

Analysis of the Relationship between Employment and Investments in Education for the ARIMA Model

Junyi Dai *

Academic Center for Chinese Economic Practice and Thinking, Tsinghua University, Beijing, China

* Corresponding Author: daijunyi@tsinghua.edu.cn

Abstract. The link between education investments and the workforce in China will be investigated under the current population fluctuation. It is widely agreed that education investments prompt employment. However, it remains ambiguous as to how the two variables correlate in Chinese society. This study aims to answer the question. The study first investigates the current social milieu and employment trends in China, then focuses on population change, the labor market, workforce shift, and the aging problem. The first is to find data on employment trends in the three sectors and education investment from two chosen periods. The research also further analyzes the correlation between the selected data. The model is the Autoregressive Composite Moving Average (ARIMA) model to examine the relationship between education investment and employment figures. This model helps build a new perspective on the complex relationship between education trends, population, labor, and work. Furthermore, the methodology of this study also provides a framework for subsequent research that can delve into the dynamics in different markets or economies.

Keywords: Employment, Investments in Education, ARIMA Model.

1. Introduction

The correlation between education investments and employment in China is of critical importance under the current population fluctuation. Chinese newborn numbers will plummet to a record low in 2023 [1]. In addition, the dwindling workforce requires an increasing amount of education investment to make it capable and effective. The studies under the current social milieu are expected to yield valuable suggestions for developing education and focus on education investments.

The trend of fewer newborns requires tailored spending on preschool education [2]. The quality of compulsory education needs improvement, and more analysis should be done to negate the high dropout rate, which affects employment to some extent [1]. Regional disparity is to be considered. Major areas like Beijing and Shanghai enjoy an unparalleled level of education investment, a phenomenon rendering both an irrational trend of investment and a surplus of excellent educational resources. Future regulation should establish new models to balance regional demands and take effective measures accordingly [3].

Another trend affecting employment is for overseas studies, but this trend has an inward fashion an individual must spend about 270 thousand CNY for a localized overseas education, a rather daunting amount for an ordinary working family [4]. These decisions include potential risks and drive-up expectations for the new workforce [5].

The labor market in China is expected to maintain a steady tendency for the next 10 to 15 years. Still, around 2040, this balance is expected to break, with shortages of labor and population aging problems. One inevitable issue is wages. Along with it manifests the nettling issue of wage polarization: to wit, practitioners of certain occupations (jurisdiction, finance, etc.) and a decent number of graduates from prominent universities (especially 985 and 211) demand higher remuneration, whereas the ordinary working class and many more graduating from lower-tier institutes tend to demand less [6]. Wage polarization severely affects education investment, wherein the elevation in high-skill wages is prone to enhance investment in higher education. Still, the increase in low-skill wages is witnessing an opposing trend—a decrease in educational investment. This fact is startling in that the working class, especially those in rural areas, are the ones who need to invest in education so their children can leap from low-skill wages to high-skill wages [7].

Moreover, China is now experiencing the alteration from a “quantitative workforce” to a “qualitative workforce”. An essential endeavor is to increase the rates of undergraduate and postgraduate enrollment, thereby forging a workforce with improved efficiency and adequate knowledge to settle sophisticated situations and tasks. To this end, it is calculated that the higher education enrollment rate should be close to 60% (9.3 million) in 2025, about 67% (9.7 million) in 2030, and approximately 75% (10 million) in 2035, figures demanding increasing investment in education, from the current 4.3% of aggregate GDP to 4.6% in 2035 [8]. The aim is to promote education and develop a workforce capable of handling an equivalent number of challenging tasks in the further development of the Chinese economy.

In addition, a large portion of the Chinese workforce comes from vocational education, which has many aspects to improve. One major issue is the lack of coordination between vocational education and economic development, wherein arises the unresolved problem of educational spending and lack of return in the market [9]. The key issue is interaction, and instances can be learned from previous endeavors taken by Germany, the U.S., and Japan. The method should be people-oriented, encompassing international knowledge and technology, and harnessing a sufficient number of clear and concise regulations. Integrating knowledge from other countries in the further development of vocational education merits more effort [9].

