

HEALTH CAPITAL FORMATION MACROECONOMIC FACTORS IN CHINA

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ABSTRACT

Introduction. Health capital, both a driver and a product of economic growth, is instrumental for China to capitalize on its vast human resources and advance its economic development. This study is aimed at examining the formation mechanism of macroeconomic health capital in China.

Materials and methods. Drawing on public data from China's National Bureau of Statistics (1990–2023), this study utilized a vector autoregressive model to calculate elasticity coefficients from a linearized equation, thereby investigating the linkages between macroeconomic factors and health capital at a macro level.

Results. No significant associations have been observed between the macroeconomic factors and macroeconomic health capital. However, the second lag of health capital exerted significant negative effects per capita government health expenditure, per capita educational funds, and the full employment rate.

Discussion. In terms of the return on health investment, China's government health expenditure has demonstrated suboptimal efficiency. Our study has not identified significant effects of macroeconomic factors on monetized health capital. China's aging population was one of the potential factors affecting the outcome. Moreover, the income effect of health capital in the labor market, its substitution effect on educational funds, and government health expenditure driven by health needs indicated that health capital has aligned more closely with a consumption model than an investment framework.

KEYWORDS

Health capital, government health expenditure, education, full employment rate.

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AUTHORS' CONTRIBUTION

Mao Renjie – conceived and designed the study, performed the preliminary data analysis, and wrote the original draft of the manuscript.

Svetlana V. Panikarova – provided the research topic, supervised the entire research process, and reviewed and edited the manuscript.

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Wang Juan – contributed to the data curation by processing the monetary data to adjust for inflation using the PRODUCT function in Excel.

All authors reviewed and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

USE OF AI TOOLS DECLARATION

All authors declare that they have not used Artificial Intelligence (AI) tools for the creation of this article.

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

МАКРОЭКОНОМИЧЕСКИЕ ФАКТОРЫ ФОРМИРОВАНИЯ КАПИТАЛА ЗДОРОВЬЯ В КИТАЕ

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АННОТАЦИЯ

Введение. Капитал здоровья, являясь одновременно движущей силой и продуктом экономического роста, играет важную роль в использовании Китаем его обширных человеческих ресурсов для достижения экономического развития. Целью данного исследования было изучение механизма формирования капитала здоровья на макроэкономическом уровне в Китае.

Материалы и методы. Опираясь на общедоступные данные Национального бюро статистики Китая (1990–2023), в этом исследовании использовалась модель векторной авторегрессии для расчета коэффициентов эластичности из линеаризованного уравнения, тем самым исследовалась связь между макроэкономическими факторами и капиталом здоровья на макроуровне.

Результаты. Значимой связи между выбранными макроэкономическими переменными и макроэкономическим капиталом здоровья не выявлено. Однако второй лаг капитала здравоохранения показал существенную отрицательную связь с государственными расходами на здравоохранение на душу населения, подушевыми образовательными расходами и уровнем полной занятости.

Обсуждение. С точки зрения отдачи от инвестиций в здравоохранение, государственные расходы Китая на здравоохранение продемонстрировали неоптимальную эффективность. Не выявлено существенного влияния макроэкономических факторов на монетизированный капитал здравоохранения. Старение населения Китая было одним из потенциальных факторов, влияющих на результат. Эффект дохода от капитала здравоохранения на рынке труда, его эффект замещения в финансировании образования и государственные расходы на здравоохранение, обусловленные потребностями в здравоохранении, показали, что капитал здравоохранения больше соответствует модели потребления, чем инвестиционной модели.

КЛЮЧЕВЫЕ СЛОВА

Капитал здравоохранения, государственные расходы на здравоохранение, образование, уровень полной занятости.

ФИНАНСИРОВАНИЕ

Статья выполнена без внешнего финансирования.

ДЛЯ ЦИТИРОВАНИЯ

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ВКЛАД АВТОРОВ

Жэньцзе М. – разработал концепцию и дизайн исследования, провел предварительный анализ данных и написал первоначальный вариант рукописи. Паникарова С. В. – предложила тему исследования, руководила всем исследовательским процессом, а также рецензировала и редактировала рукопись. Хуан В. – внесла вклад в обработку данных, обработав денежные данные с учетом инфляции с помощью функции PRODUCT в Excel.

Все авторы ознакомились с окончательной версией рукописи и одобрили ее.

КОНФЛИКТ ИНТЕРЕСОВ

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Авторы заявляют о том, что при написании данной статьи не применялись средства генеративного искусственного интеллекта.

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■ INTRODUCTION

In 1961, Schultz¹ systematically articulated the theory of human capital for the first time, defining it as the aggregate of an individual's physical strength, knowledge, skills, and health status. He identified human capital as a crucial factor of production comprising two interconnected dimensions: first, educational human capital, developed through investments in education to enhance workers' intellectual abilities, thereby raising their labor productivity; and second, health human capital, built through health-related investments that improve individuals' physiological and psychological conditions. This, in turn, extended working lifespans, reduced societal healthcare costs, and boosted overall labor productivity.

Mushkin [1] extended the study of health human capital into the micro-level domain, treating health as a form of investment and evaluating its returns. Meanwhile, Grossman [2] conceptualized health as a type of commodity. He argued that individuals in good health generally experience a higher level of well-being compared to those in poor health. As such, health generates utility and can be incorporated into the utility function for further analysis.

Grossman [2] constructed a personal health demand model that describes all the complex trade-offs involved in health management. Health in the Grossman model directly affects personal utility. An individual's behavior may affect both health level and consumption of non-health goods. For example, drinking alcohol increases consumption of non-health goods, but may have a negative impact

on health. Engagement in travel may simultaneously enhance both health status and the consumption of non-health services. Grossman thought that time constrained an individual's ability to obtain utility, so individuals had to weigh different behaviors that affect health level and consumption of non-health goods [3]. If an individual possesses a high baseline health endowment and exhibits low morbidity, the marginal contribution of health to production time is negligible. However, for an individual in poor health, even a modest health improvement can generate a significant increase in production time. Therefore, the marginal benefit of health to production time is diminishing. According to this model [3], reduction in morbidity is contingent upon the enhancement of health status. Any input or time that promotes health may generate additional production time. The newly generated production time can be used to continue investing in activities that promote health, or it can be used for work and entertainment. This means that the ultimate goal of reducing sick time is to have more time to produce health and consume non-health goods. In this framework [3], the production of health is an activity independent of work, entertainment, and illness. Therefore, an individual's investment in health means that the individual gives up the opportunity to invest resources in other market investment projects, thereby generating opportunity costs. In order to ensure the rationality of health investment, the return on health investment must at least cover the opportunity cost

¹ Schultz, T. W. (1961). Investment in human capital. *The American economic review*, 51 (1), 1–17. – URL: <https://www.jstor.org/stable/1818907> (accessed: 27.10.2025).

and depreciation cost. The marginal efficiency of health capital determines that when the marginal cost of health investment is equal to the marginal benefit of health investment, the individual is at the optimal health level.

Grossman [3] divided the returns on health investment into two types: consumption returns and investment returns. The former stems from the utility directly obtained from health. It satisfies an individual's need to avoid the pain and discomfort caused by disease. In terms of consumption returns, health is a durable consumption good that can directly bring happiness; the latter stems from the fact that health capital can produce health time. It satisfies an individual's need to ensure working hours and labor efficiency. In terms of investment returns, health is a productive capital that can generate income. Therefore, the author further posited that the returns on health investment could be explained by consumption models and investment models [3].

This form of capital, as an important component of human capital², is both a driver of economic growth [4] and a product of economic growth [5]. Healthy individuals have higher labor efficiency and labor force participation rates than those in poor health, and have a longer life expectancy to participate in economic activities [6]. Therefore, health capital influences individual income and the country's economic level [7].

