“Investment in Physical Capital, Investment in Health and Economic Growth in China”

AUTHORS	Xie Xiaoqing
ARTICLE INFO	Xie Xiaoqing (2005). Investment in Physical Capital, Investment in Health and Economic Growth in China. *Investment Management and Financial Innovations*, *2*(1)
RELEASED ON	Wednesday, 23 March 2005
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

Investment in Physical Capital, Investment in Health and Economic Growth in China

Xie Xiaoqing

Abstract

This article investigates the effects of investment in physical capital and investment in health and economic growth in China, modeling Cobb-Douglas production function includes physical capital and health. Using annual data for the period of 1978-2002, the article estimates a regressive model of economic growth and the results indicate the share of investment of GDP is increasing and provide insights about policy formulation and implementation.

1. Introduction

The purpose of this study is to explain the growth of China taking into account the effects of investment in physical capital and investment in health. A particular feature of the analysis is its accommodation of the effects of investment in health as a part of human capital on the growth of China.

Economic growth and its determinants are always been concerned by economists. Harrod (1939) and Domar (1946) attempted to integrate Keynesian analysis with elements of economic growth, during this period, almost the same time they presented two similar economic growth models respectively, so their results are called for Harrod-Domar model. The most crucial assumptions of the model are that capital output ratio is a fixed constant, and there is little substitutability between the capital and labor. However, this is not consistent with the reality. It is very difficult to meet the identical equation of Harrod-Domar model in economic growth with the above limitations.

Solow (1956) and Swan (1956) revised the assumptions that capital can not replace labour in the Harrod-Domar model. The key aspect of the Solow-Swan model is the neoclassical form of the production function, a specification that assumes constant returns to scale, diminishing returns to each input, and some positive and smooth elasticity of substitution between the inputs. In 1957, Solow attempted to develop an analytical method for total factor productivity growth in the application. During 1909-1944 in the American non-agriculture sector capital and labor jointly contribute to 12.5% of the overall economic growth. The remaining 87.5% was unexplained named as Solow residual. The Solow residual is interpreted as a measure of the contribution of technological progress. So, in fact, the Solow model presented the view that technological progress is the most important contribution of economic growth at the first. But, there is a deficiency in the Solow model because of its assuming that factors are only capital and labor, and they are regarded as endogenous variables, technological progress is regarded as an exogenous variable.

Solow's residual drew attention from economists. Denison (1967), Young (1995), Hsieh (1988a) attempted to reveal the secrets of the Solow residual by using growth accounting method. Shell (1967) assumes that knowledge is an intentional goods, thus technology is endogenous. He argues that knowledge is the product of the research sector provided by the government, maximizing behavior plays in generating technological progress. In the Shell model, every individual firm's scale is constant, but the whole economy's scale increases. In a partial equilibrium model proposed by Shell (1973) and Griliches (1979), authors assumed that expenditure on research was compensated out of quasi rents. Moreover, the production function takes the form F (A_N , A_E , X), where A_E represents an excludable part of the benefits of research and development and A_N represents the nonexcludable part. Since A_E is excludable, it is accumulated intentionally. The nonexcludable part A_N is created as a side effect of producing A_E .

To emphasize the important role of human capital in economic growth, many growth models assume that economy consists of two sectors; resources need to be allocated between them. An important model of them is presented by Uzawa (1965). He assumed that an education sector that produces human capital exists in the economy, the given resources are allocated in the education sector, thus new knowledge (human capital) is produced, new knowledge increases the rate of production and other sectors have free access to the new knowledge. The education sector realizes indirect contribution to production by improving the level of technology in the manufacturing sector, thus the production function equation is Y=F (K, AL_p), where L_p represents labor force allocation in the manufacturing sector. The production function indicates that output is a function of tangible factors and technological progress that the education sector brings. Although the Uzawa model also treats technological progress as endogenous, the inferences of the neoclassical theory, in the Uzawa model, the rate of equilibrium growth equals 2n. And there is no growth if the rate of population or labor growth is not greater than zero.

Neoclassical growth theory does not provide satisfying answers to our central questions about economic growth. The only determinant of income in the model is the "effectiveness of labor" (A), whose exact meaning is not specified and whose behavior is treated as exogenous. And there is another shortcoming of neoclassical growth theory, which is the evidence, does not support the conclusion of the issue of convergence.

