector accounted for only 7.9% of total public spending in 2012 (WHO, 2015).

Health has therefore played a central role in both government and household spending. And one of the main theoretical motivations for public spending on health is related to the economy. The hypothesis is that a healthy population will be more productive and capable of generating more wealth for the country.

However, health took time to be considered an important factor for economic growth. It is only in the twenty-first century that the subject has become central for growth economists.

Initially, health was incorporated into growth models through human capital. Health affects labor supply, either by working hours or labor market participation. The consequence of this modeling strategy is predictable - the higher the overall health, the greater the human capital and the higher the rate of economic growth. Lopez, Rivera and Currais (2005) emphasize that good health is important to sustain high levels of human capital, with positive effects on productivity and growth. A healthy workforce would be less prone to disease and more willing to work. Raising productivity by improving workers' health would be greater for manual workers, so increased health may have a particularly significant impact on the growth rates of less developed countries.

The second channel between health and growth is demography. Improved health not only allows an increase in life expectancy but also an increase in the number of productive years for each worker. On the other hand, more health means reducing child mortality. Considering the two effects, health improvement helps population growth which is one of the foundations of economic growth. Weil (2005) argues that better health also favors growth by increasing life expectancy that encourages the population to save more, with positive effects on capital accumulation.

Positive externalities associated with health also impact economic growth. The level of health of an individual does not only depend on whether he cares for himself but also depends on the general state of health of the entire population. Low levels of the general health of the population can not only reduce human capital but also negatively influence production, reducing investment and the accumulation of physical capital. Lucas model⁴ although not directly concerned with health, has been the most relevant theoretical basis in the development of endogenous growth models related to health.

However, the literature is not unanimous about the positive relationship between health and growth. Zon and Muysken (1997) argue that the health sector is not a productive activity and that it competes with production activities for scarce resources of the economy. They suggest that when health is incorporated into the utility function, the relationship between health and economic growth may be negative.

Empirical analysis reinforces the relationship between growth and health. Knowles and Owen (1995) use the same strategy of Mankiw, Romer and Weil (1992) for a panel of countries for the period 1960-85. They found a positive correlation between health and economic growth. Similar models, like Rivera and Currais (1999) and Hashmati (2001), suggested that health spending has a positive impact on growth in OECD countries.

Bloom, Canning and Sevilla (2004) studied a panel of countries between 1960 and 1990 and concluded that good health has a positive and statistically significant impact on aggregate output. Macedo and Beuren

(2013) found a similar relationship in Latin America in a study about the relationship between the composition of public expenditures and the economic growth of Latin American countries between 2000 and 2010. It was found that countries which allocated more resources to health had higher rates of growth.

In the national literature, two studies found completely different results. Both estimate the relationship between growth and health for the Brazilian States. Mora e Barona (2000) applied the Barro (1996) model and found a negative relationship between growth and health. Interestingly, Cermeno (2000) with the same model of Mankiw, Romer and Weil (1992) suggested there was a positive relationship between growth and health.

Figueiredo, Noronha e Andrade (2003) studied whether health status impacted Brazilian economic growth in the 1990s based on an econometric estimation of the Solow model. They found that health status contributes directly and positively to economic growth, but also influences the accumulation of human capital. A worsening of health status tends to reduce the positive impact of education on growth.

This article contributes to the Brazilian literature to analyze the influence of the health sector for growth with an endogenous growth model. The national literature has focused on applied econometric studies and the use of endogenous growth models represents an innovation in Brazil. These models allow us to capture the externalities of the health sector, as well as its influence on the accumulation of human capital and output.

A second contribution of the article, also innovative in the national literature, is to study the effects of pension reforms, such as increasing the retirement age, on economic growth, with health as its main channel. In Brazil, studies on social security changes are limited to estimating the economic effects of reforms, especially on fiscal policy, disregarding the health sector completely². In summary, to our best knowledge, this paper was the first to investigate the relationship between social security, health and economic growth in Brazilian literature.

METHODOLOGY

The model is the same of van Zon and Muysken (2001). The population is considered to be divided into two parts. Young people who work in the production of output, health services, human capital formation, and old people who consume output and health services. People live up to age T , and are active in production up to age A . It is assumed that every period n people are born living t years with health g and human capital h . By hypothesis, longevity T is proportional to the average health level g of the population. Therefore,

$$T = \mu \cdot g \tag{1}$$

² For example, Ferreira (2002), Ellery and Bugarin (2003) and Caetano et al. (2016).

