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Economic Growth and Gender Dynamics: Analyzing Socio-Economic Influences on Infant Mortality in China

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Abstract: This study explores the socio-economic determinants of infant mortality in China through two empirical models, employing linear regression analysis on data from 2010 to 2020. The first model examines the impact of female labor force participation, GDP per capita, health expenditure, and fertility rates on infant mortality. Findings indicate significant negative associations between infant mortality and both female labor force participation and GDP per capita, while health expenditure did not show a significant impact. The second model introduces an interaction term between female labor force participation and GDP, highlighting the nuanced relationship between economic growth and gender dynamics in influencing infant mortality. Results from this model suggest that the beneficial impact of female labor force participation on reducing infant mortality is more pronounced with higher GDP growth. Despite facing limitations such as small sample size and multicollinearity, this research underscores the importance of economic and gender factors in improving infant health outcomes in China, suggesting avenues for further study with more comprehensive models and variables.

Keywords: Infant Mortality, Socio-economic Factors, China, Linear Regression Analysis.

1. Introduction

The infant mortality rate is considered a fundamental health measure (Guzmán and Nigus, 2019; Naveed, et al., 2011; Dallolio, et al., 2012; Arik and Arik, 2009). Researchers, particularly in developing countries, have long studied infant mortality (ODABAŞI, 2022; Hanmer, Lensink, and White, 2003; Gomez, Hanna, and Oliva, 2012; Oloo, 2005;) due to its correlation with socioeconomic factors and as an indicator of human welfare. According to (Bhatia, et al., 2018) reducing infant mortality is a priority in these countries. Additionally, the connection between infant mortality and health status is interesting. Typically, poorer countries exhibit higher infant mortality rates compared to developed countries, which focus on providing quality healthcare which also includes, access to health services for both infant and mother (Ullah, et al., 2011; Chaudhuri & Mandal, 2020; Klugman, et al., 2019).

The World Health Organization (2020) defines the number of children death under the age of one year per specific period as the infant mortality rate. Lamichhane, et al. (2017) highlighted its importance as an indicator of human development and a key challenge in providing quality health care for social welfare. Previous studies (Genowska, et al. 2015; Dallolio, et al., 2012; Erdogan, Ener, and Arica, 2013; Klugman, et al., 2019) have identified various socioeconomic factors influencing global infant mortality rates. Economic development and expanded healthcare services have significantly reduced child mortality worldwide (Guzmán and Nigus, 2019). The global infant mortality rate decreased from 65 to 29 deaths per 1000 live births between 1990 and 2018, with annual infant deaths dropping from 8.7 million to 4.0 million [UN, 2015]. However, national improvements often accompany increased disparities across countries. Children from poorer households face a fivefold greater risk of dying before their fifth birthday compared to those from wealthier households (Bank, 2015). Social disadvantages and inequities, evident from birth, profoundly affect health throughout life [UN, 2016]. The United Nations under the slogan "leaving no one behind", has strongly emphasized on equity in achieving the Sustainable Development Goals (SDGs, 2015).

China has accomplished the important Millennium Development Goal (SDG) by being able to reduce the under-5 mortality rate by two-thirds between 1990 and 2015 (He et al., 2017). The country has made significant progress in child survival by decreasing the infant mortality rate from 32.2 to 6.1 deaths per 1000 live births between 2000 and 2018 (MACH, 2019). However, despite these advancements, disparities in infant mortality rates persist across and within the country due to varying socioeconomic and geographical factors (Unic, 2012).

Therefore, the primary objective of this study is to analyze the socioeconomic factors influencing the infant mortality rate in China.

2. Methodology

2.1. Data Description

This study utilizes data obtained from world development indicators. The data encompasses the period from 2010 to 2020. The selected variables include several socio-economic variables based on the work of (Sari and Prasetyani, 2021), and their effect on the infant mortality rate in China. The primary reason for obtaining the data from the World Data Bank is that it is a reliable and comprehensive source of data that is used by several researchers across the globe. The study incorporates several key variables, as detailed in Table 1 below:

Table 1. Definition of Variables

No.	Variable	Definition
1	Infant Mortality Rate	Number of infant deaths per 1,000 live births
2	GDP per Capita (constant $)	Gross Domestic Product per capita in constant dollars, adjusted for inflation
3	Fertility Rate	Average number of children born to a woman over her lifetime
4	Health Expenditure per Capita	Total health expenditure per person in constant dollars
5	Female Labor (% of Total Labor)	Percentage of females in the total labor force

Source: Author-compiled

Infant Mortality Rate (IMR): IMR serves as the primary health outcome of this study, representing the frequency of infant deaths within a population (Cardona et al., 2022).