Such investments can promote economic growth and increase economic resilience by improving productivity [8]. Financial outlays in this sector can come from public sector health expenditure or from individual health expenditure. The determinants of health are not limited to the health system but also exist in a wider range of outcomes [9]. Public policies that are not directly related to public health expenditure may also influence macroeconomic health capital because individuals weigh the costs and benefits of health investments in terms of money and time [3]. This creates a more complex connection between the production of macroeconomic health capital and macroeconomic factors.

China had the world's second-largest population, which signified its abundant human resources [10]. However, human resources are not the same as human capital. Human resources need to be transformed into human capital before they can be used in production activities to reflect their value [11]. Health, as one of the elements of human capital, is a key factor in China's utilization of human resources and economic development. Therefore, it is essential to research the production mechanism of macroeconomic health capital in China.

Liu's [12] study showed that China's health human capital had been growing from 2005 to 2019, but there were obvious regional differences. The health human capital in regions with higher economic levels contributed more to regional economic growth than the health human capital in regions with lower economic levels [12]. Bu's [13] study found that strengthening mental health and social adaptation could narrow the regional differences in China's macroeconomic health capital.

Yang [14] studied 21 developing countries and found that under different human capital levels, the effect of health expenditure on economic growth was different. Under low human capital levels, health expenditure was negatively correlated with economic growth; under high human capital levels, health expenditure was positively correlated with economic growth. The higher the level of human capital, the more significant the positive correlation between health expenditure and economic growth [14]. Shuyong [15] used public health expenditure as an activity for the production of health human capital and found that the efficiency of the Chinese government's investment in health human capital was lower in the economically developed eastern regions of China, but higher in the economically underdeveloped central and western regions. It is not clear whether this is related to the diminishing marginal returns of health human capital production.

We thought that any activity that can improve China's macroeconomic health capital should be considered a health production activity. The influence of social capital on China's macroeconomic health capital cannot be ignored. Social capital was defined as resources that can be obtained from connections between individuals and groups [16]. It can be seen as a public product that benefits the entire society [17]. Gao's [18] study found that higher workplace social capital was significantly associated with higher levels of mental health among Chinese employees. Increased social capital helped improve the health behavior of Chinese residents. Wang's [19] study showed that social capital was significantly correlated with the health behavior of Chinese middle-aged and elderly people. During the COVID-19 pandemic, social capital, as a mediator of cultural capital, positively influenced the health literacy of Chinese community residents [20]. Therefore, public policy intervention in social capital can be a way to produce China's macroeconomic health capital.

Zhao³ constructed China's macro health production function by taking medical and health services, public health facilities and medical and health

² Schultz, T. W. (1961). Investment in human capital. *The American economic review*, 51 (1), 1–17. – URL: <https://www.jstor.org/stable/1818907> (accessed: 27.10.2025).

³ Zhao, Q. (2018). The impact of my country's medical and health investment on residents' health status - a study based on macroeconomic health production function. *Economic Research Reference*, (25), 74–80. – URL: <https://d.wanfangdata.com.cn/periodical/jjyjck201825009> (accessed: 27.10.2025).

facilities as macro factors and mortality rate as the evaluation index of macro health level. She found that although medical and health services can reduce the mortality rate of the population to a certain extent, their influence on the mortality rate of the population was not significant. Public health facilities did not play a role in reducing the mortality rate of the population, and medical and health facilities were very inefficient in improving the mortality rate of the population.

Li [21] integrated multiple macro factors, taking into account economic, social, educational, and medical factors as independent variables and life expectancy as the dependent variable, and constructed a macro health production function for China. The study found that health expenditure, education, and GDP per capita have a positive long-term effect on life expectancy, while inflation and population growth exert a negative influence. Using bootstrap ARDL cointegration analysis over the period 2000–2023, the author demonstrated that the impact of health production factors on population health status exhibits significant time lags, with long-run elasticities being more pronounced than short-run effects. Public healthcare spending showed a positive and statistically significant association with life expectancy in the long run, suggesting that health investment contributes to improved population health outcomes over time. However, the efficiency of public health resources may be moderated by macroeconomic conditions, as inflation was found to negatively affect life expectancy.

The above studies on China's health production function all used mortality as the standard for evaluating macro health levels, rather than capitalized health as macro standards. The health production function with mortality as the macro health level was based on the fact that should enjoy equal health rights and the right to non-discriminatory treatment by public policies. However, our study attempted to construct a macroeconomic health capital function and focused on the efficiency of public policies oriented to health human capital.

■ MATERIALS AND METHODS

According to the objectives of this study, we proposed the following hypotheses:

H1: Per Capita Government Health Expenditure has a positive effect on health capital.

H2: Per Capita Social Health Expenditure has a positive effect on health capital.

H3: Per Capita Total Investment in the Treatment of Environmental Pollution has a positive effect on health capital.

H4: Per Capita Disposable Income Nationwide has a positive effect on health capital.

H5: Per Capita Educational Funds has a positive effect on health capital.

H6: Number of Medical Technical Personnel in Health Care Institutions per 10001 Persons has a positive effect on health capital.

H7: Full Employment Rate has a positive effect on health capital.

Based on the theories of Grossman [2] and Jorgenson [22], this study used the lifetime income approach to construct a calculation formula for macroeconomic health capital:

$$H_{Macro} = \sum_{i=1}^n (l - i) \cdot P_i \cdot E \quad (i \leq l) \quad (1)$$

l: life expectancy per capita

i: age

P_i: population of different ages

E: per capita income

We expressed the health capital production mechanism in the Grossman model as the Cobb-Douglas production function and linearized the equation by taking its natural logarithm⁴:

$$\ln Y = \alpha \ln X_1 + \beta \ln X_2 + \gamma \ln X_3 + \delta \ln X_4 + \varepsilon \ln X_5 + \zeta \ln X_6 + \eta \ln X_7 \quad (2)$$

Y: Health Capital

X1: Per Capita Government Health Expenditure

X2: Per Capita Social Health Expenditure

X3: Per Capita Total Investment in the Treatment of Environmental Pollution

X4: Per Capita Disposable Income Nationwide

X5: Per Capita Educational Funds

X6: Number of Medical Technical Personnel in Health Care Institutions per 10001 Persons

X7: Full Employment Rate

Based on public data from the National Bureau of Statistics of China from 1990 to 2023⁵, we used a vector autoregressive (VAR) model to calculate the elasticity coefficients in the linearized equation and analyze the relationship between macroeconomic factors and macroeconomic health capital. All monetary data were adjusted for inflation using the consumer price index. The number of people of different ages was calculated based on the median of the population of different age groups. Missing values for life expectancy per capita were interpolated using the annualized growth rate. The full employment rate in this study was the employment rate that did not include self-employed individuals.

■ RESULTS

All data met the requirements of the Augmented Dickey-Fuller Unit Root Test after first or second difference (Table 1).

⁴ Cobb, C. W., & Douglas, P. H. (1928). A theory of production. *The American economic review*, 18 (1), 139–165. – URL: <https://www.jstor.org/stable/1811556> (accessed: 27.10.2025).

⁵ National Data // Official Website of National Bureau of Statistics of China – URL: <https://data.stats.gov.cn/english/easyquery.htm?cn=C01> (accessed: 27.10.2025).