As China is witnessing an encroaching aging population, ensuing problems will gradually manifest, creating challenges in many aspects. The effect of the aging population on educational investment is proven to be an inverted U trend, with the initial stage of aging conducive to educational investment. Still, the subsequent stages significantly diminish the effectiveness of educational investment [10]. Governments of all levels should foresee and take ample preparation for this trend in the coming decades (especially from 2040), as well as hasten the pace of urbanization. Investment in tertiary education and aging-related nascent industries should be of vital significance. Overall, the link between education investments and employment is a crucial realm of investigation and should be more intensely studied to yield suggestions for a sustained force capable of the vigorous development of China. It is of critical significance to investigate the correlation between employment and education trends in certain recent periods to discover how education investments affect employment on both a short-term and long-term basis.

2. Method

2.1. Model Significance

The correlation between employment trends and education trends is a pivotal factor for the analysis of employment and education investment. Under such circumstances, the utilization of ARIMA models for the three industries and the education trends can yield valuable statistical information about the future trend between employment and education investment. Employment trends data from 1990-2021 and education investments data from 2005-2007 and 2015-2017 are selected from the National Bureau of Statistics of China. These two periods are utilized because they marked a relatively steady growth and stable development of the Chinese economy. Due to the 2008 economic recession and the 2019 COVID-19 pandemic, data from other periods lack credibility or effectiveness. The model can be applied to studying employment and education funding in China. Under the background of a population plummet and growing education expenditure, this model presents a means to help governments, policymakers, institutions, and relevant stakeholders obtain a concise view of how education trends affect employment.

2.2. Model Method

This study develops and applies the Autoregressive Composite Moving Average (ARIMA) model to examine the relationship between education investment and employment figures. The ARIMA model is a statistical analysis method used to predict time series data and was chosen because it is

highly skilled in analyzing and predicting non-stationary data. This is especially true for the study, given the dynamic nature of education funding and job market numbers.

3. Result

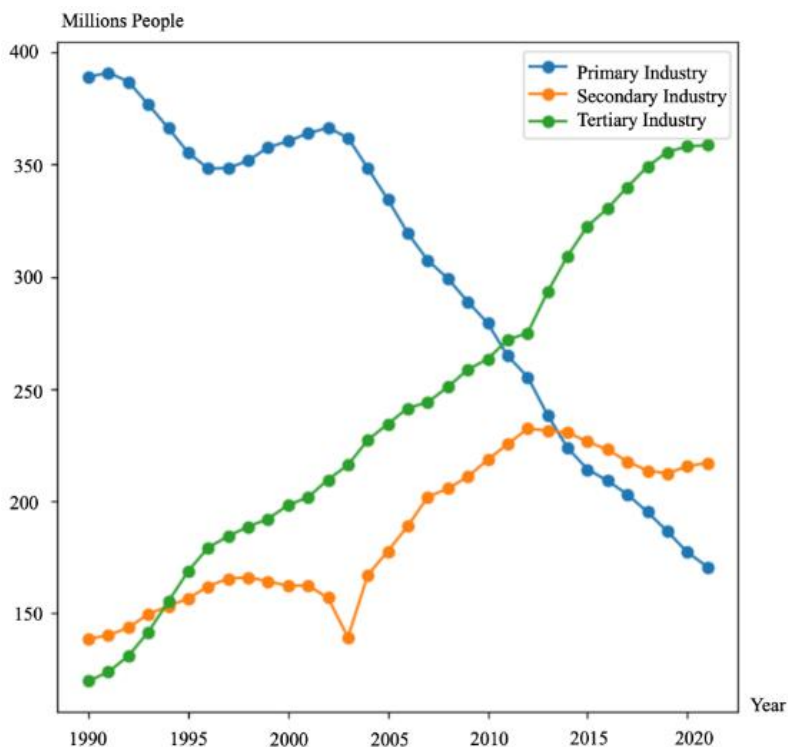


Figure 1. Employment in the three sectors from 1990 to 2021 (Photo/Picture credit: Original).

