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Unravelling the Dynamics of Macroeconomic Variables and Infant Mortality in India Based on ARDL Model Analysis

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Abstract

The well-being of mothers and children serves as a vital indicator of a nation's prosperity and is influenced by a range of factors, including macroeconomic variables such as Gross Domestic Product (GDP), unemployment, inflation, income, education, and healthcare expenditure. Escalating inflation precipitates higher food prices, amplifies household living costs, and diminishes purchasing power, consequently exerting a substantial impact on individuals' nutritional and physical health. This study aims to examine the correlation between macroeconomic variables, specifically GDP per capita, Consumer Price Index (CPI), unemployment, and infant mortality in the Indian context. Despite the significance of this relationship, there exists a dearth of research on the association between macroeconomic variables and maternal and child mortality, particularly within the Indian context. Prior studies consistently underscore the indispensability of macroeconomic stability in achieving improved outcomes in maternal and child health. The analysis draws upon secondary data procured from reputable sources such as the World Bank and Reserve Bank of India (RBI), encompassing time series data about both the dependent variable, namely the infant mortality rate, and the explanatory variables. To investigate the impact of macroeconomic variables on infant mortality, the study employs the Autoregressive Distributed Lag (ARDL) Error Correction Model, which accounts for the interplay between the variables over time. Empirical findings establish the existence of long-term cointegration between macroeconomic variables and the infant mortality rate. However, in the short run, some variability in cointegration arises due to a multitude of factors, including policy interventions, demographic characteristics, and socio-cultural determinants. This study substantiates the proposition that sustaining macroeconomic stability and fostering economic growth play pivotal roles in attaining health sector objectives, particularly in emerging economies like India. Consequently, while formulating health policies, equal emphasis must be placed on measures aimed at stabilizing the economy to ensure favourable outcomes of such policies.

Keywords: Consumer Price Index, Infant Mortality Rate, GDP Per capita, Unemployment, ARDL-Error Correction Model

1. Introduction

Maternal and child health is an indispensable measure of a country's well-being. High rates of maternal and child mortality compromise population health and human capital, inhibiting economic growth and advancement. They can also be used to measure the health of the population and whether an economy is successful or not (Sen, 1998). India is one of the countries in which maternal and child health has improved, albeit at a slow pace. Maternal mortality rates in the early 21st century were higher than the

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global average, at around 254 per cent live births. The fifth Millennium Development Goal aimed to reduce the MMR by three-quarters between 1990 and 2015. Although development has been inconsistent, India has made great progress towards the Millennium Development Goals and has met certain targets by the 2015 deadline. Several variables, including GDP, unemployment, income, education, health expenditure and ethnic disparities, have an impact on the level of maternal and child health (Liu *et al.*, 2019; Romaniuk *et al.*, 2020). Family life and inflation are closely linked, as inflation is an essential macroeconomic indicator (Weeks & Weinstein, 2017). Rising inflation drives up food prices, increases the cost of living for households, and reduces purchasing power, significantly affecting people's nutritional and physical health (Christian, 2010). Since the outbreak of the coronavirus epidemic, global commodity price spikes have resulted in varying levels of inflation in several countries (Maital & Barzani, 2020).

Maternal health is a crucial component of any nation's growth in terms of promoting equity and reducing poverty. The survival and well-being of mothers are essential in addressing the key issues of the economy, society, and child development. The high rate of maternal mortality indicates a lack of access to adequate medical services and a significant difference in wealth between the well-off and the poor. Prime attention has been given to mother and child healthcare in the Millennium Development Goal (MDG) summit in which goal four of MDG was to reduce child mortality and goal five was to improve maternal health. Over 90 per cent of all maternal deaths are in low- and middle-income countries. India must give more attention to the survival of children. This includes increasing child survival, especially among disadvantaged populations, and effectively managing neonatal and pediatric diseases. Target four of the MDGs was linked to infant mortality. In India, the child mortality rate was 112 for every 1000 live births in 1990. The MDG set a goal of reducing it by two-thirds. This means reducing the under-five mortality rate to 42 per 1,000 live births by 2015.