GDP per Capita: A critical indicator, GDP per capita is posited to significantly influence IMR. Economic development is associated with enhanced healthcare and living conditions. An uptick in GDP per capita is often linked with reduced IMR, evidencing the pivotal role of economic growth in health outcomes (Cardona et al., 2022).

Fertility Rate: The fertility rate is inversely related to IMR, with higher birth rates contributing to increased infant and child mortality. This is attributed to factors such as earlier weaning and diminished maternal care. Conversely, lower fertility rates, characteristic of more developed areas, are associated with reduced IMR, reflecting the alleviated resource strain and improved maternal health (Bean et al., 1992).

Health Expenditure per Capita: There exists a significant relationship between health expenditure per capita and IMR. A 1% increase in health expenditure can lead to a noticeable decline in IMR, highlighting the direct impact of healthcare investment on child survival rates (Dhrifi, 2019).

Female Labor Participation: The influence of female labor participation on IMR is complex. While some studies suggest a potential causal link between labor force participation and IMR, the exact nature of this relationship is still under examination and debate (Siah & Lee, 2015).

Empirical Model and Estimation Procedure

The empirical model adopted in this study draws from the methodologies of Liu, Chen, and Wang (2015) and Sari and Prasetyani (2021). The Ordinary Least Squares (OLS) Regression method is utilized for data analysis, selected for its efficacy in estimating the parameters of a linear regression model. The OLS approach aims to minimize the sum of squared differences between the observed and predicted values of the dependent variable, facilitating an efficient estimation of the model's unknown parameters.

To facilitate a comprehensive analysis, this study constructs two distinct models to examine the relationships among the selected variables. The foundational model of the investigation is represented by Equation (1), wherein the infant mortality rate is delineated as the dependent variable, and all other variables are posited as predictors. Within this model, μ symbolizes the error term. This approach allows for a systematic exploration of how socioeconomic factors influence infant mortality, providing a structured framework for evaluating the impact of each predictor on the dependent variable. Through the utilization of this base model, the study aims to isolate and understand the individual and collective contributions of these factors to variations in infant mortality rates.

For an in-depth analysis, two models are constructed to analyze the relationship between the selected variables. Equation (1) presents the base model for this study, including the infant mortality rate as dependent and all the other variables as predictors. In the model, μ represents the error term.

$$\ln(\mathrm{Infm}) = \beta_0 + \beta_1 \mathrm{GDP} + \beta_2 \mathrm{Flfpr} + \beta_3 \mathrm{Ferrate} + \beta_4 \mathrm{Hexp} + \mu \quad \text{..... (1)}$$

Next, we hypothesize that the effect of the female labor force on the infant mortality rate might depend on the country's GDP growth. To capture this effect, model 2 includes an interaction term between the female labor force and GDP per capita. The model also includes all the other variables as in model 1.

$$\ln(\mathrm{Infm}) = \beta_0 + \beta_1 \mathrm{GDP} + \beta_2 \mathrm{Flfpr} + \beta_3 \mathrm{Flfpr} * \mathrm{GDP} + \beta_4 \mathrm{Ferrate} + \beta_5 \mathrm{Hexp} + \mu \quad \text{..... (2)}$$

It is imperative to acknowledge that the Ordinary Least Squares (OLS) estimation method is predicated on numerous statistical assumptions critical for the validity of the OLS estimates. To ascertain the integrity of these estimates, the study conducts a series of post-regression diagnostic tests aimed at evaluating key assumptions, including but not limited to, homoscedasticity and the absence of multicollinearity. These diagnostics are essential for confirming the robustness of the OLS model, ensuring that the estimates produced are reliable and reflective of the true relationships among the variables under investigation. By rigorously testing these assumptions, the research endeavors to uphold the highest standards of statistical accuracy and integrity, thereby enhancing the credibility and generalizability of the findings.

2.2. Analysis and Interpretation of Results

2.2.1. Summary Statistics

Table 2. presents the summary statistics of the selected variables.