The ARIMA models are economic models that depict the correlation between employment and education trends. In Figure 1, employment trends in the three industries from 1990 to 2021 are utilized as baseline statistical data (the horizontal axis denotes millions of people). In Figures 2-5, education trends based on different categories from two time periods (first 2005-2007, second 2015-2017) are also employed (the horizontal axis denotes education investment in CNY).

3.1. Three Significant Categories (2005-07)

As shown in Figures 1 and 2, it can be seen that for the primary sector, the higher education investment in this area is inversely related to the employment population. The estimated coefficients of the first three lag orders in the ARIMA model are relatively large, at -0.9912, -0.5945, and 0.8291, respectively. Meanwhile, the residual variance is a large 2806.6896, indicating significant short-term fluctuations in employment in the primary industry. The trend negates for the tertiary sector, in which education investment (higher and regular higher) corresponds directly with the employment population. The model demonstrates a particular direction in the coefficients of the first three lag orders, at 1.3318, -0.1260, -0.3686, -0.5190, and 0.6676, respectively. The residual variance is a small 156.8719, indicating that long-term trends have a significant impact on employment data in the tertiary industry. By contrast, the secondary industry shows relatively stable estimated parameters, with coefficients of similar magnitudes for each order. The residual variance is 111.7416, indicating relatively stable employment. In this area, education funding is not straightforwardly related to employment.

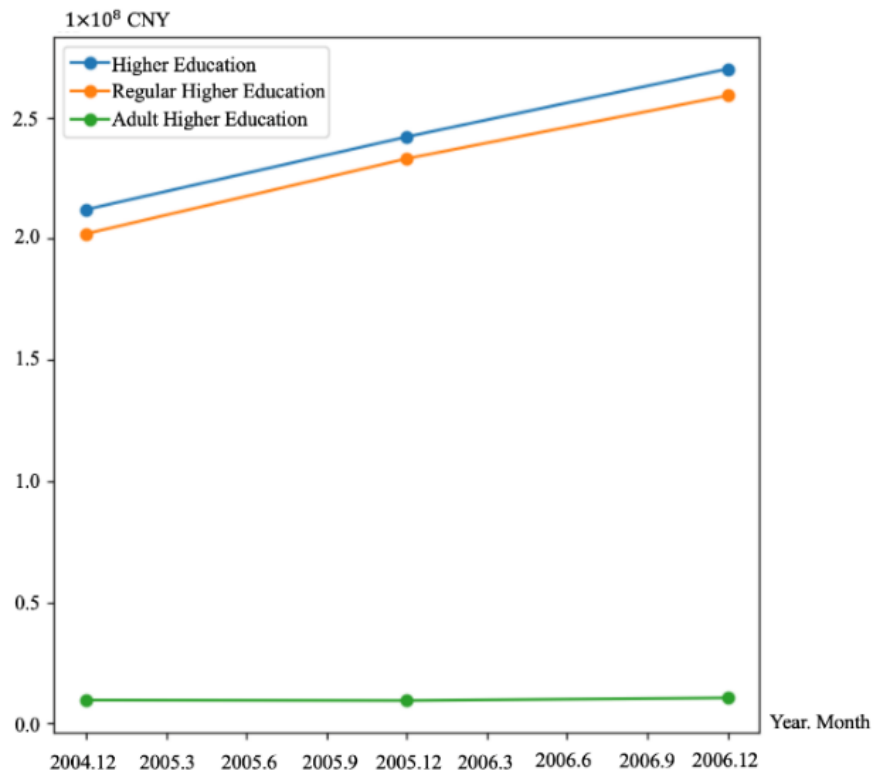


Figure 2. Education investment in three significant categories from 2005 to 2007 (Photo/Picture credit: Original).

