

Evaluate the Correlation Between Identified Social Issues and Ultra-low Fertility Rates in Hong Kong

Yujia Xie*

Department of Social Sciences, The Hong Kong Polytechnic University, HKSAR, China

*Corresponding author: 22102917d@connect.polyu.hk

Abstract. Hong Kong has witnessed a significant and continuous decline in its total fertility rate (TFR) over the past few decades, hitting an ultra-low level. This article investigates various social issues that would probably contribute to this decline as previous studies suggest, including the women's role incongruence, the extremely heavy financial burden, and the limited scope of government policies in Hong Kong society. The persistence of such low TFR in societies would deteriorate aging problems, increase the old-age dependency ratio, and shrink the labor force. These issues are thereby posing significant challenges to Hong Kong's economic and political sustainability. Hence, it is necessary for policymakers to introduce effective policies to improve TFR by figuring out where the problem derives. To comprehensively comprehend the correlation between ultra-low TFR and identified social issues, this research employs two statistical models which are multiple linear regression and decision tree analysis. The results reveal a strong correlation between low TFR and some identified social problems, while also elucidating the coefficient of each factor. Simultaneously, the findings contradict some previous hypotheses claimed by scholars.

Keywords: Fertility rate; Hong Kong; Multinomial regression; Decision tree analysis.

1. Introduction

Hong Kong has experienced a significant and prolonged decline in its total fertility rate (TFR) since 1961 [1]. According to the Hong Kong Census and Statistics Department, the TFR was initially above the replacement level in 1961 but dropped below 2.1 of the replacement levels by 1980. The situation has since continuously worsened, with the TFR reaching around 0.77 in 2021. The causes of this decline are complex and diverse. Research on fertility decisions has concluded various factors that contribute to the low TFR. Nevertheless, the effect of these factors has long remained inconclusive due to the lack of proper quantitative analysis.

To commence on, ultra-low fertility is partly caused by constrained policies and services provided by the government. The prevailing ideology of neoliberalism under the capitalist system in Hong Kong perceives social support as supplementary and emphasizes the market and family as primary sources of support, as mentioned in a study [2]. Apart from that, the Hong Kong government has a comparatively low revenue with the implementation of an extraordinarily low tax rate. Consequently, there are few government policies and services aimed at encouraging fertility, and existing ones have a relatively narrow impact. This lack of comprehensive and forward-thinking population policies hampers efforts to increase the TFR in Hong Kong. Some researchers agree that limited policies and services play a crucial role in limiting the TFR and conducted research on family policies and services that aim to improve TFR [3]. The research divides policies and services into different levels. The findings demonstrate an increase in the number of children per couple from 0.84 to 1.27 after adopting the most effective measures in each area, including the working leave policy, regulations on working hours, childcare services, and housing policy. On the contrary, researchers have not yet completed a conclusive study to quantify the effect of other potentially related issues. To this end, this article will dig deep into concerning aspects to unveil the key factors that may affect the TFR.

One of the primary factors contributing to the low fertility rate is the incongruence between individual-oriented and family-oriented institutions [4]. This incongruence arises from the incompatibility between women's economic and domestic roles, leading to delayed and fewer marriages as well as a reduced intention for childbirth. Before industrialization, married couples have

less division of labor, with wives primarily responsible for child-rearing, and husbands fulfilling the role of providers. Industrialization has made it difficult for women to balance childcare and work responsibilities, with work locations often far from home and inflexible working schedules. Furthermore, it is illustrated that women's role has undergone a notable transformation, women have achieved higher education and more women actively participate in the labor market to pursue personal goals and fulfill individual values [5]. Consequently, women are inclined to have less desire to give birth to children.

Moreover, the financial burden of raising a child in Hong Kong is exceedingly heavy, leading to the constant low level of TFR. It is argued that in many East Asian countries, including Hong Kong, house ownership is considered a prerequisite for getting married and giving birth to children [6]. Meanwhile, housing takes up a significant proportion of family expenditures. Therefore, the housing index would have a detrimental impact on TFR. However, the city has the highest housing prices globally, which leads to the postponement of marriage and delay in having children since both women and men are inclined to save more money. Besides, the exceptionally demanding educational expectations for children in Hong Kong result in excessive expenditures on private tutoring and education, further discouraging fertility. Additionally, the continuously growing pricing level of daily goods and necessities also discourages couples from raising children.