Table 1 – Augmented Dickey-Fuller Unit Root Test
Таблица 1 – Расширенный тест Дики-Фуллера на единичный корень

Variables	Test equation (intercept/trend/maxlag)	ADF test statistic	1% level	5% level	10% level	Prob.	Durbin-Watson stat
$\Delta^2 Y$	none/none/3	-10.27983	-2.641672	-1.952066	-1.610400	0.0000	2.262531
$\Delta^2 X_1$	none/none/3	-11.50566	-2.641672	-1.952066	-1.610400	0.0000	1.871761
ΔX_2	intercept/none/3	-3.428909	-3.653730	-2.957110	-2.617434	0.0172	2.112717
$\Delta^2 X_3$	none/none/3	-6.978054	-2.644302	-1.952473	-1.610211	0.0000	1.956252
$\Delta^2 X_4$	none/none/3	-11.05260	-2.641672	-1.952066	-1.610400	0.0000	2.294591
ΔX_5	intercept/none/3	-2.985458	-3.653730	-2.957110	-2.617434	0.0470	2.266824
$\Delta^2 X_6$	none/none/3	-9.973236	-2.641672	-1.952066	-1.610400	0.0000	2.314094
$\Delta^2 X_7$	none/none/3	-5.700659	-2.644302	-1.952473	-1.610211	0.0000	2.057551

Δ : 1st difference

The VAR model showed that none of the macroeconomic factors had any significant effect on macroeconomic health capital. The second lag of health capital had a significant negative effect on per capita government health expenditure, per capita educational funds, and the full employment rate. The first lag of per capita social health expenditure had a significant positive effect on per capita government health expenditure, while the second lag of per capita social health expenditure had a significant negative effect on per capita

government health expenditure. The first and second lag of number of medical technical personnel in health care institutions per 10,001 persons had a significant positive effect on per capita government health expenditure. The second lag of full employment rate had a significant positive effect on per capita social health expenditure. The second lag of per capita educational funds had a significant positive effect on full employment rate (Table 2). All of these effects were confirmed by the Granger Causality Test at the 5% significance level.

Table 2 – VAR model results of macroeconomic factors and health capital
Таблица 2 – Результаты модели VAR макроэкономических факторов и капитала здоровья

Vector Autoregression Estimates Standard errors in () & t-statistics in []								
	X1	X2	X3	X4	X5	X6	X7	Y
X1(-1)	-0.457247	0.078473	0.707716	-0.056928	0.060552	0.026910	0.028163	-0.089973
	(0.20677)	(0.17783)	(0.31317)	(0.06218)	(0.08614)	(0.07362)	(0.00945)	(0.06289)
	[-2.21137]	[0.44127]	[2.25987]	[-0.91548]	[0.70293]	[0.36553]	[2.98023]	[-1.43070]
X1(-2)	-0.206890	-0.107275	0.237434	0.036611	0.201783	-0.026551	0.007958	0.012503
	(0.24187)	(0.20802)	(0.36632)	(0.07274)	(0.10076)	(0.08611)	(0.01105)	(0.07356)
	[-0.85538]	[-0.51569]	[0.64815]	[0.50332]	[2.00253]	[-0.30832]	[0.71992]	[0.16997]
X2(-1)	0.981646	0.693487	0.231529	-0.089525	-0.060150	0.075711	-0.004776	-0.087700
	(0.30269)	(0.26033)	(0.45844)	(0.09103)	(0.12610)	(0.10777)	(0.01383)	(0.09206)
	[3.24312]	[2.66392]	[0.50504]	[-0.98348]	[-0.47700]	[0.70254]	[-0.34529]	[-0.95265]
X2(-2)	-1.025806	0.034331	-0.377828	0.050660	0.070606	0.071323	-0.018564	0.063843
	(0.28774)	(0.24747)	(0.43580)	(0.08653)	(0.11987)	(0.10245)	(0.01315)	(0.08751)
	[-3.56506]	[0.13873]	[-0.86698]	[0.58544]	[0.58900]	[0.69620]	[-1.41169]	[0.72952]
X3(-1)	0.418076	0.283336	-0.839690	-0.003513	-0.096559	0.040180	-0.006966	0.003638
	(0.17583)	(0.15122)	(0.26630)	(0.05288)	(0.07325)	(0.06260)	(0.00804)	(0.05348)
	[2.37775]	[1.87365]	[-3.15314]	[-0.06643]	[-1.31819]	[0.64183]	[-0.86682]	[0.06803]

X3(-2)	0.160962	0.159566	-0.388044	0.032762	-0.000535	0.060806	-0.013771	0.045890
	(0.16140)	(0.13881)	(0.24444)	(0.04854)	(0.06724)	(0.05746)	(0.00738)	(0.04909)
	[0.99731]	[1.14953]	[-1.58745]	[0.67499]	[-0.00796]	[1.05817]	[-1.86691]	[0.93487]
X4(-1)	-2.500739	-8.148841	-5.626226	-2.348187	4.492382	-3.116350	0.236267	-2.443611
	(6.09075)	(5.23837)	(9.22481)	(1.83171)	(2.53745)	(2.16855)	(0.27836)	(1.85245)
	[-0.41058]	[-1.55560]	[-0.60990]	[-1.28197]	[1.77043]	[-1.43707]	[0.84878]	[-1.31912]
X4(-2)	21.74494	-2.722884	5.044605	0.972715	6.920427	-1.749400	0.720385	0.786696
	(6.27993)	(5.40108)	(9.51133)	(1.88860)	(2.61627)	(2.23590)	(0.28701)	(1.90999)
	[3.46261]	[-0.50414]	[0.53038]	[0.51505]	[2.64515]	[-0.78241]	[2.50998]	[0.41189]
X5(-1)	-0.200225	0.381924	-0.943050	0.107388	0.393789	0.140073	-0.048054	0.200493
	(0.59136)	(0.50860)	(0.89564)	(0.17784)	(0.24636)	(0.21055)	(0.02703)	(0.17986)
	[-0.33859]	[0.75094]	[-1.05293]	[0.60384]	[1.59841]	[0.66529]	[-1.77806]	[1.11474]
X5(-2)	-0.237641	-0.218189	0.186538	-0.036196	0.400361	-0.139319	0.076590	-0.109455
	(0.65209)	(0.56083)	(0.98763)	(0.19611)	(0.27167)	(0.23217)	(0.02980)	(0.19833)
	[-0.36443]	[-0.38904]	[0.18887]	[-0.18457]	[1.47372]	[-0.60007]	[2.56994]	[-0.55189]
X6(-1)	1.720112	0.060620	1.946702	-0.258294	-0.295001	-0.792371	0.002394	-0.288863
	(0.65887)	(0.56666)	(0.99790)	(0.19815)	(0.27449)	(0.23458)	(0.03011)	(0.20039)
	[2.61070]	[0.10698]	[1.95080]	[-1.30356]	[-1.07472]	[-3.37777]	[0.07952]	[-1.44150]
X6(-2)	1.256675	-0.389546	1.860846	0.115306	0.254066	-0.210740	-0.030645	0.098043
	(0.58226)	(0.50077)	(0.88186)	(0.17511)	(0.24257)	(0.20731)	(0.02661)	(0.17709)
	[2.15828]	[-0.77789]	[2.11013]	[0.65849]	[1.04738]	[-1.01656]	[-1.15162]	[0.55364]
X7(-1)	9.158837	-0.808658	2.463598	-0.244959	-0.940999	2.914885	-0.247055	0.059616
	(5.15562)	(4.43411)	(7.80849)	(1.55048)	(2.14787)	(1.83560)	(0.23562)	(1.56804)
	[1.77648]	[-0.18237]	[0.31550]	[-0.15799]	[-0.43811]	[1.58797]	[-1.04851]	[0.03802]
X7(-2)	-7.097077	9.303024	-1.581163	0.918970	2.800804	-1.198998	-0.931966	1.285251
	(5.13358)	(4.41516)	(7.77512)	(1.54385)	(2.13869)	(1.82776)	(0.23462)	(1.56134)
	[-1.38248]	[2.10707]	[-0.20336]	[0.59525]	[1.30959]	[-0.65599]	[-3.97228]	[0.82317]
Y(-1)	4.694962	7.207879	8.839407	1.750924	-3.994773	3.123207	-0.188555	1.745245
	(5.75311)	(4.94799)	(8.71344)	(1.73017)	(2.39679)	(2.04834)	(0.26293)	(1.74976)
	[0.81607]	[1.45673]	[1.01446]	[1.01200]	[-1.66672]	[1.52475]	[-0.71712]	[0.99742]
Y(-2)	-20.05923	1.831499	-4.419918	-0.797862	-6.066347	2.167686	-0.813042	-0.530453
	(6.30135)	(5.41951)	(9.54379)	(1.89504)	(2.62519)	(2.24353)	(0.28799)	(1.91651)
	[-3.18332]	[0.33795]	[-0.46312]	[-0.42103]	[-2.31082]	[0.96619]	[-2.82318]	[-0.27678]
C	0.041550	0.022172	0.092489	-0.003315	0.014723	-0.008869	-0.001603	-0.007196
	(0.04104)	(0.03530)	(0.06216)	(0.01234)	(0.01710)	(0.01461)	(0.00188)	(0.01248)
	[1.01245]	[0.62819]	[1.48802]	[-0.26856]	[0.86117]	[-0.60696]	[-0.85480]	[-0.57653]
Adj. R ²	0.630531	0.411098	0.586810	0.437815	0.689746	0.486131	0.412040	0.457227