3.2. Other Major Categories (2005-07)

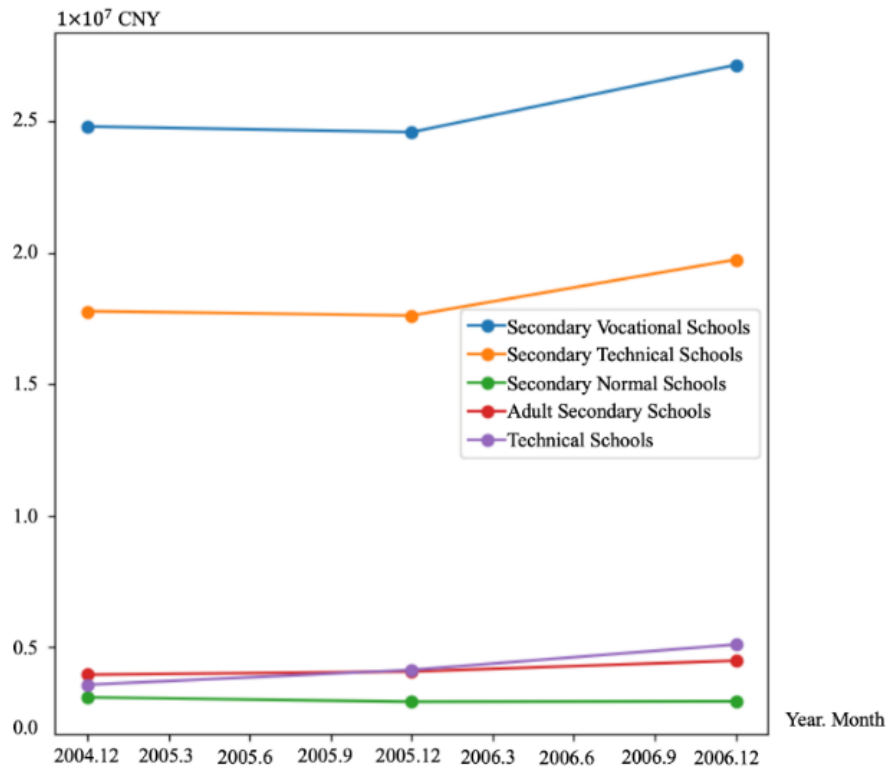


Figure 3. Education investment in other major categories from 2005 to 2007 (Photo/Picture credit: Original).

As shown in Figures 1 and 3, it is shown that in the primary sector, the ARIMA model exhibits significant fluctuations in the parameter values, particularly in the initial lag periods. The model’s residual variance is a large 2005.2773, suggesting that employment in the primary industry is subject

to considerable short-term fluctuations that might vary over time. Changes in educational investment are estimated to have a substantial impact on jobs in the primary industry. The education investment in most secondary and technical schools is inversely related to the employment-population in the primary sector. Still, a reversed trend is observed in the tertiary industry, in which the model indicates some significant parameter values in the lag periods. The residual variance of the model is a small 131.1508, suggesting that employment in the tertiary industry is heavily influenced by long-term trends. Changes in educational investment are likely to have a significant effect on jobs in the tertiary industry. In the tertiary sector, education investment (secondary and technical) corresponds directly with the employment population. Meanwhile, the model for the secondary industry shows relatively stable parameter values with some minor fluctuations. The residual variance of the model is 214.7573, indicating that employment in the secondary industry is less affected by short-term factors and relative education investment.