2. Statistical Analysis

2.1. Variables and Data

In this article, it is primarily focusing on two key aspects: the incongruence between women's economic and domestic roles, and the cost of raising children. Scholars have identified these factors as primary causes for the ultra-low fertility rate in Hong Kong. The objective of this study is to determine the significance of these factors and their impact on the TFR. The TFR in Hong Kong serves as the dependent variable (y) in the multinomial regression model [7].

Regarding the incongruence between women's economic and domestic roles, indicators such as the employment rate and income of women are deemed important. The employment rate of women (x_1) represents the proportion of economically active women aged 15 and above, encompassing both part-time and full-time employees. The income level of women (x_2) is indicated by the median value of women's income aged 15 and above, as using the mean value could be biased by extreme values.

There are two hypotheses in this study. The hypothesis 1 states that increasing the employment rate and income level of women can discourage TFR. As for the financial burden, considering all expenses comprehensively can be complex. To ensure clarity and intuitiveness, the housing index (x_3) is utilized as the sole indicator of financial burden. Housing, taking up the largest proportion of family expenditure, can somewhat reflect the price levels of other daily expenses. Housing refers to private dwellings across the entire territory of Hong Kong, and housing prices are indicated by the price indices of private dwellings. The hypothesis 2 states that increasing the housing index can discourage TFR. The data input in the model is from 1985 to 2021, data on women's employment rate and income level over the years are derived from HKCSD, while the housing index over the years is from the Rating and Valuation Department of Hong Kong.

2.2. Models and Methods

In this article, multinomial regression and decision tree analysis are adopted. Multinomial regression can reveal the relationship between the variables and the dependent variable, namely, how changes in variables will affect the dependent variable. The decision tree serves as a supplementary analysis to further support the results found in multinomial regression. These two methods can be helpful to pin down a receivable conclusion.

It is known that no event exists in isolation, and the factors associated with it are always not singular in nature. A dependent variable is frequently influenced by a multitude of significant independent variables, as well as numerous other less discernible independent variables. In such a scenario, the selection of any independent variable could profoundly impact the analysis of the dependent variable. Consequently, the utilization of univariate linear regression analysis for predictions could potentially lead to erroneous conclusions. Therefore, in such circumstances, multiple regression analysis is the recommended approach. This involves establishing a correlation analysis between two or more independent variables and a dependent variable. When a linear relationship exists between the dependent variable and the independent variables, this is referred to as multiple linear regression analysis [8]. The regression equation is

$$\hat{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \quad (1)$$

The decision tree operates on a tree structure, assessing one or more attributes of the samples in a top-down manner, segregating the samples into leaf nodes, and producing the outcome. For each division, the aim is to allocate samples of the same class to the same branch, while endeavoring to assign samples of different classes to distinct branches. As the partitioning process progresses, the samples contained within the branch nodes of the decision tree ideally belong to the same category as much as possible, thereby increasing the purity of the nodes progressively.

From the variables listed above, it is found variables 1, 2, and 3 are percentage, integer, and index respectively. As a result, inputting the raw data directly into the model would affect the accuracy of the relevant model, especially the values of the coefficient [9]. Therefore, the normalization strategy is employed, which states that

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}. \quad (2)$$

3. Results

3.1. Multinomial Regression

From the results attained, the fitted regression equation is

$$\hat{y} = 0.9644 - 0.1269x_1 - 1.5964x_2 + 1.1175x_3 \quad (3)$$

The results demonstrate three variables have a strong correlation with y (Multiple R=0.8479) and 71.9 percent (R Square=0.7190) of the variation in y due to their linear relationship with x_1 , x_2 , and x_3 . To test the overall significance of the multiple linear regression model. The null hypothesis and alternative hypothesis are $H_0: \beta_1 = \beta_2 = \beta_3 = 0$ and H_1 : at least one $\beta_i \neq 0$. From the results attained, $F = 28.15$, $F_{0.05,3,33} = 3.21473 \times 10^{-9}$, therefore, $F > F_{0.05,3,33}$, H_0 is rejected at the 0.05 level of significance. Hence, the multiple regression equation is highly significant.