The impulse response function showed that the negative effect of health capital on per capita educational funds was maximized in the third time period. The negative effect was significantly reduced in the fourth time period and further

significantly reduced in the seventh time period (Figure 1). This may be the result of the continuous and stable substitution effect of health capital on the demand for education for the purpose of increasing income.

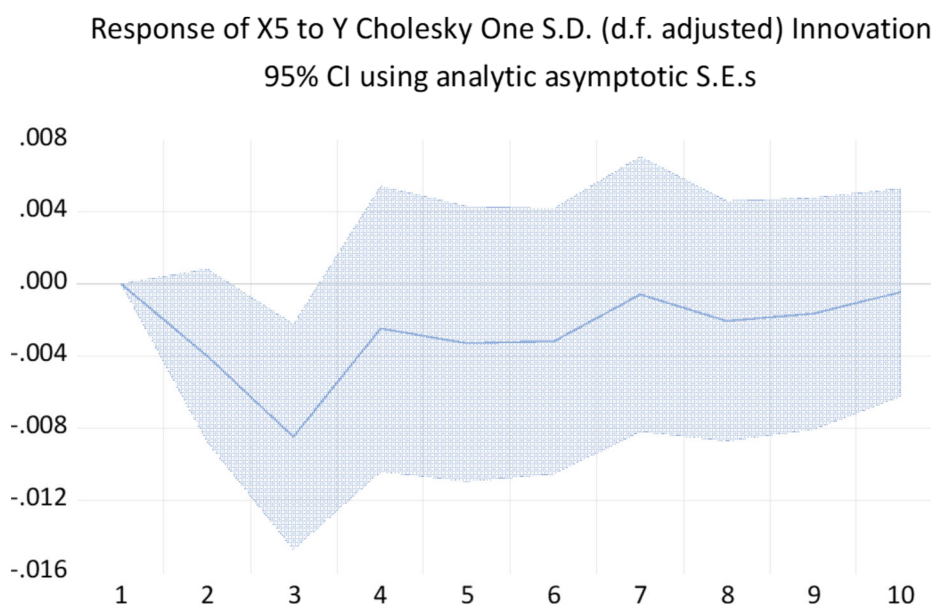


Figure 1 – Impulse Response of Per Capita Educational Funds to Health Capital
Рисунок 1 – Импульсная реакция фондов на образование на душу населения на капитал здравоохранения

The negative effect of health capital on the full employment rate was maximized in the third time period and turned positive in the fifth time period. It again became negative in the seventh time period and turned positive in the ninth time period (Figure 2). The magnitude of the alternating positive and

negative effects of health capital on the full employment rate gradually decreased. This may be because health capital has the dual characteristics of both a consumption good and an investment good, resulting in a shift in its role in labor force participation decisions as individuals' income changes.

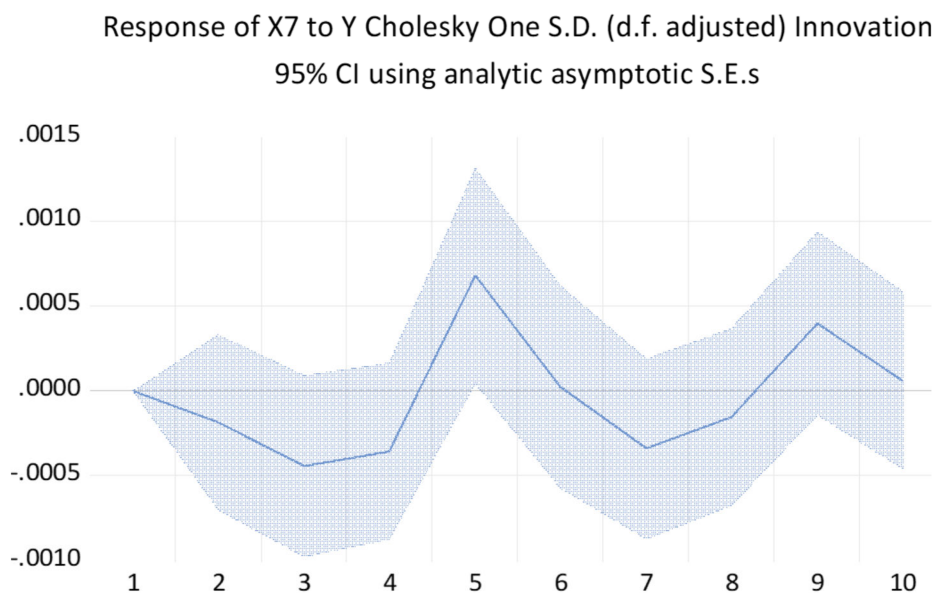


Figure 2 – Impulse Response of Full Employment Rate to Health Capital
Рисунок 2 – Импульсная реакция уровня полной занятости на капитал здравоохранения

Hypotheses H1, H2, H3, H4, H5, H6 and H7 were not supported by empirical evidence.

■ DISCUSSION

Our research found that China's social health expenditure initially drove government health expenditure, but subsequently reduced it. Government health expenditure rose with the full employment

rate. However, none of the macroeconomic factors included in this study, including social health expenditure and government health expenditure, had any significant effect on macroeconomic health capital in China. Considering that the increase in the number of medical technicians was found to be one of the factors contributing to the continued increase in government health expenditure, China's government

health expenditure might indicate potential inefficiencies in monetization of health capital investment.

An expansion of China's macroeconomic health capital was associated with a reduction in government health expenditure. Notably, this accumulation of health capital also coincided with a decline in both the full employment rate and per capita educational funding. However, a rise in per capita educational funds appeared to exert a positive effect on the full employment rate. One possible explanation is that improvements in health capital enhance productivity and income, thereby enabling individuals to maintain their previous income levels while reducing labor supply. Consequently, a higher stock of health capital may lead to a contraction in labor supply. Pintor [23] explained this phenomenon as the «income effect» in the labor market.

Mushkin [1] listed health and education as twin concepts under the human capital framework, and the relationship between health and education is close and complex. Jayachandran [24] found in a study on the relationship between life expectancy and human capital investment in Sri Lanka that for every additional year of life expectancy of residents in the region, the number of years of education received by residents would increase by 0.11 years, and the literacy rate would increase by 0.7 percentage points. Fortson [25] analyzed the prevalence of AIDS and human capital investment in 15 countries in sub-Saharan Africa and found that in areas with a high prevalence of AIDS, the number of years of schooling decreased relatively significantly. Adults in the region had an expected life expectancy of 0.386 years of education per year.