To accomplish these objectives, the Indian government established the National Rural Health Mission (NRHM) in 2005. The mission's dual objectives are to promote high-quality infrastructure, particularly in underdeveloped areas, and to enhance maternal, infant, and child health conditions. All regions have seen improvements since its introduction, although maternal health conditions remain dismal. Indicators still frequently lag in several situations. However, when it comes to MMR, India and several of its states have fallen short of the MDG objective (158 in 2015). Even though the IMR objective was met, several states still have relatively high IMR levels. There we can see a wide discrepancy among states in the sense that the performance of high-income states is quite good when compared with low-income states in achieving the targets of millennium development goals. This reiterates that the macroeconomic variables like level of income, economic growth, and different aspects of development like education, employment, inflation, poverty, etc. have a significant impact on mother and child health care.

2. Literature Review

Studies reveal unemployment and inflation affect mother and child healthcare. If the price level increases the overall purchasing power of households decreases and this will severely affect the healthcare service delivery and utilisation. The rate of inflation has been increasing in almost all countries after the outbreak of the pandemic. It is high for the USA, Israel, Italy, Greece, China, Indonesia, Russia, and most of the Asian nations. In this type of economic crisis, retarded growth, unemployment, and inflation are the biggest concerns. They, directly or indirectly, affect the mother and child's healthcare. The cost of health services will increase due to inflation. Due to increased unemployment, there will be negative income effects. When labour is replaced with technology in the health sector, it will increase unemployment and the cost of healthcare services further. Altogether, the service delivery and utilisation in the health sector in general and mother and child healthcare particularly is severely affected by malnutrition, missed checkups, unattended delivery, etc. and ultimately lead to an increase in MMR or IMR or both. Thus, it is significant to study the relationship between mother and child healthcare,

say, MMR and IMR, with macroeconomic variables, since India has also been affected by unemployment and inflation in the past few years, especially after the pandemic. Here we are considering only IMR for finding out the relationship because the data for MMR is not enough to apply the ARDL model.

The world around us provides evidence for studies on the link between IMR and other macroeconomic variables, but hard to find similar studies about the Indian context. Multiple kinds of research have demonstrated that macroeconomic variables like inflation, rise in food prices and poverty in underdeveloped regions limit pregnant women's and children's doors to nutrition and lead to a reduction in mother and child health (Wodon & Zaman, 2010). Akinlo and Ibrahim (2016) examined the impacts of increased food prices on newborn and under-five mortality in African countries using fixed and random effects, differential GMMs, and systematic GMMs. The study's findings demonstrate that rising food prices in sub-Saharan Africa have a considerable negative impact on infant and under-five mortality. Supply-side factors like the increased number of doctors, pharmacies, technological changes etc. also lead to medical inflation and thus general inflation and may cause to increase in mother and infant mortality. Macroeconomic variables such as GDP per capita, unemployment, and poverty are specifically connected with lower child mortality (Bourne, 2012). According to studies, economic prosperity decreases infant mortality whereas economic crises increase it (Paxson & Schady, 2005; Cnattingius & Haglund, 1992). Similar findings, that economic growth is inversely connected with child mortality, can also be drawn from emerging nations (Pérez-Moreno *et al.*, 2016; Baird *et al.*, 2011). Lin (2006), utilising a panel dataset of 23 Taiwanese cities and a fixed-effects model, discovers that newborn and neonatal death rates in Taiwan change counter-cyclically with urban unemployment. Studies have also revealed a link between higher IMR and low rates of mother and paternal work, as well as poor income and wealth (Ko *et al.*, 2014; Cutler *et al.*, 2006).

All the studies available reiterate that better mother and child health is not possible without the stability of macroeconomic variables in the economy. No studies were found that directly measure the relationship between macroeconomic variables and infant mortality in India; however, studies worldwide explain a strong relationship between the infant mortality ratio and macroeconomic variables like unemployment, GDP per capita, poverty, health expenditure, and inflation. Thus, as crucial indicators that influence factors like MMR and IMR, macroeconomic variables have great research value. Therefore, it is pertinent to investigate the connection between macroeconomic variables and infant deaths in India.

3. Methodology

This descriptive-analytical study is aimed at finding out the relationship between macroeconomic variables, say the consumer price index, GDP per capita, the unemployment rate, and the IMR.

3.1 Data Source

This study is based on secondary data, in which the data related to all the variables between 1971 and 2020 have been extracted from the World Bank and RBI.