As hypothesized, the employment rate and income level of women exhibit a negative relationship with the TFR. However, according to the model results, the employment rate is only at a 5 percent significance level. On the other hand, income level emerges as a significant explanatory variable ($p < 0.01$). A one-unit increase in income corresponds to a decrease of 1.5963 units in the TFR. On one hand, it is argued that the Hong Kong government should implement the necessary policies to raise the TFR. On the other hand, the government should safeguard and ensure women's rights in the labor market, promoting gender equality [10]. Therefore, it is impossible to reduce women's income or employment rate. To increase the TFR, the government should consider achieving a balance between women's economic and domestic roles by introducing additional work leave policies, providing childcare services, or even imposing restrictions on working hours in Hong Kong. These measures would allow women to have time for childbirth and child-rearing while preserving their competitiveness in the labor market.

Contrary to hypothesis 2 that higher housing prices lead to lower TFR, the model demonstrates a positive relationship between the housing price index and the TFR ($p < 0.01$). This does not imply that individuals who do not own private dwellings are more willing to have children. Rather, it suggests that the situation is no longer purely driven by financial costs but may indicate the preferences of those who already own homes. More specifically, when housing prices increase, individuals may perceive their properties as gaining more value and exhibit confidence in future economic growth or expect higher future income. Consequently, the Hong Kong people who already own houses may adopt a more positive outlook regarding their future financial situation and become more inclined to spend money presently, including on childbirth. The key indicators of the selected variables are shown in Table 1.

Table 1. Key indicators of selected variables.

	Intercept	X Variable 1	X Variable 2	X Variable 3
Coefficients	0.96438113	-0.1268765	-1.596359	1.11750058
Standard Error	0.054194763	0.107975636	0.220673352	0.18064695
t Stat	17.7947292	-1.1750472	-7.2340361	6.18610265
P-value	1.7584E-18	0.24838492	2.693E-08	5.5849E-07
Lower 95%	0.854121059	-0.346554554	-2.045322304	0.749971592
Upper 95%	1.07464121	0.09280161	-1.1473957	1.48502956
Lower 99.0%	0.81625185	-0.4220038	-2.1995203	0.62374249
Upper 99.0%	1.11251041	0.16825081	-0.9931977	1.61125866

3.2. Decision Tree Analysis

The analysis indicates how the range of y is divided by different values of x_1 , x_2 , and x_3 , and how significantly can they affect y . From the graph shown in Fig. 1, it is observed that x_2 is the most significant variable in dividing y , which is the same as the multinomial regression, with x_2 having the biggest coefficient. In addition, it is also the same that x_3 and x_1 are the second and least influencing variables as the multinomial regression indicated. Additionally, it can be generally observed that x_2 is positively related to y , while x_3 is negatively related to y .