Healthy individuals tend to have longer lifespans than unhealthy individuals, which means that healthy individuals have more time to receive education. Individuals with more educational resources may be better at maintaining their health and thus prolonging their lifespans than those with less educational resources. The longer lifespan of an individual means that he or she has more time to receive education and has more opportunities to receive education. However, health capital depreciates with age and depreciates faster after a certain stage in the life cycle until death [26]. This means that as the number of years of full-time education received by an individual increases, the depreciation rate of the stock of health capital increases.

Health and education, as important factors in human capital investment, can both improve individual productivity [27]. Education and health are also believed to have positive effects on each other. Education can promote health [28], and improved health levels can extend the years of education [24; 25]. Araki's [29] research showed that the mediating effect of health on education increased as people age. However, our study found that per capita education expenditure had no significant influence on health

capital, and the increase in health capital led to a decrease in per capita educational funds.

We thought this was because increased individual health capital led to higher income, which increased the opportunity cost of education. The cost for individuals to forgo higher income in exchange for educational investment became greater, leading to a decline in their willingness to pursue education. In labor economics, a tight labor market was correlated with dropout rates. von Simson [30] assessed the impact of the opportunity cost and returns of education on high school dropout rates among Norwegian youth. The results showed that both significantly influenced individual dropout decisions. The opportunity cost of education had a greater impact on Norwegian youth's dropout decisions than the returns. Therefore, we thought that it might be due to the substitution effect of health on education.

In addition, our study also showed that Grossman's health capital theory overestimated people's economic-oriented motivation for health capital production. In the Grossman model, individuals can live forever as long as they have enough health capital [2; 3]. This meant that individuals had the motivation to produce as much health capital as possible, including receiving more education to improve the efficiency of health capital production, because the utility of health was not limited by the time of use under the condition of immortality. However, no one can have an infinite life, so the utility of health was overestimated. We believed that, given sufficient health capital or income, people would tend to spend their limited time on goods that are not beneficial to their health, rather than investing in education to increase their health capital or income. Therefore, health capital had a substitution effect on education.

Some studies suggested that health needs and therapeutic care were more like consumption and could not be accounted for in investment models [31]. Our study also failed to capture the significant effects of macroeconomic factors on monetized health. It suggested that health capital might not be suitable for investment models.

Furthermore, the income effect of health capital in the labor market and its substitution effect on educational funds suggested that health capital was more suited to consumption models than investment models.

In this study, we found no evidence to support the idea that health capital investment can generate health capital returns. We thought the direct cause of this result was that Grossman's method of calculating monetized health capital ignored the non-monetary returns of health capital. Grossman used the income generated by an individual during health time as the standard for evaluating health capital, thus focusing on the monetized investment returns of health capital in production activities. This method of calculating monetized health capital aligns with

human capital theory in Western economics. Human capital, as a factor of production, capitalizes the value of labor in production activities. Health capitalized in production activities can be fully measured in monetary terms. However, the non-monetary returns of health capital are not entirely obtained in production activities. Non-monetary returns include consumption returns in Grossman's theory and other returns not reused in production activities, including the knowledge, skills, and health acquired by individuals at work. The latter is «accumulated value», not «realized value». It is capitalized but not monetized.

Grossman [2; 3] proposed that health needs stemmed from consumption motivation and investment motivation. According to Maslow's hierarchy of needs [32], we argued that the consumption motivation for health investment took precedence over the investment motivation. The consumption motivation for health investment includes an individual's needs for survival, relief from physical discomfort, and longevity. It mainly stems from an individual's physical needs, which are the most basic needs in Maslow's hierarchy of needs, especially survival needs [32]. However, the investment motivation for health investment includes the needs for income and career development. It mainly stems from an individual's esteem needs and self-actualization, which are the highest level of needs in Maslow's hierarchy of needs [32]. Therefore, individuals will prioritize meeting consumption needs among the benefits of health investment. Without monetary constraints, individuals will sacrifice investment returns to obtain more consumption benefits; with monetary constraints, individuals will weigh consumption benefits against investment returns while prioritizing consumption, such as presenteeism. We thought that the consumption benefits of health capital crowded out the potential growth space of investment returns, making it difficult for us to capture the returns of monetized health capital investment.

Becker [33; 34] proposed that health needs were «derived» from people's pursuit of higher income and quality of life. Grossman accepted Becker's view that health needs were derived from investment needs, thus the Grossman model was an investment model of health needs [2; 3]. However, we thought that Maslow's hierarchy of needs better explained people's health needs. People seek curative care or preventive care primarily to relieve or avoid the suffering caused by illness and to protect and prolong their lives, rather than to gain more income in the future. Zweifel [35] proposed the «Red Herring» Hypothesis to explain the rise in healthcare expenditure in health economics. Its core argument was that the primary factor determining an individual's healthcare expenditure was not their chronological age, but rather their time away from death. Numerous empirical studies have documented that an individual's healthcare expenditure surges towards the end of

life [36; 37; 38]. Approximately one-quarter of total healthcare expenditure occurred in the last year of life. Medical costs at the end of life were ten times, or even higher, than in normal years [38]. If healthcare was primarily aimed at increasing future income, then those who have retired, especially those nearing death, should cease spending. However, the reality is quite the opposite. Empirical research in China also indicated that the time until death was the primary factor determining household healthcare expenditure, while age had a negligible impact [37]. This strongly suggested that people prioritized the quality and length of life itself, rather than income. In other words, the reality is exactly the opposite of the Grossman model. Investment needs should be derived from health needs. It was supported by our empirical research. Government health expenditure was driven by the number of medical technicians. This indicated that government health investment was «derived» from people's needs for pain relief and extended life. That is, health investment is a derivative of health consumption, not the other way around. We thought that government health expenditure brought more consumption benefits than investment benefits.

In theory, health investments can generate monetized health capital gains. However, the difficulty in fully restoring health levels and the depreciation rate of health capital mean that the potential for individual investment returns diminishes with age, leading to a reduction in the marginal benefits of health investments. This implies that the returns from health investments cannot be accumulated according to the production model assumed in the Grossman model and thus cannot be captured by our model.

On the other hand, health capital has an intergenerational effect [39]. Healthy parents are more likely to give birth to healthy children. Strong children, because they inherit their parents' strong genes, are more resistant to disease. Parents with high health capital tend to have high incomes. Although they have a stronger incentive to invest and may seek more preventive care for their children, the marginal benefit of their investment in the health of their children with high health levels is less. Parents with low health capital tend to have low incomes. This may result in them lacking sufficient funds to invest in their children's health capital. Therefore, they may seek more curative care for their children to gain non-monetary health capital gains.

In addition, information asymmetry in health services and uncertainty in health investment returns reduce our chances of capturing monetized health capital gains in a macroeconomic health capital model.

From a macroeconomic perspective, the capitalization of health may be affected by life expectancy and retirement policies. Life expectancy is a result of health. Kuhn 's [40] empirical study showed that the impact of the extension of life expectancy on

the macroeconomy depended on the retirement age. If the retirement age cannot grow in sync with life expectancy, the extension of life expectancy will not have a positive impact on economic growth. In the context of production activities, the health stock of retirees has limited potential to be transformed into a form of capital. In fact, China's health capital development has also encountered this problem. From 1949 to 1980, life expectancy in China increased by nearly one year per year on average [41]. In 1981, China's life expectancy was 67.77 years, while by 2020 it had increased to 77.93 years⁶. However, China's statutory retirement age has never been adjusted from 1949 to 2024. The statutory retirement age for men is 60 years old; the statutory retirement age for women is 55 years old⁷. We thought that the fact that China's statutory retirement age and pension policies had not changed with the extension of life expectancy was one of the possible reasons why health investment had not generated health capital returns. In a quantitative assessment of exogenous health improvements, Ashraf [42] determined that the impact on per capita income was modest. They observed that while a demographic dividend arising from mortality decline did materialize, its manifestation was postponed for more than half a century. They argued that health benefits might temporarily or permanently diminish per capita income, contending that the rationale for health improvements should be humanitarian rather than economic.