In the middle of 1980's, new growth theory represented by Romer, Lucas, Rebelo, Barro, assumed that technological progress is endogenous, and endogenous factors promote economic growth. Two models of new growth theory (Romer, 1986, 1990; Lucas, 1988; Grossman/Helpman, 1991; Barro/Sala-i-martin, 1995; Aghion/Howitt, 1998) started to seek that one of the motive forces of economic growth is investment. Investment can improve productive capacity and bring the profits by the production of capital goods. The possibility of endogenous growth depends on if the given capital stock accumulation and the given marginal profits are interrelated. The incentives for investment therefore can continue, and the externalities of including physical capital and human capital accumulation have led to endogenous growth on incomes per capita. With the emergence and development of human capital theory, increasing attention has been paid to the special contribution of human capital to economic growth from research. From separating human capital from physical capital, and separating labor quantity from labor quality, the proportion of contribution of human capital to economic growth is discovered.

Human capital models such as those presented by King and Rebelo (1987), Jones and Manuelli (1988) and Rebelo (1988) treat all forms of intangible knowledge as being analogous to human capital skills that are rivalrous and excludable. Romer (1990) described that labor services are skills such as eye-hand coordination that are available from a healthy physical body. Thus, health is treated as a part of human capital. Mankiw, Romer and Weil (1992) presented that the share of physical capital, non-skilled labor and human capital accounts for one-third of the production function respectively. Dornbusch, Fischer and Startz (1998) argued that in developing countries, health investment is the main form of contribution to human capital. The crucial investment can provide enough calorific value for workers; make them obtain the results of labor. However, the share of human capital is greater in the developed countries. Snooks (1994) suggested that the contribution of population to economic activities depends on the level of their education and their health. The health state of labor is the most important factor in the economy.

In the next section, we'll focus on the role of investment in physical capital and investment in health and economic growth. A growth model about physical capital and health will be described. An econometric test using Cobb-Douglas production function will be carried out. Final section deals with related policy recommendations.

2. Investment in Physical Capital, Investment in Health and Economic Growth

In a given period, with given inputs and resources allocation in the society will improve marginal productivity and bring the steady national economy growth. Investment in physical capital and health is the precondition of economic growth. An advanced production technology can be obtained by increasing the investment in physical capital. On the one hand, if manufacturing sectors process physical capital and advanced production technology, moreover, resources can be put to rational use, and all of these will enlarge the scale of production and increase employment; therefore, the level of the national income can be improved. On the other hand, the investment in health can enhance people's confidence and human capital. With the rise of people's income, saving and consuming can be increased, which in turn will make the manufacturing sector enlarge the investment, thus the rate of economic growth can rise to a higher level.

Investment in health is one of the constituents of investment in human capital. Human capital lies in individuals, without health, human capital can't be transformed into actual productive forces. The proportion of health expenditure in human capital expenditure gets bigger and bigger. Investment in health indicates the expenditure used to cure the diseases, safeguard and maintain people's mental and physical health in a given period. Extensively, investment in health also includes the expenditure that is used to entertainment, physical training etc. So investment in health is the productive investment that can bring profits to the investors. It is important to study economic growth, including health investment.

3. Empirical Analysis

3.1. A model of Investment in Physical Capital, Investment in Health and Economic Growth

The assumptions and functional form is Cobb-Douglas. The inputs to production are investment in physical capital (K) and investment in health (H). Suppose final output (Y) is produced using a Cobb-Douglas combination of physical capital and health, thus final output is

$$y = f(k,h) = Ak^{\alpha}h^{\beta}, \tag{1}$$

where A is the effective coefficient, α is the elasticity of output with respect to K, β is the elasticity of output with respect to H. A, α and β are parameters. The assumptions that $A>0$, and $0<\alpha<1$, $0<\beta<1$, our assumption here is that physical capital and health have a positive effect on economic growth. If A, α and β are positive and significant, then it can be concluded that investment in physical capital and investment in health play a large role in economic growth. Furthermore, the form of specification stochastic disturbance or error term with respect to equation (1) is