3.2 Model Applied

For empirical analysis, we used the ARDL Error Correction Model. Pesaran *et al.* (2001) created the ARDL model to combine the I (0) and I (1) variables in a single calculation. Because many of the variables change over time and do not behave like constants as required by OLS, we cannot estimate conventional OLS on them if any or all of the variables are I (1). OLS will falsely show high t values and significant results while inflating the results due to the common time component. When the R square of the model exceeds the Durban Watson statistic, this is referred to as spurious results in econometrics. To manage I (1) variables, we move to a new set of models. When the variables are stationary at level, at the first difference, or both, the ARDL model is regarded as the finest econometric technique. It is a good model to capture the short- and long-term effects of explanatory variables on the outcome variable i.e. IMR, considering the study's aims.

3.3 Variables Used

The study aims to determine how India's infant mortality rate and important macroeconomic

variables are related. The major macroeconomic variables used in this study for empirical analysis are listed in Table 1.

Here we included the unemployment rate, GDP per capita, and consumer price index as explanatory variables. IMR is the dependent variable.

Rising consumer prices can significantly impact the cost of living for households, particularly affecting their ability to afford essential goods and services necessary for infant health and well-being. Inflationary pressures, reflected by CPI, can lead to increased prices of food, healthcare, and other vital resources, potentially limiting access to adequate nutrition and healthcare services for infants. Infants are particularly vulnerable to changes in the affordability and accessibility of necessities such as food, healthcare, and sanitation. When CPI increases, it can impact the purchasing power of households, potentially limiting their ability to provide adequate nutrition and healthcare for infants. By considering CPI as a variable, the study aims to explore how changes in the cost of living, influenced by inflation, can indirectly affect infant mortality rates through their impact on affordability and accessibility of essential resources.

Unemployment rates can serve as indicators of economic hardship and limited resources within households, which can impact the well-being of infants. Unemployed individuals may face financial constraints that hinder their ability to access quality healthcare services for their infants, including prenatal care, immunizations, and postnatal support. High unemployment rates can also exacerbate social and economic disparities, potentially leading to increased stress, reduced access to health care, and adverse health outcomes for infants. By including unemployment as a variable, the study seeks to explore how variations in employment levels may indirectly affect infant mortality rates through their influence on household resources and well-being.

GDP per capita serves as a proxy for the standard of living and economic well-being within a country. Higher GDP per capita indicates greater availability of resources, including healthcare infrastructure, nutrition programs, and social support systems, which can positively impact maternal and child health outcomes. Economic development, as reflected by GDP per capita, can contribute to improved access to prenatal care, healthcare facilities, sanitation, and nutrition, potentially reducing infant mortality rates. By considering GDP per capita as a variable, the study aims to examine how economic development and the availability of resources influence infant mortality rates, exploring the potential pathways through which macroeconomic factors impact infant health outcomes.

There are empirical researches that reinforce the importance of considering macroeconomic variables when examining the determinants of infant mortality. The findings of most of the studies reveal that higher GDP per capita and lower levels of inflation and unemployment are associated with lower infant mortality rates, highlighting the importance of economic stability for infant health outcomes (Dehejia & Lleras-Muney, 2003; Yaya & Bishwajit, 2019). These studies provide evidence of the importance of macroeconomic variables in the analysis of infant mortality rates, highlighting their influence on infant health outcomes across various regions.

Moreover, by understanding how macroeconomic variables such as consumer price index, unemployment, and GDP per capita influence infant mortality rates, policymakers can identify key areas for intervention.

Table 1. Description of dependent (IMR) and independent variables considered for the study

Variables	Descriptions	Measurement Units	Source
IMR	Infant Mortality Ratio	Ratio (under age 1 children's death/100000 live births)	https://data.worldbank.org
CPI	Consumer Price Index	Index	https://www.rbi.org.in
Unemp	Unemployment	Percentage of the total labour force (modelled ILO estimate)	https://data.worldbank.org
GDPPer	GDP Per capita	US$	https://data.worldbank.org

Based on the knowledge of their correlation, policymakers can allocate the available resources effectively. These macroeconomic variables can guide the development of targeted policies aimed at reducing infant mortality rates. Recognizing the impact of macroeconomic variables on infant mortality rates emphasizes the need for a comprehensive, health-in-all-policies approach. By monitoring changes in these variables and their subsequent effects on infant mortality, policymakers can assess the effectiveness of implemented measures, make necessary adjustments, and develop evidence-based policies to achieve better maternal and child health outcomes. Thus, all the selected macroeconomic variables for this study, including consumer price index, unemployment, and GDP per capita, are pertinent for identifying their impact on infant mortality.