On the other hand, we thought that low fertility rates reduced the intergenerational effects and returns on health capital. If healthy individuals do not have children for various subjective and objective reasons, their investment in health capital will not have an intergenerational effect. The decline in the next generation's population will negatively impact the production of macroeconomic health capital. In 1980, China implemented the family planning policy to control population growth. The main reason was that China did not have enough resources to support the growing population. One of the sustainable development goals of the family planning policy was to improve the quality of the population faster by reducing the growth rate of population quantity. In the early stages of China's implementation of the family planning policy, the fertility decline induced a shift in human capital investment patterns. Families could invest more resources in individual education and

health. From a human resources perspective, the early influence of low fertility rates was to improve the quality of the labor force by sacrificing the growth in the quantity of the labor force. A falling dependency ratio significantly boosted China's savings rate and economic growth⁸. Demographic shifts led to a demographic dividend in China starting in the mid-1960s. The number and proportion of China's population with higher education were gradually increasing. In 1977, only 270,000 people were admitted to universities in China, with an admission rate of 4.8%. In 2015, approximately 7 million people were admitted to universities in China, with an admission rate of 74.3% [43]. In 2013, China relaxed its population control measures as the side effects of low fertility began to emerge, but the decline in fertility did not reverse. The number of births per year fluctuated slightly between 2013 and 2016, and then sharply reduced from 18.83 million in 2016 to 9.02 million in 2023 [44]. In a national sample survey of marriage and fertility intentions among 14418 college students conducted in 2021, only 49% of female respondents and 74% of male respondents reported a strong intention for marriage in their life plans, and the planned number of children was only 1.19 among women and 1.55 among men⁹. Compared with their male peers, highly educated young women had lower intentions for marriage and childbearing. On the other hand, the rapid growth in the number of young Chinese people with different levels of education had begun to exceed the actual demand in the labor market, which had led to over-education and declining income related to the macroeconomic health capital spillover effect [45]. Over-education had led to delayed marriage and a decline in fertility among Chinese women [46]. Delayed marriage led to delayed childbearing. Older mothers had a higher risk of adverse pregnancy outcomes and high-risk maternal complications than younger mothers [47]. This had a negative influence on the health of both pregnant women and children. Ageing also increased the risk of infertility in both men and women, making it difficult to have offspring. In addition, China's population structure faced a serious gender imbalance, with a significantly larger male population than female population. In 2020, China's total population sex ratio was 105.07, which is far higher than the standard level set by the United Nations [48]. The direct cause of China's gender imbalance was the imbalance in the sex ratio of

⁶ National Data // Official Website of National Bureau of Statistics of China – URL: <https://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A000K&sj=2010> (accessed: 27.10.2025).

⁷ China is gradually raising the retirement age to address the issue of an aging population // Official Website of THE STATE COUNCIL INFORMATION OFFICE – THE PEOPLE'S REPUBLIC OF CHINA. – URL: http://english.scio.gov.cn/m/chinavoices/2025-01/02/content_117641102.html (accessed: 27.10.2025).

⁸ Wang, D., Cai, F., & Zhang, X. (2004). Saving and growth effects of demographic transition: the population factor in the sustainability of China's economic growth. *Population Research*, 28 (5), 2–11. – URL: <https://rkyj.ruc.edu.cn/EN/abstract/abstract576.shtml> (accessed: 27.10.2025).

⁹ Li, T., Zheng, Y., & Yan, Y. (2022). Have marriage and fertility been de-institutionalized in China? Findings from a survey on marriage and fertility intentions among college students. *Journal of Chinese Women's Studies*, 3, 85–102. – URL: <https://d.wanfangdata.com.cn/periodical/fnyjlc202203006> (accessed: 27.10.2025).

newborns. The natural sex ratio at birth for humans was about 104 to 107 boys to 100 girls [49]. Sex ratio at birth in China was as high as 108 boys per 100 girls in the 1980s and increased to 111 in 1990, 116.9 in 2000, and 120.5 in 2005 [50]. Under the influence of China's social preference for men and the family planning policy, selective abortion and artificial genetic sex selection had led to an imbalance in the sex ratio of newborns [49; 51]. China had not only lost a large number of potential female population, but also lost the next generation of population that these potential female population could have given birth to. On the other hand, the serious imbalance in the sex ratio would cause a large number of men to be unable to find a spouse throughout their lives, leading to mental health problems such as sexual stress and lack of emotional belonging [48], as well as social health problems such as trafficking of women and sexual violence crimes [52]. China's excessively high proportion of male population had increased crime rates [53], and women living in areas of China with more severe gender imbalance were more likely to report having been forced to have sex. The high proportion of males also increased sexual risk behaviors and promoted the spread of sexually transmitted diseases [54]. In addition, China's gender imbalance had created structural problems in marriage due to urban-rural differences and marriage migration. China's rural areas had a stronger preference for males, resulting in a higher proportion of male newborns in rural areas than in urban areas. In 2005, sex ratio at birth was 115.2 in cities, 119.9 in towns, and 122.9 in rural areas [50; 51]. In addition, in China, the proportion of women who migrate from economically underdeveloped areas to economically developed areas through marriage was higher. Between 2012 and 2015, 70.72% of the population who moved to Shanghai due to marriage were women. This had led to an increasingly obvious population structure problem of too many rural men and too many urban women. This had resulted in a large number of marriage resources being unable to be effectively utilized, and might have negative influence on the marriage rate and fertility rate. In addition, Wang's [55] research showed

that the son preference of migrant women was still strong, which led women with only daughters to have significantly higher possibility of having another child and results in a higher imbalance in the sex ratio with higher parity. Therefore, the gender imbalance in China's population had a negative impact on the fertility rate.

Increased life expectancy and low fertility rates led to an aging population structure in China. From 2014 to 2021, the proportion of people aged 60 and above increased by one percentage point every two years. By the end of 2021, the proportion had exceeded 18%, indicating that China had entered a deeply ageing society [56]. By the end of 2022, China's population had decreased by 850,000 compared to the end of the previous year (9.56 million births and 10.41 million deaths), and the natural population growth rate was -0.60% . This marked the first time in 73 years that China had experienced negative population growth [57]. Population aging in China led to the challenges of health capitalization and diminishing intergenerational returns to health capital. We thought that raising the statutory retirement age and adjusting the pension policy framework might promote health capitalization among the elderly. However, diminishing intergenerational returns to health capital was a systemic problem that could not be solved by a single approach because the causes of low fertility were highly complex. It involved factors such as public policy, education, employment environment, marriage, health risks, cultural attitudes, and uneven regional economic development, as well as the synergistic interactions among them.

For the reasons stated above, we thought that the monetization of health capital was difficult to be driven by investment. However, this did not mean that health capital could not be produced through health investment, because consumption needs had a higher priority in the motivation for health investment, accumulating in the form of non-monetary health capital.

Our research provided new theoretical and empirical insights into the characteristics of health capital production models.