Where μ is a constant. Inactive people are equal to $(T - A) \cdot n$ and an increase in longevity will increase the number of inactive people in the economy, increasing consumption of health services. In the steady state the population remains constant, that is, the number of birth per period equals the number of deaths.

The utility function considers the link between health, longevity, and total population size,

$$U = \int_0^\infty e^{-\rho\tau} (g^\vartheta \left(\frac{C}{L}\right)^{1-\gamma})^{1-\theta} \frac{L}{(1-\theta)} d\tau, 0 < \theta < 1 \quad (2)$$

Where ρ is the discount rate and $1/\theta$ is the intertemporal substitution elasticity and $0 \leq \vartheta \leq 1$ measures the relative contribution of health to the utility. Total private consumption is C , while $L = n \cdot T$ is the size of the population. Note, therefore, that longevity is an implicit argument of the utility function that contributes positively to households' welfare. The total effective labor supply, which considers the level of human capital and the quality of health, is therefore $h \cdot g \cdot n \cdot A$.

Production of health services

To integrate health and growth in the context of endogenous growth, productivity is considered to increase due to human capital accumulation and decreasing returns. It is assumed that the production of health services is performed by medical specializations so that a fraction v_i of effective work is employed in the production of knowledge of the medical specialization i . It is assumed that the number of medical specializations is proportional to the size of human capital, $\Omega = \pi \cdot h$. Thus, the average increase in the level of health quality is given by:

$$\begin{aligned} \frac{dg}{dt} &= \int_0^{h\pi} \psi \left(hg v_i \frac{nA}{nT} \right)^\beta \cdot di = \psi \cdot \pi \cdot h \cdot \left(\frac{hgvA}{\pi h \mu g} \right)^\beta \\ &= \psi \cdot \left(\frac{A}{\mu} \right)^\beta \cdot \pi^{1-\beta} \cdot h \cdot v^\beta \end{aligned} \quad (3)$$

Where ψ is the productivity parameter and v is the fraction of the total effective labor supply employed in the health sector. The inequality $0 < \beta \leq 1$ guarantees the hypothesis of decreasing returns in the production of health services.

The increase in the general level of health and medical specializations also has costs. The more specialties, the greater the demand for medical care, which includes an increase in visits to doctors and a growing number of lab exams, which leads to a reduction of work due to technological

developments. It is assumed that this loss is proportional to the number of specializations by a factor ς :

$$\frac{dg}{dt} = \left[\psi \cdot \left(\frac{A}{\mu}\right)^\beta \cdot \pi^{1-\beta} \cdot v^\beta - \varsigma \cdot \pi \cdot g \right] \cdot h \quad (4)$$

It is then possible to obtain the steady-state health quality level:

$$g^* = \frac{\psi}{\varsigma} \cdot \left(\frac{A}{\pi \cdot \mu}\right)^\beta \cdot v^\beta = z_0 \cdot v^\beta \quad (5)$$

Where $z_0 = \frac{\psi}{\varsigma} \cdot \left(\frac{A}{\pi \cdot \mu}\right)^\beta$. Note that the more work destined to the production of the health sector, the higher the quality of health.

Output and Human Capital Accumulation

The production function can be represented by a Cobb-Douglas function:

$$Y = B \cdot [(1 - u - v) \cdot h \cdot g \cdot n \cdot A]^\alpha \cdot K^{1-\alpha} \quad (6)$$

Where Y represents output, K is the capital stock and B is a constant productivity parameter. The fraction $(1-u-v)$ of the labor supply is used in the output, and the remaining fractions u and v are used for human capital accumulation and production of health services respectively.

The process of human capital accumulation takes into account the health of the population:

$$\frac{dh}{dt} = \delta \cdot u \cdot g \cdot h \quad (7)$$

Where δ is the productivity parameter. Finally, the accumulation of physical capital is given by:

$$\frac{dK}{dt} = Y - C \quad (8)$$

Model Solution

In order to solve the model, Social Planner should maximize intertemporal utility (2) with respect to C , u and v , subject to conditions (6), (7), (8) e (4).