The following model was created to determine how outcome and explanatory variables are related:

$$\begin{aligned} \mathrm{IMR}_t &= \alpha + \beta_1 \mathrm{CPI}_t \\ &+ \beta_2 Unemp_t + \beta_3 GDPPer_t + \in_t \end{aligned} \quad (1)$$

where, indicates the time (from 1971 to 2020); - Infant Mortality Ratio; -Consumer Price Index; - Unemployment rate; -Gross Domestic Product Percapita; is the intercept; are the coefficients; and is the error term. Equation (1) can be represented in ARDL form as

$$\begin{aligned} \Delta IMR_t &= \alpha + \sum_{k=1}^{n} \beta_1 \Delta IMR_{t-k} + \sum_{k=1}^{n} \beta_2 \Delta CPI_{t-k} \\ &+ \sum_{k=1}^{n} \beta_3 \Delta Unemp_{t-k} + \sum_{k=1}^{n} \beta_4 \Delta GDPPer_{t-k} + \\ &+ \gamma_1 IMR_{t-1} + \gamma_2 CPI_{t-1} + \gamma_3 Unemp_{t-1} \\ &+ \gamma_4 GDPPer_{t-1} + \in_t \end{aligned} \quad (2)$$

where, shows the first difference. is the intercept; are the coefficients; and is the error term. The study employs the Schwarz-Bayesian Criterion (SBC), the Akaike Information Criterion (AIC), and the Hannan-Quin Information Criterion (HQC) to determine the ideal lag length. The study employs the Error Correction Model (ECM) to identify the short-run dynamics that exist between variables after identifying their long-run associations. The following formulation is the ECM generic version of Equation:

$$\begin{aligned} \Delta \mathrm{IMR}_t &= \alpha + \sum_{k=1}^{n} \beta_1 \Delta IMR_{t-k} \\ &+ \sum_{k=1}^{n} \beta_2 \Delta CPI_{t-k} + \sum_{k=1}^{n} \beta_3 \Delta Unemp_{t-k} \\ &+ \sum_{k=1}^{n} \beta_4 \Delta GDPPer_{t-k} + \phi ECM_{t-k} + \in_t \end{aligned} \quad (3)$$

where, Δ represents the first difference while ∅ is the coefficients of ECM for short-run dynamics. The ECM displays the rate of long-term equilibrium adjustment following short-term shocks. The Wald test is used to confirm the long-term connection among all the variables. The Wald test's null hypothesis states that cointegration is not present. Lower- and upper-bound values are contrasted with the estimated F-statistics (Pesaran & Shin, 1999). There will be cointegration if the projected F-statistic value is greater than the lowest and upper bound. Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUMSUMSQ) are used to evaluate the model's goodness of fit. The residuals of ECM are shown using these experiments. The results indicate that the ARDL model's coefficients are stable if the statistics in the plot fall within the critical boundaries at a 5 per cent significant value.

4. Results and Discussion

4.1 Results

To determine the impact of the Consumer Price Index (CPI), GDP per capita, and unemployment on the infant mortality ratio, this study used time-series data from 1971 to 2020. We can see that unemployment is both leptokurtic and significantly negatively skewed as explained by the descriptive statistics. GDP per capita is positively skewed and platykurtic, whereas CPI is positively skewed (Table 2). According to the Jarque-Bera test and the skewness and kurtosis tests, residuals show a normal distribution.

The trend lines of the variables (Figure 1) clearly show either increasing or decreasing trends except for the consumer price index, which had a deep dip in 1996–1997. The unemployment trend line indicates higher

and continuous growth until 1994, after which it is stationary or slightly falling.