REFERENCES

1. Mushkin, S. J. (1962) Health as an Investment. *Journal of political economy*, 70 (5, Part 2), pp. 129–157. <https://doi.org/10.1086/258730>.
2. Grossman, M. (1972) On the concept of health capital and the demand for health. *Journal of Political economy*, 80 (2), pp. 223–255. <https://doi.org/10.1086/259880>.
3. Bhattacharya, J., Hyde, T., Tu, P. (2014) *Health economics*. Bloomsbury Publishing. <https://doi.org/10.1007/978-1-137-02997-3>.
4. Fumagalli, E., Pintor, M. P., Suhrcke, M. (2024) The impact of health on economic growth: A narrative literature review. *Health policy*, 143, article 105039. <https://doi.org/10.1016/j.healthpol.2024.105039>.
5. Niu, X. T., Yang, Y. C., Wang, Y. C. (2021) Does the economic growth improve public health? A cross-regional heterogeneous study in China. *Frontiers in Public Health*, 9, article 704155. <https://doi.org/10.3389/fpubh.2021.704155>.
6. Scott, A., Ashwin, J., Ellison, M., Sinclair, D. (2023) International gains to achieving healthy longevity. *Cold Spring Harbor Perspectives in Medicine*, 13 (2), article a041202. <https://doi.org/10.1101/2023.01.12.23281111>.

- org/10.1101/cshperspect.a041202. <https://elibrary.ru/gspshd>.
7. Ridhwan, M. M., Nijkamp, P., Ismail, A. M. Irsyad, L. (2022) The effect of health on economic growth: A meta-regression analysis. *Empirical Economics*, 63 (6), pp. 3211–3251. <https://doi.org/10.1007/s00181-022-02226-4>. <https://elibrary.ru/ujznsi>.
 8. Guo, T., Tong, Y., Yu, Y. (2025) The influence of government health investment on economic resilience: A perspective from health human capital. *International Review of Economics & Finance*, 99, article 104050. <https://doi.org/10.1016/j.iref.2025.104050>. <https://elibrary.ru/zuikykk>.
 9. Greer, S. L., Bekker, M., De Leeuw, E., Wismar, M., Helderma, J. K., Ribeiro, S., Stuckler, D. (2017) Policy, politics and public health. *The European Journal of Public Health*, 27 (suppl_4), pp. 40–43. <https://doi.org/10.1093/eurpub/ckx152>.
 10. Wu, W., Long, S., Cerda, A. A., Garcia, L. Y., Jakovljevic, M. (2023) Population ageing and sustainability of healthcare financing in China. *Cost Effectiveness and Resource Allocation*, 21 (1), p. 97. <https://doi.org/10.1186/s12962-023-00505-0> <https://elibrary.ru/duumfi>.
 11. Zakaria, S. (2011) Transforming human resources into human capital. *Information Management and Business Review*, 2 (2), pp. 48–54. <https://doi.org/10.22610/imbr.v2i2.882>.
 12. Liu, Y., Huo, S. (2024) Measurement of health human capital and its economic effect in China. *Humanities and Social Sciences Communications*, 11 (1), article 774. <https://doi.org/10.1057/s41599-024-03060-y>. <https://elibrary.ru/efywmng>.
 13. Bu, T., Ma, R., Wang, Y., Wang, X., Tang, D., Deng, L. (2024) Measurement on Health Capital of Workforce: Evidence from China. *Social Indicators Research*, 174 (2), pp. 569–587. <https://doi.org/10.1007/s11205-024-03403-x>. <https://elibrary.ru/xlopfd>.
 14. Yang, X. (2020) Health expenditure, human capital, and economic growth: an empirical study of developing countries. *International journal of health economics and management*, 20 (2), pp. 163–176. <https://doi.org/10.1007/s10754-019-09275-w>. <https://elibrary.ru/sfwzue>.
 15. Shuyong, F., Shuyu, C., Maimaituxun, M. (2024) Discussion on the relationship between Chinese government's investment in health human capital and economic growth. *Journal of the Knowledge Economy*, 15 (4), pp. 19183–19202. <https://doi.org/10.1007/s13132-024-01771-w>. <https://elibrary.ru/xiuuhn>.
 16. Bhandari, H., Yasunobu, K. (2009) What is social capital? A comprehensive review of the concept. *Asian Journal of Social Science*, 37 (3), pp. 480–510. <https://doi.org/10.1163/156853109x436847>.
 17. Alpino, M., Mehlum, H. (2023) Two notions of social capital. *The Journal of mathematical sociology*, 47 (4), pp. 255–282. <https://doi.org/10.1080/0022250X.2021.2004597>. <https://elibrary.ru/qjsdtw>.
 18. Gao, J., Weaver, S. R., Dai, J., Jia, Y., Liu, X., Jin, K., Fu, H. (2014) Workplace social capital and mental health among Chinese employees: a multi-level, cross-sectional study. *PloS one*, 9 (1), article e85005. <https://doi.org/10.1371/journal.pone.0085005>.
 19. Wang, Z., Fang, Y., Zhang, X. (2024) Impact of social capital on health behaviors of middle-aged and older adults in China – an analysis based on CHARLS2020 data. *Healthcare*, 12 (11), p. 1154. <https://doi.org/10.3390/healthcare12111154>. <https://elibrary.ru/wfldcg>.
 20. Luo, Y., Zhao, H., Chen, H., Xiao, M. (2023) Association between cultural capital and health literacy during the COVID-19 pandemic among community residents in China: the mediating effect of social capital. *Frontiers in Public Health*, 11, article 1199941. <https://doi.org/10.3389/fpubh.2023.1199941>. <https://elibrary.ru/omplmc>.
 21. Li, R., Zhan, Y., Tao, Y., Wang, R., Gu, X., He, Z., Zhu, B. (2025) Economic and social determinants of life expectancy in China. *Frontiers in public health*, 13, article 1554336. <https://doi.org/10.3389/fpubh.2025.1554336>. <https://elibrary.ru/tltnnn>.
 22. Jorgenson, D. W., Pachon, A. (1983) Lifetime income and human capital. In *Human Resources, Employment and Development. Volume 2: Concepts, Measurement and Long-Run Perspective: Proceedings of the Sixth World Congress of the International Economic Association held in Mexico City, 1980*, pp. 29–90. London, Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-17203-0_2.
 23. Pintor, M. P., Fumagalli, E., Suhrcke, M. (2024) The impact of health on labour market outcomes: A rapid systematic review. *Health policy*, 143, article 105057. <https://doi.org/10.1016/j.healthpol.2024.105057>. <https://elibrary.ru/mrdwio>.
 24. Jayachandran, S., Lleras-Muney, A. (2009) Life expectancy and human capital investments: Evidence from maternal mortality declines. *The Quarterly Journal of Economics*, 124 (1), pp. 349–397. <https://doi.org/10.1162/qjec.2009.124.1.349>.
 25. Fortson, J. G. (2011) Mortality risk and human capital investment: the impact of HIV/AIDS in Sub-Saharan Africa. *The Review of Economics and Statistics*, 93 (1), pp. 1–15. https://doi.org/10.1162/rest_a_00067.
 26. Grossman, M. (2000) The human capital model. *Handbook of health economics*, 1 (1), pp. 347–408. Elsevier. [https://doi.org/10.1016/S1574-0064\(00\)80166-3](https://doi.org/10.1016/S1574-0064(00)80166-3).
 27. Groot W., van den Brink H.M. (2007) *The effects of education on health. In: Hartog J, Maassen*