$$y = Ak^{\alpha}h^{\beta}e^{\varepsilon}. \tag{2}$$

Then taking two side of equation (2) logs yields

$$\ln y = \ln A + \alpha \ln k + \beta \ln h + \varepsilon. \tag{3}$$

In equation (3), ln is natural logarithm, $\ln Y$ is a dependent variable and log real GDP, $\ln A$ is constant, $\ln K$ and $\ln H$ are independent variables, ε is stochastic disturbance or error term. According to the expectation of neoclassical growth theory, the coefficient notation of the two independent variables $\ln K$ and $\ln H$ should be significantly positive. Equation (3) is the equation that is econometrially estimated in the final.

All the regressions in this study are performed using Spss software. The estimation results of the model are obtained from time series data.

3.2. Data and Measurement

First, measuring the figures of investment in health is a knotty problem, especially, measuring the numbers of investment in health of China also faces a main barrier to obtain data. In China, there are many various sources of funds for investment in health and many channels to raise funds for investment in health. The funds include budgetary expenses from government departments, medical care expenditure of all kinds that come from state-owned enterprises, collective owned enterprises, privately owned enterprises and the patients. The budgets of government for hygiene include investment in hygienic fixed assets and hygienic operating expenses. The main medical care expenses are expenses of social insurance, social welfare expenses and patients' expenditure. In the rural area, medical care services carry out the system of charges collect, thus medical care expenses are paid by the patients. Because of the limitation of statistical data, it is very difficult to measure precisely the data of investment in health over the years. To sum it up, the numbers of investment in health (Table 1) are a basic reflection of the state of investment in health in China from 1978 to 2002.

Table 1

The Measurement of Health Investment in China, 1978-2002 (100 million yuan)

Year	Investment in Hygienic Fixed Assets (1)	Health Operating Expenses (2)	Total Social Insurance and Welfare Fund (3)	Medical care One's Own Expenses (4)	Total Investment in Health (5)=(1)+(2)+(3)+(4)
1978	3.25	3.25	18.91	22.00	73.96
1979	4.21	4.21	22.11	24.00	85.16
1980	5.94	5.94	20.31	25.50	91.62
1981	6.81	6.81	21.72	27.60	100.12
1982	9.36	9.36	21.43	29.30	110.91
1983	10.82	10.82	24.04	32.10	124.33
1984	13.10	13.10	25.16	60.60	165.63
1985	24.88	24.88	31.15	60.00	193.82
1986	27.29	27.29	35.58	71.80	227.81
1987	31.33	31.33	37.40	86.10	251.05
1988	35.17	35.17	41.77	131.60	292.07
1989	31.13	31.13	170.50	142.70	432.50
1990	38.44	38.44	206.94	170.10	509.58
1991	36.05	36.05	243.42	203.50	586.03
1992	49.78	49.78	393.55	273.00	851.48
1993	72.27	72.27	557.47	429.80	1199.04
1994	98.13	98.13	775.14	561.60	1651.67
1995	110.98	110.98	992.56	752.30	2109.64
1996	135.40	135.40	1210.43	1018.70	2667.73
1997	159.28	159.28	1481.34	1234.51	3223.23
1998	196.18	196.18	1808.16	1420.15	3819.79
1999	214.01	214.01	2251.10	1648.84	4567.45
2000	238.03	238.03	2553.63	2167.57	5476.23
2001	289.66	289.66	2926.06	2418.76	6252.98
2002	374.55	374.55	3653.48	2973.27	7707.50

Sources:
(1) Wang Baoyuan, 2000, *Human Capital and Economic Development,* pp. 81.
(2) *Statistics on investment in fixed assets of China 1950-2000,* pp.173-175, pp. 260-263.
(3) *China statistical yearbook 2002,* pp. 196.
(4) *China statistical yearbook 2003,* pp. 97, pp. 206, pp. 215, pp. 345, pp. 366, pp. 371, pp. 838, pp. 843, pp. 845.
(5) *China labor statistical yearbook 2002,* pp. 4, pp. 29.
(6) *Comprehensive statistical data and materials on 50 years of new China,* pp. 17.