IMR is highest for the period 1971 and lowest for the period 2020 (Table 3). It has significantly decreased over time. The consumer price index in India was lowest (256) in 1997 and highest (1381) in 1996, according to RBI data. The average inflation rate during the period was 7.91 per cent. In 1971, India's GDP per capita was the lowest (119 US dollars), and it was the highest (2101 US dollars) in 2019. It increased over time, with an average of 16.75. There is not much variation in the unemployment rate. It was at its lowest in 1971-72 and its highest in 1994-95.

4.2 Result of Empirical Analysis

Checking the stationarity of all the variables is necessary before applying the ARDL model. The bound F-statistic test can only be performed if all the variables are stationary at level, at the first difference, or both. To confirm the stationarity of each variable, the research applies the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. IMR is stationary at level I (0) according to the unit root test, whereas all other explanatory variables are stationary at the first difference, I (1). The appropriate lag order must be selected before performing the ARDL bound test. In this work, the best lag order of the Vector Autoregression (VAR) model was determined. The model performs better at lag 1, according to the observed results, which show all of the lag selection factors employed when applying the bound test. Before determining the long and short-run correlations between the variables, in this case, the cointegration was confirmed using the ARDL bound test (Pesaran *et al.*, 2001). At 1% significance, the F-statistics value exceeds both the lower and upper bound (Table 4). As a result, the model-bound test affirms the presence of a long-term link between the outcome and explanatory variables, and the alternative hypothesis of cointegration is accepted.

Table 2. Result of descriptive statistics of dependent (IMR) and independent variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness Kurtosis
IMR	50	78.85	34.18	27	140.9	0.20 1.88
GDPPer	50	679.66	595.30	119	2101	2.83 1.13
CPI	50	553.54	294.31	194	1381	0.93 3.05
Unemp	50	5.07	0.75	3.15	5.76	-1.24 3.23

After validating the existence of a long and short-run relationship between variables using the ARDL bound test, the study identifies the short-run and long-run parameters of the variables.

In this study, based on the ARDL model, we can see that in the long run, in India, all three explanatory variables have an impact on IMR. Consumer Price Index has a positive statistically significant (p=0.011) impact on IMR (Table 5).

In the long run, if the consumer price index increases by one unit the Infant Mortality Ratio also will increase by 0.03 units. However, GDP per capita has a negative

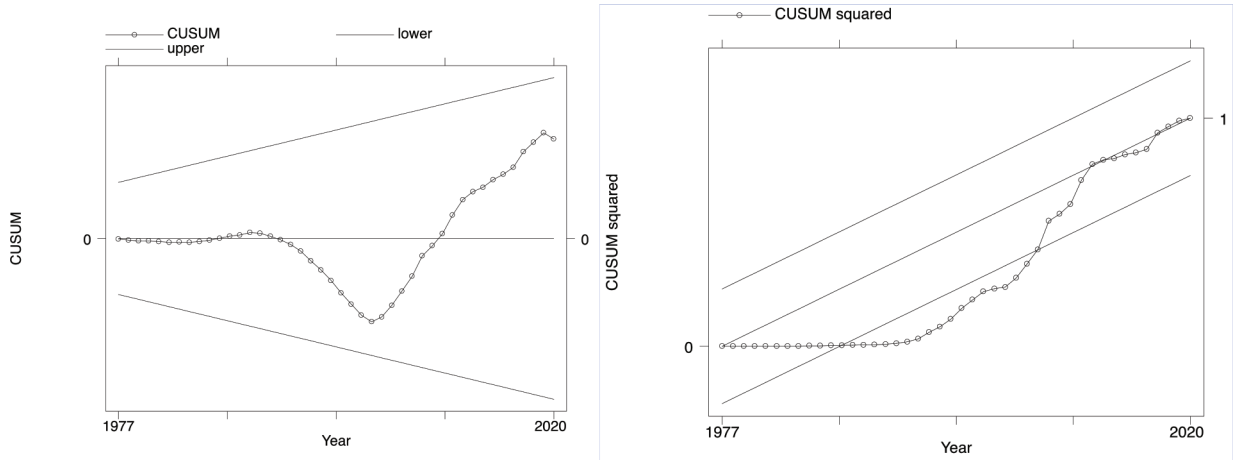

Figure 1 Trendline of IMR, GDP per capita, CPI and Unemployment from 1971 to 2020

effect on IMR (p=0.097). If it increases by one unit, the IMR will decrease by 0.02 units. Similarly, unemployment also has a statistically significant negative impact on IMR (p=0.003). If unemployment increases by one unit, the IMR will decrease by 17.58 units. The computed coefficient of ECM, which is negative, has substantially proved cointegration between variables. The pace of long-term equilibrium adjustment following short-term shocks is shown by the ECM. Every year, at 0.020 units (p=0.035), any nonconformity from the short-run equilibrium between components and IMR may be adjusted.