- van den Brink H, eds. Human Capital: Advances in Theory and Evidence. Cambridge University Press, pp. 65–80. <https://doi.org/10.1017/cbo9780511493416.006>.*
28. Raghupathi, V., Raghupathi, W. (2020) The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015. *Archives of public health*, 78 (1), article 20. <https://doi.org/10.1186/s13690-020-00402-5>. <https://elibrary.ru/lvtqqb>.
29. Araki, S. (2025) Reassessing human capital and health capital over the life course: Causal mediation analysis of higher education, health, and wages. *Social Science & Medicine*, 381, article 118299. <https://doi.org/10.1016/j.socscimed.2025.118299>. <https://elibrary.ru/yuespk>.
30. von Simson, K. (2015) Explaining upper secondary school dropout: new evidence on the role of local labor markets. *Empirical Economics*, 48 (4), pp. 1419–1444. <https://doi.org/10.1007/s00181-014-0829-3>. <https://elibrary.ru/eqmbjt>.
31. Volkova, O. N., Volkova, A. (2024) Empirical testing of Grossman's the demand for health model: the case of Russia. *Journal of Applied Economic Research*, 23 (1), pp. 33–58. <https://doi.org/10.15826/vestnik.2024.23.1.002>. <https://elibrary.ru/vwkush>.
32. Maslow, A. H. (1943) A theory of human motivation. *Psychological Review*, 50, pp. 370–396. <https://doi.org/10.1037/h0054346>.
33. Becker, G. S. (1962) Investment in human capital: A theoretical analysis. *Journal of political economy*, 70 (5, Part 2), pp. 9–49. <https://doi.org/10.1086/258724>.
34. Soares, R. R. (2015) Gary Becker's contributions in health economics. *Journal of Demographic Economics*, 81 (1), pp. 51–57. <https://doi.org/10.1017/dem.2014.10>.
35. Zweifel, P., Felder, S., Meiers, M. (1999) Ageing of population and health care expenditure: a red herring? *Health economics*, 8 (6), pp. 485–496. [https://doi.org/10.1002/\(sici\)1099-1050\(199909\)8:6<485::aid-hec461>3.0.co;2-4](https://doi.org/10.1002/(sici)1099-1050(199909)8:6<485::aid-hec461>3.0.co;2-4).
36. Zweifel, P. (2022) The 'red herring' hypothesis: some theory and new evidence. *Healthcare*, 10 (2), p. 211. <https://doi.org/10.3390/healthcare10020211>. <https://elibrary.ru/cfmlcp>.
37. Du, X., Wei, H., Zhang, X. (2024) Implications for household health expenditure in China's ageing population: based on Red Herring hypothesis. *BMC Public Health*, 24 (1), article 2984. <https://doi.org/10.1186/s12889-024-20422-y>. <https://elibrary.ru/razjcr>.
38. Yu, T. H. K., Wang, D. H. M., Wu, K. L. (2015) Reexamining the red herring effect on health-care expenditures. *Journal of Business Research*, 68 (4), pp. 783–787. <https://doi.org/10.1016/j.jbusres.2014.11.028>.
39. Bleakley, H. (2010) Health, human capital, and development. *Annual review of economics*, 2 (1), pp. 283–310. <https://doi.org/10.1146/annurev.economics.102308.124436>.
40. Kuhn, M., Prettnner, K. (2023) Rising longevity, increasing the retirement age, and the consequences for knowledge-based long-run growth. *Economica*, 90 (357), pp. 39–64. <https://doi.org/10.1111/ecca.12445>. <https://elibrary.ru/huuxua>.
41. Xinming, S., Gong, C., Xiaoying, Z. (2010) Chinese life expectancy and policy implications. *Procedia-Social and Behavioral Sciences*, 2 (5), pp. 7550–7555. <https://doi.org/10.1016/j.sbspro.2010.05.120>.
42. Ashraf, Q. H., Lester, A., Weil, D. N. (2008) When does improving health raise GDP? *NBER macroeconomics annual*, 23, pp. 157–204. <https://doi.org/10.1086/593084>.
43. Guo, L., Huang, J., Zhang, Y. (2019) Education development in China: Education return, quality, and equity. *Sustainability*, 11 (13), article 3750. <https://doi.org/10.3390/su11133750>.
44. Wang, Y., Kong, F., Fu, Y., Qiao, J. (2024) How can China tackle its declining fertility rate? *BMJ: British medical journal*, 386, article e078635. <https://doi.org/10.1136/bmj-2023-078635>. <https://elibrary.ru/sowuao>.
45. Ma, W., Baek, J., Qi, M., Li, J., Liu, B. (2022) The influence of overeducation on Chinese workers' job satisfaction from China household tracking survey (2014–2018). *International Journal of Environmental Research and Public Health*, 19 (23), article 16032. <https://doi.org/10.3390/ijerph192316032>. <https://elibrary.ru/popjcx>.
46. Chen, C., Xiong, X., Tang, G. (2024) A decomposition study on the factors influencing China's total fertility rate changes between 1990 and 2020. *Scientific Reports*, 14 (1), article 28176. <https://doi.org/10.1038/s41598-024-79999-4>. <https://elibrary.ru/dprlng>.
47. Frick, A. P. (2021) Advanced maternal age and adverse pregnancy outcomes. *Best practice & research Clinical obstetrics & gynaecology*, 70, pp. 92–100. <https://doi.org/10.1016/j.bpobgyn.2020.07.005>. <https://elibrary.ru/itfrcd>.
48. Zhang, Y., Zou, B., Zhang, H., Zhang, J. (2022) Empirical research on male preference in China: a result of gender imbalance in the seventh population census. *International Journal of Environmental Research and Public Health*, 19 (11), article 6482. <https://doi.org/10.3390/ijerph19116482>. <https://elibrary.ru/jkaxmd>.
49. Chahnazarian, A. (1988) Determinants of the sex ratio at birth: review of recent literature. *Social biology*, 35 (3-4), pp. 214–235. <https://doi.org/10.1080/19485565.1988.9988703>. <https://elibrary.ru/hkkztx>.

50. Lei, L., Pals, H. (2011) Son preference in China: Why is it stronger in rural areas? *Population review*, 50 (2). <https://doi.org/10.1353/prv.2011.0013>.
51. Wang, Q., Chiang, T. F., Xiao, J. J. (2024) Attitude toward gender inequality in China. *Humanities and Social Sciences Communications*, 11 (1), pp. 1–14. <https://doi.org/10.1057/s41599-024-02857-1>. <https://elibrary.ru/blklol>.
52. Diamond-Smith, N., Rudolph, K. (2018) The association between uneven sex ratios and violence: Evidence from 6 Asian countries. *PloS one*, 13 (6), article e0197516. <https://doi.org/10.1371/journal.pone.0197516>.
53. Edlund, L., Li, H., Yi, J., Zhang, J. (2013) Sex ratios and crime: Evidence from China. *Review of Economics and Statistics*, 95 (5), pp. 1520–1534. https://doi.org/10.1162/rest_a_00356.
54. Bien, C. H., Cai, Y., Emch, M. E., Parish, W., Tucker, J. D. (2013) High adult sex ratios and risky sexual behaviors: A systematic review. *PloS one*, 8 (8), article e71580. <https://doi.org/10.1371/journal.pone.0071580>.
55. Wang, X., Nie, W., Liu, P. (2020) Son preference and the reproductive behavior of rural-urban migrant women of childbearing age in China: empirical evidence from a cross-sectional data. *International Journal of Environmental Research and Public Health*, 17 (9), article 3221. <https://doi.org/10.3390/ijerph17093221>. <https://elibrary.ru/fgxckt>.
56. Wu, W., Long, S., Cerda, A. A., Garcia, L. Y., Jakovljevic, M. (2023) Population ageing and sustainability of healthcare financing in China. *Cost Effectiveness and Resource Allocation*, 21 (1), p. 97. <https://doi.org/10.1186/s12962-023-00505-0>. <https://elibrary.ru/duumfi>.
57. Peng, D. (2023) Negative population growth and population ageing in China. *China Population and Development Studies*, 7 (2), pp. 95–103. <https://doi.org/10.1007/s42379-023-00138-z>. <https://elibrary.ru/telaxo>.