Therefore, after obtaining the first-order conditions, the steady-state solution of the model must satisfy the following simultaneous equations:

$$v = \frac{c^2 - \alpha c + \alpha(1-\alpha)(1-\theta)(1-\gamma)/(\theta+(1-\theta)2\gamma)}{c^2 - \alpha c + (\frac{1+\beta}{\beta})\alpha(1-\alpha)(1-\theta)(1-\gamma)/(\theta+(1-\theta)2\gamma)} \quad (9)$$

$$c = 1 - \frac{(1-\alpha) \cdot r}{(\theta + \gamma(1-\theta)) \cdot r + \rho} \quad (10)$$

$$r = \frac{\delta(1-v)z_0v^{\beta-\rho}}{\theta + \gamma(1-\theta)} = \frac{\delta g^*(1-v) - \rho}{\theta + \gamma(1-\theta)} \quad (11)$$

$$u = \frac{1-c}{1-\alpha} (1-v) \quad (12)$$

Where c is the average propensity to consume and r is the balanced growth rate of the economy.

CALIBRATION

For calibrating the model we used information taken from *Instituto Brasileiro de Geografia e Estatística* - IBGE's National Accounts and literature.

The average propensity of consumption, c , was calculated using the *consumption/GDP* ratio obtained from the *National Accounts*, $c = 0.6237$. The balanced growth rate, r , was calculated from the last 20 years average GDP growth rate, $r = 2.6238\%$. The discount rate was estimated at $\rho = 0.015$, and the inverse elasticity of substitution was taken from literature - Cavalcanti (2010), $\theta = 0.7$.

The share of capital income in output was also obtained from National Accounts of 2013, $a = 0.48$. With this information, we can calculate the relative contribution of health to the utility by equation (10), $\gamma = 0.36729$. Now, it is possible to obtain $\beta = 0.0165$ from equation (9).

The fraction of the health sector in total employment can be obtained from the National Accounts in 2013. The total employed in human health and social services was 4.444.429, while the total employed was 102.537.434. Dividing both values we get $v = 0.0433$.

From equation (11) it is possible to calculate the level of health quality at steady state, $g^* = 0.3790$, assuming that the productivity parameter, δ , is equal to 0.1.

Finally, by equation (12) we obtain the participation of effective labor in the production of human capital, $u = 0.6923$.

For subsequent simulations, it will be necessary to calibrate z_0 . From equation (5), $z_0 = 0.4056$. As the average Brazilian retirement age is $A = 55$ years, we can define ξ , which is equivalent to the definition of z_0 without the retirement age term, A . Thus, $z_0 = \xi * A^\beta$, so that $\xi = 0.3791$.

RESULTS AND DISCUSSION

In order to estimate the impact of the increase in the age of retirement, it is assumed that the increase of A from 55 to 65 years, in line with the proposal of social security reform presented by the federal government at the end of 2016.

The four equilibrium equations – (9) to (12) – are solved simultaneously with the following results:

Table 1. Results: Main Variables of the Model

Variable	Initial Steady State	Final Steady State
Balanced growth rate (r)	2.62%	2.71%
Level of health quality (g^*)	0.3790	0.3860
Participation of effective labor in the production of human capital (u)	69.23%	70.25%
Share of effective labor in the production of health services (v)	4.33%	4.22%
Average propensity to consume	62.37%	61.86%

Source: Author's elaboration.

Increasing working time raises the economy's long-term growth rate, improves the average quality of health, and increases the share of effective labor in the production of human capital. On the other hand, it reduces the participation of effective labor employed in the production of health services and the propensity to consume.

The mechanisms behind the results are as follows. The increase in working time for retirement increases the productivity of the health sector by raising z_0 . The hypothesis is that with more effective work the sector becomes more productive. On the other hand, the amount of effective work allocated to the health sector is reduced due to increased productivity. The net effect is an increase in the general level of health, g^* and a reduction in the fraction of effective labor used in the production of health services, v .

The expansion of the average level of health positively affects the production of human capital, equation (7). Workers with better overall health will be able to become more productive. The increase in the rate of accumulation of human capital is reflected in the increase in the long-term growth rate of the economy. Thus, the economy starts to grow at higher rates.