The model is applied with diagnostic tests to find out the errors. The Durbin-Watson test for autocorrelation (2.08) and the Breusch-Godfrey LM test for higher-order autocorrelation (p=0.715) confirms that there is no autocorrelation. LM test for autoregressive conditional heteroskedasticity (ARCH) results (says that there is no arch effect or the problem of heteroskedasticity in the model. The anticipated Ramsey reset test shows that the predicted model's functional form is accurate. Brown *et al.*, (1975) suggested using the CUSUM (cumulative sum) and CUSUMSQ (cumulative sum of squares) tests to evaluate stability in the short-run and long-run coefficients due to the existence of structural alterations in all variables as a result of one or more structure breakdowns. Based on the results of the CUSUM and CUSUMSQ, this model demonstrates good fitness and stability (Figure 2).

Table 3. Trends in IMR, inflation, GDP per capita, and unemployment

Year	IMR	CPI-All	GDP per capita (US$)	Unemployment (% of total labour force)
1971	140.9	194	119	3.2
1972	138.8	196	123	3.3
1973	136.5	217	144	3.4
1974	133.9	263	163	3.5
1975	131	354	158	3.7
1976	128	340	161	3.8
1977	124.7	293	186	3.9
1978	121.3	324	206	4.1
1979	117.9	317	224	4.2
1980	114.6	346	267	4.3
1981	111.5	395	270	4.4
1982	108.6	444	274	4.6
1983	105.9	467	291	4.7
1984	103.3	520	277	4.8
1985	100.8	521	296	5.0
1986	98.4	546	310	5.1
1987	95.9	572	340	5.2
1988	93.4	629	354	5.3
1989	90.9	708	346	5.5
1990	88.6	746	368	5.6
1991	86.3	803	303	5.7
1992	84.2	958	317	5.7
1993	82.1	1076	301	5.7
1994	80.1	1114	346	5.8
1995	77.9	1247	374	5.7
1996	75.8	1381	400	5.6
1997	73.5	256	415	5.7
1998	71.2	264	413	5.7
1999	68.9	293	442	5.6
2000	66.7	306	443	5.6
2001	64.4	305	452	5.5
2002	62.1	309	471	5.6
2003	60	319	547	5.6
2004	57.8	331	628	5.6
2005	55.7	340	715	5.6
2006	53.6	353	807	5.6
2007	51.5	380	1028	5.4
2008	49.4	409	999	5.5
2009	47.2	450	1102	5.6
2010	45.1	513	1358	5.4
2011	43	564	1458	5.4
2012	40.9	611	1444	5.4
2013	38.8	672	1450	5.4
2014	36.9	750	1574	5.4
2015	34.9	800	1606	5.4
2016	33.1	835	1733	5.4
2017	31.4	870	1981	5.3
2018	29.8	889	1997	5.3
2019	28.3	907	2101	5.2
2020	27	980	1901	5.2

Source: https://data.worldbank.org and https://www.rbi.org.in

Table 4. Results of ARDL bound test

Critical Value	10 %	5%	1%	F-statistics	p-value
Lower Bound I(0)	2.72	3.23	4.29	9.342	0.000
Upper Bound I(1)	3.77	4.35	5.61	--	--

Table 5. Results of the ARDL model of long and short-run co-integration

D. IMR	Coef.	Std. Err.	t	p>t	[95%Conf.	Interval]
ADJ						
IMR						
L1.	-0.02	0.011	-1.770	0.035	-0.043	0.003
LR						
GDP per	-0.02	0.011	-1.700	0.097	-0.042	0.004
CPI	0.03	0.010	2.670	0.011	0.007	0.048
Unemp	-17.58	5.960	-3.170	0.003	-28.766	-6.385
SR						
IMR						
LD.	0.728	0.077	9.390	0.000	0.570	0.885
GDP per						
D1.	0.0055	0.0049	1.100	0.278	-0.0046	0.021
LD.	0.0033	0.0033	0.960	0.344	-0.0035	0.013
CPI						
D1.	-0.0021	0.0016	-1.260	0.216	-0.0052	0.002
LD.	-0.0009	0.0011	-0.830	0.415	-0.0034	0.004
Unemp						
D1.	-0.131	0.359	-0.370	0.717	-0.860	0.598
LD.	0.250	0.344	0.730	0.472	-0.449	0.950
_cons	-0.503	0.362	-1.390	0.174	-1.238	0.232