This article treats Gross Domestic Product as output, regards total investment in fixed assets as total investment in physical capital (Table 2). Without a suitable price index to adjust investment in health, there is no price index of investment in fixed assets in many years. So GDP, total investment in physical capital and total investment in health are measured by nominal prices. The effect on price is not removed from the data.

Table 2

The Measure of GDP, Total Investment in Physical Capital and Total Health Investment, China, 1978-2002 (100 million yuan)

Year	Gross Domestic Product (Y) (1)	Total Investment in Health (H) (2)	Total Investment in Physical Capital (K) (3)
1978	3624.10	73.96	668.72
1979	4038.20	85.16	699.36
1980	4517.80	91.62	910.90
1981	4862.40	100.12	961.00
1982	5294.70	110.91	1230.40
1983	5934.50	124.33	1430.10
1984	7171.00	165.63	1832.90
1985	8964.40	193.82	2543.20
1986	10202.20	227.81	3120.60
1987	11962.50	251.05	3791.70
1988	14928.30	292.07	4753.80
1989	16909.20	432.50	4410.40
1990	18547.90	509.58	4517.00
1991	21617.80	586.03	5594.50
1992	26638.10	851.48	8080.10
1993	34634.40	1199.04	13072.30
1994	46759.40	1651.67	17042.10
1995	58478.10	2109.64	20019.30
1996	67884.60.	2667.73	22913.50
1997	74462.60	3223.23	24941.10
1998	78345.20	3819.79	28406.20
1999	82067.50	4567.45	29854.70
2000	89442.20	5476.23	32917.70
2001	95933.30	6252.98	37213.50
2002	104790.60	7707.50	43499.91

Sources:
(1) *China statistical yearbook 2002*, pp. 51.
(2) *China statistical yearbook 2003*, pp. 55, pp. 186.
(3) *Comprehensive statistical data and materials on 50 years of new China*, pp. 7.

3.3. The results of econometric test

Applying Spss statistical software to regression analysis of equation (3) first of all, we compute lnY, lnK and lnH, then have a regression analysis. The detailed results are as follows:

$$\ln Y = 3.670 + 0.494\ln K + 0.306\ln H$$

$$\text{s.e.} = (0.199) \quad (0.064) \quad (0.057)$$

$$t = (18.402) \quad (7.775) \quad (5.404)$$

$$R^2 = 0.997 \quad F = 3957.840 \quad D.W = 0.569$$

where the estimate of Durbin-Watson *d* statistics is 0.569, but in Durbin-Watson table, the level of significance 5% critical value of d_l =1.454 and d_u =1.206. It is quite evident that the presence of serial correlation can be inferred.

Since the above results of regression analysis are puzzled by serial correlation, therefore, the iterative method to remove serial correlation is adopted by two-step iteration, and the detailed results are obtained as follows:

$$\ln Y = 4.267 + 0.380 \ln K + 0.368 \ln H$$

$$\text{s.e.} = (0.071) \quad (0.080) \quad (0.064)$$

$$t = (9.925) \quad (4.762) \quad (5.716)$$

$$R^2 = 0.951 \quad F = 194.784 \quad D.W = 1.777$$

where the estimate of Durbin-Watson *d* statistics is 1.777, but in Durbin-Watson table, the level of significance 5% critical value of d_l = 1.437 , d_u = 1.168 , d_u <1.777<4-d_u, the estimate of *d* statistics is in no autocorrelation zone, thus serial correlation is eliminated. Returning to the form of the original equation (1) is

$$Y = 71.307 K^{0.380} \; H^{0.368}.$$

The results of testing indicates that R^2 =0.951, F=194.784, P-value equals 0.00<0.05, so we can infer that linear regression equation is significance. To the test of significance of regression coefficients, the P-value equals 0.00<0.05, obviously, there is a statistically significant link between independent variables *K, H* and dependent variable *Y*. The estimated *α* coefficient and *β* coefficient are significantly positive. Hence, it is consistent with the expectation. The above result means that an increase in investment in physical capital (by 1 percentage points in the 1978-2002 period) is estimated to lead GDP to increase by 0.38 percentage points per year, and an increase in investment in health (by 1 percentage points in the 1978-2002 period) is estimated to lead GDP to increase by 0.368 percentage points per year.