3.3. Six Major Categories (2015-17)

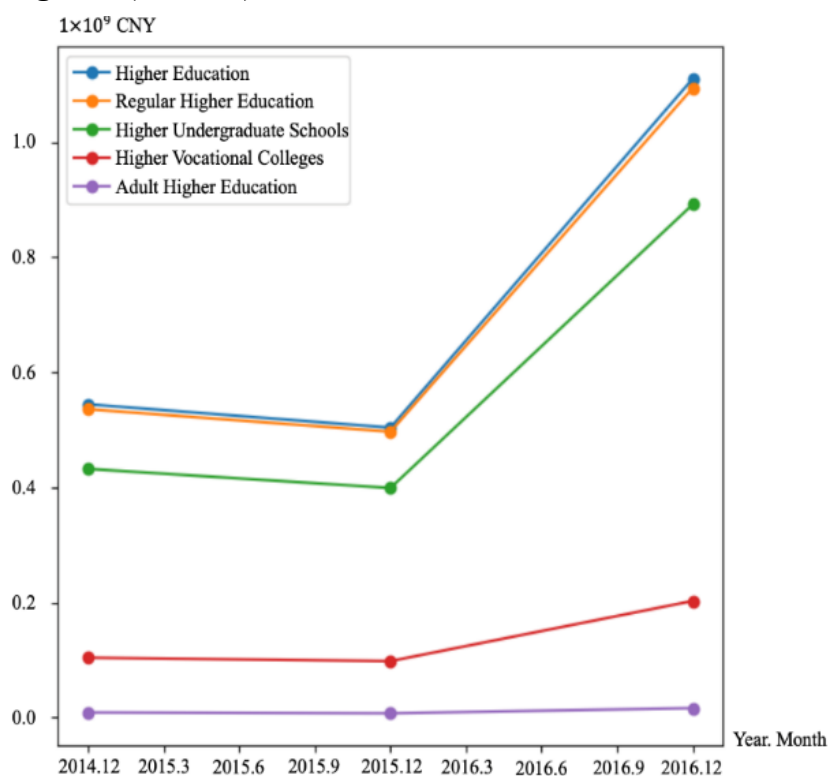


Figure 4. Education investment in six significant categories from 2015 to 2017 (Photo/Picture credit: Original).

From Figures 1 and 4, it can be seen that for the primary industry, the higher education (excluding adult education) investment in this area is inversely related to the employment-population, with 2016 to 2017 more significant. The estimated coefficients of the first three lag orders in the ARIMA model are relatively large, namely -0.9912, -0.5945, and 0.8291. At the same time, the residual variance is a high 2806.6896, indicating that employment in the primary industry is subject to significant short-term fluctuations. An opposite tendency is seen from the model for the tertiary Industry, demonstrating that the first three lag orders are 1.3318, -0.1260, -0.3686, -0.5190, and 0.6676. The residual variance is a small 156.8719, indicating that long-term trends have a significant impact on employment data in the tertiary industry. In the tertiary sector, education investment (higher, regular higher, higher undergraduate, and higher vocational) corresponds directly with the employment-population, with the years 2016 to 2017 being more significant. However, the model for the secondary industry has relatively stable parameter estimates, with coefficients of similar magnitudes. The residual variance is 111.7416, indicating that employment data is relatively stable. These trends remain the same after ten years.