Number of obs = 47 (Sample: 1974 – 2020)
R-squared = 0.7047
Adj R-squared = 0.6543
Root MSE = 0.2736

Figure 2. Plot showing the ARDL model's coefficients' stability using CUSUM and CUSUMSQ. Authors' estimations are based on data from 1971 to 2020.

4.3 Discussion

The infant mortality rate is regarded as one of the best measures of a nation's well-being. According to Alderman and Behrman (2004), it represents the social, economic, and environmental circumstances in which children (and other members of society) live, including their access to health care. Infant mortality is significantly higher in poor and middle-income nations than in high-income countries. This disparity can be attributed to multiple interconnected factors. First, limited access to healthcare infrastructure and resources in low and middle-income countries hinders the availability of quality prenatal care, skilled birth attendants, and essential healthcare services for infants. Insufficient healthcare leads to increased vulnerability and a higher risk of mortality among infants. Second, malnutrition and food insecurity prevail in these countries, affecting maternal health, fetal development, and the overall health of infants. Inadequate access to nutritious food and clean water weakens the immune system and exposes infants to higher risks of infections and diseases. Third, low and middle-income countries face a higher burden of infectious diseases due to poor sanitation, limited access to clean water, and crowded living conditions. Additionally, socioeconomic factors, including poverty and income inequality, contribute to higher infant mortality rates. Limited financial resources hinder access to healthcare services, proper nutrition, and a safe living environment. However, most developing nations saw a significant fall in infant mortality in the 1990s. The majority of studies examined the social, nutritional, and demographic factors that influence child mortality. Nevertheless, relatively little research has examined the macroeconomic factors that influence infant mortality. Implementing effective initiatives to minimise infant mortality in any country, especially in third-world nations, requires a thorough understanding of the macroeconomic primary causes of infant death.

Even though there is a very weak association, this study found that the consumer price index had a positive long-term effect on infant mortality. Many studies from Southeast Asia tried to trace the relation between inflation and infant mortality but few studies show a statistically significant relation. Even though there are mixed effects of the variables considered on infant mortality in the short run because of the fluctuations and shocks, in the long run, if the consumer price index increases maternal mortality also will increase. For one unit increase in CPI, Infant Mortality also will increase by 0.03 units ($p<0.05$). Poorer results for child mortality were correlated with rising general prices, and food prices, particularly for high-protein meat and dairy items. In the most underdeveloped states, these negative correlations were concentrated (Fledderjohann *et al.*, 2016). Whereas if GDP Per capita increases infant mortality will decrease by 0.02 units showing an inverse relationship ($p<0.10$). Studies around the globe and in India also say there is an inverse relationship between income and child mortality (O'Hare *et al.*, 2013). The findings of another study demonstrate that immunisation has a major influence on IMR in both rural and urban India, however, GDP and government financing are insufficient to help lower the IMR in India.

Increases in the CPI reflect rising inflation, indicating a general increase in the prices of goods and services. Inflationary pressures can result in higher costs of essential items such as food, healthcare, and necessities. As the cost of living rises, households, particularly those with lower incomes, may struggle to afford adequate nutrition, healthcare, and other essential resources for infants. Insufficient access to proper nutrition during pregnancy and infancy can increase the risk of developmental issues, weakened immune systems, and susceptibility to illnesses among infants. Malnutrition and inadequate nourishment can contribute to higher infant mortality rates. Inflation can also affect the cost of healthcare services, including prenatal care, childbirth, vaccinations, and treatments for infant illnesses. Higher healthcare expenses may deter families from seeking necessary medical care, leading to delays in diagnosis and treatment. Inflation tends to impact lower-income households more severely, exacerbating socioeconomic disparities. Families with limited financial resources may face greater difficulties in coping with inflationary pressures and meeting the needs of their infants. Socioeconomic factors, including income inequality and limited access

to resources, can create barriers to adequate healthcare, nutrition, and overall well-being, which in turn can contribute to higher infant mortality rates.