The increase in the rate of human capital accumulation increases the demand for effective labor in this sector. In this way, a larger fraction of the effective labor is used to produce human capital, that is, u increases.

Finally, the average propensity to consume, c , tends to decrease. This is because the increased productivity of the health services sector and the human capital accumulation sector makes an investment in both sectors

more interesting, shifting resources from consumption to investment. It is important to realize that there will be no drop in consumption since the output will grow faster, but consumption will represent a slightly lower percentage of GDP.

CONCLUSION

This paper used the model of Zon and Muyken (2001) to investigate the effect of increasing the retirement age on the production of health services, the accumulation of human capital and economic growth in Brazil. All three sectors are interrelated, since the overall level of health affects workers and the accumulation of human capital, while a higher level of human capital is related to better quality of health. And, finally, health and human capital affect the output of the economy.

The results appear to be positive from the point of view of economic growth. The increase in working time raises the economy's long-term growth rate, improves the average quality of health, and increases the share of effective labor in the production of human capital. On the other hand, it reduces the participation of effective labor employed in the production of health services and the propensity to consume.

As a future research agenda, it would be interesting to have a model that allows simulations and the analysis of transition trajectories. The endogenous growth model is suitable only for studies of long-term economic growth, so it will be necessary to build another type of model, such as the Ramsey or neoclassical models. Another topic that could be explored in more details is the relationship between productivity in the health sector and the total available workforce. In this case, an Overlapping Generations Model (OLG) would be the best choice for such simulations. This type of model is the standard for studies related to social security and demography.

Brazil has health spending as a proportion of GDP comparable to that of rich OECD countries. However, the public sector invests relatively little, accounting for less than half of the expenditure, while in developed countries the public sector disburses almost 0.75% of the total. In fact, these figures indicate the low quality of Brazilian public health, a result of low investment and the population's efforts to pay for private plans to have better care. What this exercise suggests is that a more pronounced public sector investment effort in health can help the Brazilian economy to increase its rate of growth.

Of course, there is a huge need for reductions in inefficiencies, waste, and mismanagement in the Brazilian public health sector, so that only putting more resources may not be enough to improve the average Brazilian health level. However, despite the problems, Brazilian public underfunding is a fact when making international comparisons, and although it is not a sufficient condition, it is a necessary condition for improving health quality, with positive potential impacts on the economy.

REFERENCES

BARRO, R. *Health and economic growth*. In: Convocatória para propostas de investigação sobre Inversão em Saúde y Crecimiento Económico de la Organización Panamericana de la Salud, 1996.

BARRO, R.; SALA-I-MARTIN, X. *Economic growth*. New York: McGraw-Hill, 1995.

BAUMOL, W.J. Macroeconomics of unbalanced growth: the anatomy of urban crisis. *American Economic Review*, v.57, n.3, p.415-426, 1967.

BLOOM, D. E.; CANNING, D; SEVILLA, J. *The effect of health on economic growth: Theory and evidence*. Cambridge: National Bureau of Economic Research. Working Paper n° 8.587, 2001. Available at: <<http://dx.doi.org/10.3386/w8587>>.

CAETANO, M.; RANGEL, L.; PEREIRA, E.; ANSILIERO, G.; PAIVA, L.H.; CONSTANZI, R. *O fim do fator previdenciário e a introdução da idade mínima: questões para a previdência social no Brasil*. Texto para Discussão IPEA n° 2.230. Brasília, 2016

CAVALCANTI, M.A.F.H.; DA SILVA, N.L.C. Impactos de políticas de desoneração do setor produtivo: uma avaliação a partir de um modelo de gerações superpostas. *Estudos Econômicos (São Paulo)*, v. 40, n. 4, p. 943-966. 2010. Available at: <<http://dx.doi.org/10.1590/S0101-41612010000400008>>.

CERMEÑO, R. Education, health and growth: Panel regressions for Latin America, Brazil, Colombia and México. In.: MAYER, D. M.; CERMEÑO, R.; BARONA, A.B.; DURVEYEAU, S. (Orgs) *Health, growth and income distribution in Latin America and the Caribbean: a study of determinants and regional and local behavior*. Research in Public Health Technical Papers, 18, Washington, DC.: Pan-American Health Organization, 2000.