3.4. Other Major Categories (2015-17)

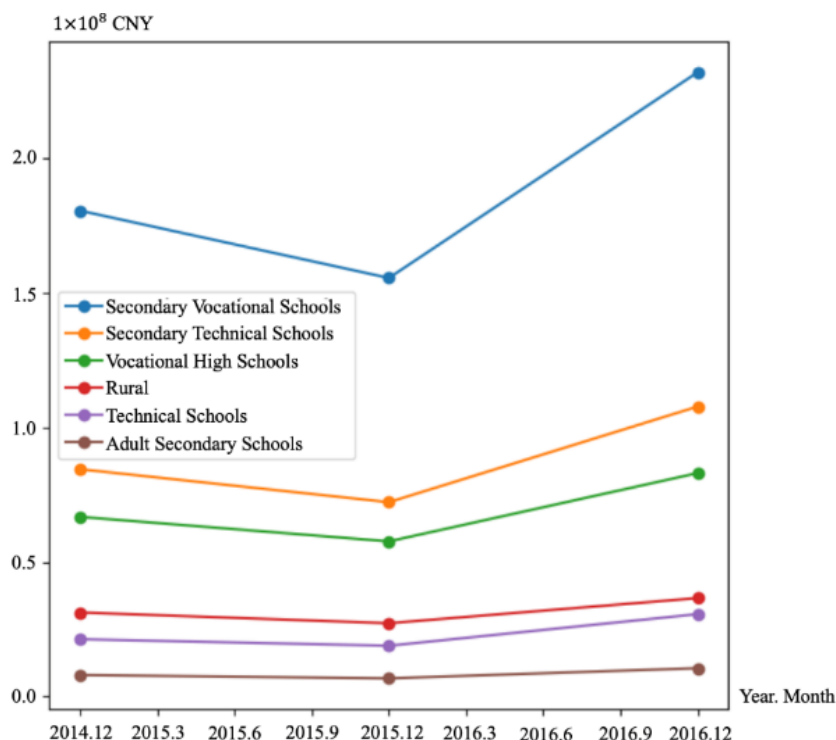


Figure 5. Education investment in other major categories from 2015 to 2017 (Photo/Picture credit: Original)

Moreover, from Figures 1 and 5, it can be seen that for the primary industry, the model suggests the employment data might be subject to short-term fluctuations, with some parameters showing significant fluctuations. The significant residual variance of a high 2806.6896 indicates that various short-term factors influence employment in the primary industry. The higher education (excluding adult secondary schools) investment in this area is mostly inversely related to the employment-population, with the years 2015 to 2016 slightly deviating, but the years 2016 to 2017 more salient. On the contrary, the tertiary industry model also has some significant parameter values, especially in the lag periods. The residual variance of a small 156.8719 means that various long-term trends significantly influence employment in the tertiary industry. In the tertiary sector, education investment (secondary, rural, vocational, and technical schools) corresponds directly with the employment-population, with the years 2015 to 2016 slightly opposite, and 2016 to 2017 more significant. For the second industry, the residual variance of 111.7416 indicates a comparatively lower impact of short-term education investment.

3.5. Implications

Overall, employment in the primary industry is more influenced by short-term education investment factors. In contrast, employment in the tertiary industry is more affected by long-term trends, and employment in the secondary industry is relatively stable. In the long run, the impact of education investments on the tertiary industry might be the most significant.

To ascertain model effectiveness, it is imperative to embark on empirical research from data analysis. This model, based on historical data from different periods, can provide insights into the interplay between education trends and employment for an extended period. Within employment trend by industries is the baseline criterion, while the other figures serve as the dependent variables. Education trend slots from the past and the current years need to be selected. For capturing the most reliable figures and trends, government statistics are utilized. The outcomes of this analysis will not only yield the correlation between inputs but also provide a view of how education trends shape employment now and in the future.

It should be noted that, as with any empirical research, this approach is not without challenges. Besides the meticulous selection of variables and ensuring the model's specification aligns with the data's underlying realities, it is worth noting that these models exhibit some instability, indicating the need for further optimization to obtain more accurate results. The model has a high condition number, suggesting the need for additional validation of the model's stability. Addressing these challenges is pivotal for the validity and robustness of the conclusions.

4. Conclusion

This study takes a systematic perspective on employment and education by combining education trends and employment figures into the ARIMA models. This approach analyzes the impact of short-term and long-term education investments on employment in modern Chinese society. Employment in the primary industry is more influenced by short-term education investment factors. In contrast, employment in the tertiary industry is more affected by long-term trends, and employment in the secondary industry is relatively stable. This correlation gives us a new perspective on the complex relationship between education trends, population, labor, and work. The methodology of this study also provides a framework for subsequent research that can delve into the dynamics in different markets or economies. Further work can be directed to investigate what factors significantly affect the employment of the secondary industry.

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