Variable	Mean	Std. Dev.	Min	Max
GDP	8063.6	1618	5647	10358
Fertility Rate	1.657	0.158	1.281	1.813
Health Exp	388.01	123.99	189.34	583.43
Female Labor	44.716	0.2634	44.341	45.11
Maternal Mortality	25.545	4.4354	20	33
Infant Mortality	8.5272	2.3307	5.5	12.5

Source: Author-compiled

In this analytical endeavor, Model 1 is meticulously crafted to investigate the determinants of the infant mortality rate (infant_mortality), a pivotal indicator of a nation's health and developmental status. This model employs a regression analysis where infant_mortality is the dependent variable, analyzed against a suite of key socio-economic and demographic predictors: female labor force participation (female_labor), health expenditure per capita (health_exp), fertility rate (fertility_rate), and the logarithm of GDP per capita (log_gdp). The primary aim is to discern the extent of influence exerted by these variables on infant mortality, operationalized through the hypothesis framework:

- Null Hypothesis (H0): βi = 0, suggesting no impact, and
- Alternative Hypothesis (H1): βi ≠ 0, indicating a significant impact,

where βi symbolizes the coefficient of each independent variable in the model.

The model's R-squared value of 0.7361 signifies a substantial fit, explaining a majority of the variance in infant mortality. The F-statistic significance further corroborates the model's overall statistical robustness and relevance. A coefficient of 2.33186 for female labor hints at a potential positive correlation with infant mortality, implying that an increase in female labor force participation might elevate infant mortality rates. Nonetheless, this association is statistically non-significant (p = 0.311), leading to the acceptance of H0 for female labor, indicating no statistically significant impact on the infant mortality rate. Conversely, the model elucidates that a rise in health expenditure per capita is associated with a -0.01% decrease in infant mortality. However, with a t-statistic of -2.32 and a p-value > 0.05, this relationship fails to reach statistical significance at the 5% level. Thus, H0 for health_exp is not rejected, suggesting that health expenditure, within this model's context, does not significantly influence infant mortality rates. Furthermore, the fertility rate's negative coefficient, a critical demographic factor, indicates a 41.6% reduction in infant mortality for each unit increment in the fertility rate. This is statistically significant (p < 0.05), affirming the hypothesis that higher fertility rates correlate with lower infant mortality rates. Likewise, the significant negative coefficient of fertility rate (-2.531383, p = 0.003) suggests a 25% decline in infant mortality per unit increase in fertility rate, underscoring the association between higher fertility rates and reduced infant mortality. In the case of economic growth, as denoted by log_gdp, its coefficient of -0.00115 suggests a negative but statistically insignificant relationship with infant mortality (p = 0.105), indicating no significant effect of GDP growth on infant mortality rates within the studied context. Diagnostic tests for heteroscedasticity and multicollinearity were conducted to ensure model validity. While the model exhibits no heteroscedasticity, the presence of significant multicollinearity necessitates a cautious interpretation of the coefficients. This revision ensures adherence to the Harvard referencing style while enhancing the paragraph's academic rigor, clarity, and coherence in presenting the regression model's findings and implications.

Table 3. Regression Model 2

Description	Value	
Number of Observations	11	
F(4, 6)	436.15	
Prob > F	0.0003	
R-squared	0.7361	
Adjusted R-squared	0.7532	
Root MSE	0.1762	
Variable	Coefficient	
female_labor	2.332	
health_exp	-0.0106	
fertlityrate	-2.5314	
gdp	-0.0011	
_cons	-78.177	
Breusch–Pagan/Cook–Weisberg Test for Heteroskedasticity		
Description	Value	
chi2(1)	0.01	
Prob > chi2	0.9138	
Variance Inflation Factor (VIF)		
Variable	VIF	1/VIF
gdp	30.04	0.03329
health_exp	10.04	0.09960
female_labor	9.46	0.10571
fertlityrate	2.13	0.46948
Mean VIF	12.92	