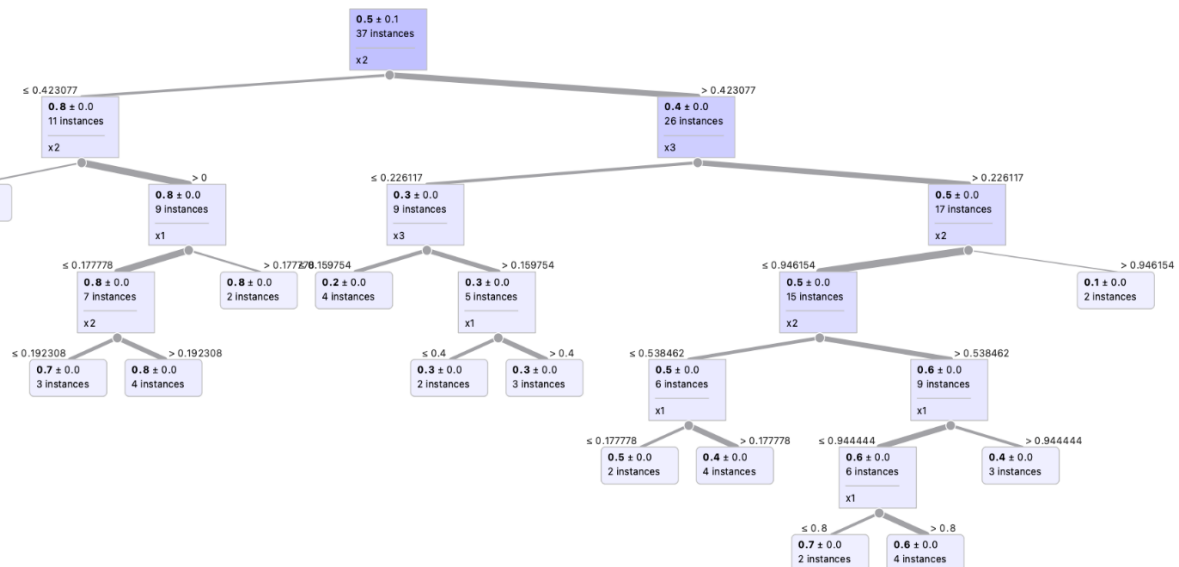


Fig. 1 Decision tree result of the variables that affect total fertility rate.

4. Conclusion

In conclusion, from the perspective of causes, it can generally be inferred that the income level of women significantly affects the TFR. However, the impact of women's employment rate, financial costs not including housing, and other relevant factors of TFR remains unclear using this quantitative methodology. The regression model only incorporates data from the years 1985 to 2021, which may not be sufficient to draw comprehensive conclusions or propose detailed recommendations for future TFR growth. Furthermore, given the $R^2 < 1$ and fixed sample size 37, R^2 will generally increase as more independent variables apart from x_1 , x_2 , and x_3 are included in the multiple regression equation, representing that the current model is not complete enough. Factors influencing the TFR extend beyond the three variables that are included in the regression model. Limited policies, other daily costs, and the opportunity cost of raising children also hold significant importance. Estimation conducted in 2007 suggests that households spent HKD \$1,150 per month on average on private tuition fees for their children. While opportunity costs are also substantial. Parents need to dedicate more time to taking care of their children, often resulting in less time available for entertainment or relaxation, potential impacts on working performance, or even job resignations. However, measuring these effects accurately proves challenging, and thus they were not incorporated into the regression model. Consequently, the accuracy of the model is adversely affected due to the absence of these factors.

If the TFR continues to decline, Hong Kong's aging problem will worsen, with a growing elderly population and a shrinking labor force, which would pose significant challenges for policymakers and threaten the social and economic stability of Hong Kong. To address these issues, it is crucial for the government to implement corresponding policies and provide necessary services that cater to the diverse needs of different families thus encouraging TFR. Identifying and quantifying the impact of each cause can be beneficial for the government to get the right focus on specific aspects instead of being misled, comprehensively understand the needs of people, and enact appropriate policies in terms of certain issues and their influencing levels. Based on the findings, it is suggested the government should take women's role incompatibility into consideration and enact or improve corresponding policies, including working leave policies, working hour legislation, and child-care services to potentially increase TFR.

References

- [1] Gavin J., Hamid W. Singapore's pro-natalist policies: To what extent have they worked. Springer, 2015.
- [2] Shik A. W. Y., Wong C. K. Demise of the developmental state? Implications for social policy development in Hong Kong. *Asian Social Work and Policy Review*, 2012, 6(2): 95-110.
- [3] Lui L., Cheung A.K.L. Family policies, social norms, and marital fertility decisions: A quasi-experimental study. *International Journal of Social Welfare*, 2021, 30(4): 396-409.
- [4] Lam G., Yan Y., Tu E. J. C. Significance of family-friendly measures on fertility in Hong Kong. *Asian Education and Development Studies*, 2017, 6(2): 125-137.
- [5] Esping-Andersen, G. Incomplete revolution: Adapting welfare states to women's new roles. Polity, 2009.
- [6] Rindfuss R. R., Choe M. K. (Eds.). Low and lower fertility: Variations across developed countries. Springer, 2015.
- [7] Chan K. K. W. Youth and consumption. Kowloon: University of Hong Kong Press, 2010.
- [8] Zhang Hongliang, Ji Dongxiao, Lyu Liping. Analysis of the Impact of Declining Birth Rate on Future Vocational Education. *Journal of Tianjin Vocational Institute*. 2023, 32(6): 27-31+43.
- [9] Li Mengmeng, Wang Zhenyu, Gao Zhipeng. The costs of infant-rearing, the availability of child care resources, and the birth rate. *Population and Development*, 2023, 29(6): 152-121.
- [10] Chu Zhaochao. Spatio-temporal evolution and influencing factors of birth rate in Jiangsu Province. *Marker Week*. 2023, 36(9): 30-34.