ELLERY, R.; BUGARIN, M.N.S. Previdência social e bem estar no Brasil. *Revista Brasileira de Economia*, v. 57, n. 1, p. 27-57, 2003. Available at: <<http://dx.doi.org/10.1590/S0034-71402003000100002>>.

FERREIRA, Sergio G. Transitional and Long Run Effects of Reforming Social Security in Brazil. *Texto para Discussão PUC-RJ*, Rio de Janeiro, 2002.

FIGUEIREDO, L.; NORONHA, K.V.; ANDRADE, M.V. *Os impactos da saúde sobre o crescimento econômico na década de 90: uma análise para os estados brasileiros*. Texto para discussão n° 219 Cedeplar/UFMG, 2003.

HASHMATI, A. *On the causality between GDP and healthcare expenditure in augmented Solow growth model*. SSE/EFI Working Paper Series in Economics and Finance n° 423, 2001.

KNOWLES, S.; OWEN, P. D. Health capital and cross-country variation in income per capita in the Mankiw Romer Weil-Model. *Economics Letters*, v. 48, n.1, p. 99-106, 1995. Available at: <[https://doi.org/10.1016/0165-1765\(94\)00577-O](https://doi.org/10.1016/0165-1765(94)00577-O)>.

LOPEZ, C.; RIVERA, B.; CURRAIS, L. *Health and Economic growth, findings and policy implication*. London: MIT Press Cambridge, 2005.

LUCAS, R.E. On the Mechanics of Economic Development. *Journal of Monetary Economics*, v.22, n.1, p. 3-42, 1988. Available at: <[https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)>.

MACÊDO, F.F.R.R.; BEUREN, I.M. *Relação entre composição das despesas públicas e crescimento econômico dos países da América Latina*. In: XX Congresso Brasileiro de Custos - Uberlândia, MG, 2013.

MANKIW, N. G.; ROMER, D.; WEIL, D. A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, v.107, n.2, p. 407-437, 1992. Available at: <<https://doi.org/10.2307/2118477>>.

MORA, H.; BARONA, A. B. Health in the economic growth of Latin America. In: MAYER, D. M.; CERMEÑO, R.; BARONA, A.B.; DURVEYEAU, S. (Orgs) *Health, growth and income distribution in Latin America and the Caribbean: a study of determinants and regional and local behavior*. Research in Public Health Technical Papers, 18, Washington, DC.: Pan-American Health Organization, 2000.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT - OECD. *Health at a glance 2015: OECD indicators*. OECD Publishing, Paris, 2015. Available at: <<http://dx.doi.org/10.1787/19991312>>.

_____. Health Statistics 2016. Available at: <<http://www.oecd.org/els/health-systems/health-data.htm>>. Accessed: 1 Jan 2017.

RIVERA, B.; CURRAIS, L. Income variation and health expenditure: evidence for OECD countries. *Review of Development Economics*, n.3, v.3, 258-267, 1999. Available at: <<https://doi.org/10.1111/1467-9361.00066>>.

ROMER, P.M., Endogenous technological change. *Journal of Political Economy*, v.5, n.1, p.71-102, 1990. Available at: <<https://doi.org/10.1086/261725>>.

SOLOW, R.M. A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, v.70, n.1, p. 65-94, 1956. Available at: <<https://doi.org/10.2307/1884513>>.

WEIL, D. *Accounting for the effect of health on economic growth*. National Bureau of Economic Research, Working Paper n° 11.455, 2005.

WORLD BANK. *World Development Indicators*. Washington, USA, 2014.

WORLD HEALTH ORGANIZATION - WHO. *World health statistics 2015*. WHO Publishing, Geneva, 2015.

ZON, A. VAN; MUYSKEN, J. *Health, education and endogenous growth*. Paper presented at the annual conference of the International Institute of Public Finance, Kyoto, 1997. MERIT Research Memorandum, n. 97-009. Available at: <<https://cris.maastrichtuniversity.nl/portal/files/1030114/guid-683ff455-adc7-4a69-bcc2-d4a09229e886-ASSET1.0>>. Accessed: 23 Nov 2016.

_____. Health and endogenous growth. *Journal of Health Economics*, v.20, n.1, p.169-185, 2001. Available at: <[https://doi.org/10.1016/S0167-6296\(00\)00072-2](https://doi.org/10.1016/S0167-6296(00)00072-2)>.