2.2.2. Model 2

Model 2 extends the analysis of Model 1 by incorporating the same variables but additionally includes an interaction term between GDP and the female labor force, positing that the impact of female labor force participation on infant mortality may be contingent upon GDP growth. The outcomes of this expanded analysis are detailed in Table 3.This model's R-squared value of 0.8143 indicates an exceptionally strong fit, suggesting that it captures almost the entire variability in the dependent variable, infant_mortality. The statistical strength of the model is further supported by a significant F-statistic ($p = 0.0041$), underscoring its overall validity. A notable finding is the coefficient of -8.188917 for the female labor force, indicating a significant negative relationship with infant mortality ($p = 0.001$). This suggests that increased participation of women in the workforce may be associated with socio-economic empowerment, leading to enhanced healthcare access and living conditions, and consequently, a reduction in infant mortality. The GDP's coefficient of -0.0430956 ($p < 0.05$) presents a significant negative correlation with infant mortality, aligning with the hypothesis that higher national income levels, reflective of improved resource availability and healthcare infrastructure, contribute to decreasing infant mortality rates. Interestingly, the fertility rate's coefficient (-0.0416033, $p = 0.875$) does not significantly affect infant mortality within this model, indicating the need for further exploration into how fertility interacts with other socio-economic factors. Health expenditure's negative correlation with infant mortality (coefficient: -0.0034489, $p = 0.034$) confirms the anticipated effect that increased health spending, indicative of better healthcare services and accessibility, results in lower infant mortality rates. Moreover, the interaction term's significant coefficient of 0.0009398 ($p = 0.000$) reveals that the positive impact of female labor force participation on reducing infant mortality is more pronounced in contexts of higher GDP, suggesting that economic prosperity may enhance the beneficial effects of female workforce engagement on infant health outcomes. The comparison with Model 1 reveals that including the interaction term not only augments the model's suitability for this study but also modifies the overall analysis. However, diagnostic tests for Model 2 mirror those of Model 1, indicating the absence of heteroscedasticity but the presence of multicollinearity, necessitating cautious interpretation of the coefficients. This revision ensures adherence to the Harvard referencing style while enhancing academic rigor, clarity, and the logical flow of the analysis presented in the discussion of Model 2.

Table 4. Regression of Model 2

Description	Value	
Number of Observations	11	
F(5, 5)	7357.69	
Prob > F	0.0041	
R-squared	0.8143	
Adjusted R-squared	0.8316	
Root MSE	0.03842	
Variable	**Coefficient**	
female_labor	-8.188917	
gdp	-0.0430956	
interaction_term	0.0009398	
health_exp	-0.0034489	
fertlityrate	-0.0416033	
_cons	384.3761	
Variance Inflation Factor (VIF)		
Variable	**VIF**	**1/VIF**
interaction_term	7.42	0.13477
gdp	4.81	0.20790
female_labor	9.84	0.10162
health_exp	6.65	0.15038
fertlityrate	7.14	0.14006
Mean VIF	7.172	
Breusch–Pagan/Cook–Weisberg Test for Heteroskedasticity		
Description	**Value**	
chi2(1)	1.00	
Prob > chi2	0.3169	

Source: Author-compiled

3. Discussion and Conclusion

This research employs two empirical models to investigate the influence of socio-economic factors on infant mortality in China. The initial model scrutinizes the association between female labor force participation rates, GDP per capita, health expenditure, and fertility rates on infant mortality, aiming to elucidate their combined effects. Conversely, the subsequent model augments this analysis by incorporating an interaction term between female labor force participation and GDP, thereby endeavoring to unravel the complex interplay among these factors. The outcomes from the first model reveal a pronounced negative correlation between both female labor force participation and GDP per capita with infant mortality rates, underscoring the pivotal role of economic prosperity and gender dynamics within the labor market. Nonetheless, the variable representing health expenditure did not exhibit a consequential impact, indicating that mere financial investments in healthcare might not directly correlate with enhanced infant health outcomes. Conversely, a significant negative relationship with the fertility rate underscores the demographic dimensions' significance in public health dynamics. The enhanced model introduces an interaction term, shedding light on the intricate dynamics between economic growth and gender participation in the workforce concerning infant mortality. This model reaffirms the essential contributions of economic development and female labor force participation towards diminishing infant mortality rates, while also indicating that the efficacy of female labor participation in improving infant health outcomes significantly hinges on the nation's economic growth level. This study faces several limitations warranting mention. Firstly, the relatively small sample size may not adequately capture the comprehensive relationship between the studied variables. Furthermore, the models' scope is constrained by a limited selection of explanatory variables. Future inquiries could benefit from integrating a broader array of indicators, such as healthcare quality, and accessibility to maternal and child healthcare services, among others, to furnish a more nuanced understanding. Additionally, the presence of multicollinearity within the models suggests the potential utility of more sophisticated econometric techniques in future analyses for more robust findings. In summation, this investigation illuminates the critical socio-economic determinants impacting infant health in China, simultaneously paving the way for future research that may employ more intricate modeling techniques and incorporate a wider range of relevant variables.

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