4. Policy recommendation

Using the data of investment in physical capital, investment in health and GDP in China from 1978 to 2002, it can be estimated that investment in physical capital and investment in health contribute to GDP. The empirical analysis leads us to the following policy recommendations:

First, the investment policy should pay more attention to the increasing pressure of employment; gradually transform the single target of promoting economic growth into the double targets of promoting economic growth and creating the chance of employment. The plan of labor resources development and utilization should be included in the government program of economy and investment. The policymakers should lay stress on realizing full employment.

Second, the efforts of China medical security systems reforms to accelerate the scope of medical insurance, and to improve sanitation are suited to the need of social development. With the policy of opening to the outside world, the quantity of floating population continues to rise in China. At present, there are about 9000 thousand floating population. A large number of floating population creates conditions for the spread of illness. In the course of industrialization, professional harm gets more and more serious, especially in poisoning, unexpected harm, etc. Environment pollution will also be important sanitation issue.

Third, social security systems should be continued to improve. Especially, income standards of the low-income groups should be further raised. To improve their income will directly bring about an increase in social consume.

Finally, the government should further reform the medical systems and prevent the phenomenon of medical charge in disorder. According to the statistics, in 1998, retail price indices increases -2.6%, but medical care services increases 17.2%; in 2000, retail price indices increases -1.5%, but medical care services increases11.1%; in 2001, retail price indices increases -0.8%, but medical care services increases 10.5%; in 2002, retail price indices increases -1.3%, but medical care services increases 8.2%. Medical care expenditure is increasing so fast that the scope of medical care services is reduced, to a great extent, this hinder improvement of the level of health.

References

1. Zhao Man, 2002, China Labor and Social Security Development Research Reports, China Fiscal Economy Press, Beijing.
2. Li Baoyuan, 2002, Human Capital and Economic Development, Beijing University of Teacher-Training Press, Beijing.
3. David Romer, 2000, 2nd edn, Advanced Macroeconomics, The McGraw-Hill Companies, Inc., New York.
4. Damodar N. Gujarati, 1995, 3rd edn, Basic Economics, McGraw-Hill, Inc., New York.
5. Rudiger Dornbusch, Stanley Fischer, and Richard Startz, 1998, 7th edn, Macroeconomics, McGraw-Hill, Inc., New York.
6. Graeme. D. Snooks, 1994, Portrait of the Family Within the Total Economy – a Study in Longrun Dynamics, Australia 1788-1990, the Press Syndicate of the University of Cambridge, Cambridge and Melbourne.
7. N.G.Mankiw, D.Romer, and D.Weil, 1992,'A Contribution to the Empirics of Economic Growt', Quarterly Journal of Economics, vol. 107, pp. 407-437.
8. Barro R. and X. Sala-I-Martin, 1995, Economic Growth, McGraw-Hill, New York.
9. Rebelo, S., 1991, 'Long-run Policy Analysis and Long-Run Growth', Journal of Political Economy, vol. 99, pp. 500-521.
10. Lucas, Robert E. Jr., 1988, 'On the Mechanism of Economic Development', Journal of Monetary Economics, vol. 22, pp. 3-22.
11. Romer, Paul M., 1990, 'Endogenous Technological Change', Journal of Political Economy, vol. 98, pp. 71-102.
12. Compiled by Department of Statistics on Investment in Fixed Assets National Bureau of Statistics of China, May 2002, Statistics on investment in fixed assets of China 1950-2000, China Statistics Press, Beijing.
13. Compiled by National Bureau of Statistics of China, September 2002, China Statistical Yearbook 2002, China Statistics Press, Beijing.
14. Compiled by National Bureau of Statistics of China, September 2003, China Statistical Yearbook 2003, China Statistics Press, Beijing.
15. Compiled by Department of Comprehensive Statistics of National Bureau of Statistics of China, November 1999, Comprehensive Statistical Data and Materials on 50 Years of New China, China Statistics Press, Beijing.
16. Compiled by Department of Population, Social, Science and Technology Statistics, National Bureau of Statistics, P.R.C., Department of Planning and Finance ministry of Labor and Social Security, P.R.C., November 2002, China labor Statistical Yearbook 2002, China Statistics Press, Beijing.