Policymakers should focus on implementing measures to control inflation and stabilize prices, particularly for essential goods and services that directly affect infant health, such as food and healthcare. This may involve monetary policies, fiscal policies, and targeted interventions to mitigate the adverse effects of inflation on vulnerable populations. Developing and strengthening social safety net programs can help protect vulnerable families from the negative consequences of inflation. These programs may include income support, food assistance, healthcare subsidies, and other forms of social assistance to ensure access to necessities and healthcare services for infants. Policies should be designed to enhance the affordability and accessibility of healthcare services for families, especially those with limited financial resources. This may involve expanding healthcare coverage, improving healthcare infrastructure, and implementing financial assistance programs to reduce out-of-pocket expenses associated with healthcare for infants. Implementing and supporting nutrition programs specifically targeting pregnant women and infants can help mitigate the impact of inflation on infant mortality.

However, in the case of unemployment, the result shows a statistically significant inverse relationship. If unemployment increases by one unit, Infant Mortality will decrease by 17.58 units ($p<0.01$). This finding is supported by other Indian studies. If unemployment increases the IMR will decrease, despite its numerous benefits, women's participation in economic activities in India has been linked to an increase in newborn and early child mortality. Compared to mothers who do not work, mothers who work have a 10% higher neonatal mortality rate and a 36% higher child mortality rate (Sunita & Sulabha, 1998). Proper prenatal care necessitates medical examinations beginning at thirteen weeks of pregnancy and continuing until the baby is delivered. Mothers from rural regions who work often miss out on regular prenatal check-ups during their pregnancy and thus experience higher infant mortality rates (Kessner *et al.*, 1973).

Unemployment is generally not considered a direct determinant of infant mortality. Infant mortality rates are influenced by a multitude of factors, such as access to healthcare, prenatal care, nutrition, sanitation, maternal health, socioeconomic conditions, and public health interventions. These factors are not directly linked to unemployment rates. It is essential to emphasize that effectively reducing infant mortality requires a comprehensive approach that encompasses improving healthcare infrastructure, enhancing access to quality healthcare services, strengthening maternal and child health programs, and addressing socioeconomic disparities. While there may exist certain indirect mechanisms or contextual factors that can potentially influence both unemployment rates and infant mortality rates, it is imperative to thoroughly investigate specific factors before drawing any conclusive relationship. Hence, it is evident that the relationship between unemployment rates and infant mortality rates in India is influenced by a variety of factors, many of which are unrelated to unemployment.

It is imperative to address the specific barriers hindering rural working women's access to and utilization of antenatal and postnatal care services, as these challenges contribute to higher infant mortality rates. The study underscores the significance of tailored interventions and targeted support to ensure sufficient antenatal and postnatal care for this population group. Recognizing the limitations of uniform approaches, policy initiatives should be directed towards introducing workplace support mechanisms and policies that facilitate antenatal and postnatal care for rural working women. This could encompass measures such as flexible working hours, provisions for maternity leave, and the creation of nurturing environments that promote women's prioritization of their health and the well-being of their infants. Consequently, policy efforts should concentrate on enhancing healthcare infrastructure, raising awareness, and mitigating the barriers preventing rural working women from accessing crucial maternal and child health services.

The relationship between GDP per capita and infant mortality in India is complex and multifaceted. While there is generally an association between higher

GDP per capita and lower infant mortality rates, it is important to note that GDP per capita alone does not determine infant mortality rates. Higher GDP per capita often allows for greater investment in healthcare infrastructure, including hospitals, clinics, and healthcare facilities. This can lead to improved access to healthcare services, including prenatal and postnatal care, which contributes to reducing infant mortality rates. Higher GDP per capita is also associated with improved living standards, including better access to nutrition and sanitation facilities. Adequate nutrition and sanitation play crucial roles in reducing infant mortality rates by promoting healthy growth and development and reducing the risk of infections. Higher GDP per capita is often linked to improved socioeconomic conditions, such as higher education levels, income levels, and social safety nets. These factors can positively influence infant mortality rates by reducing poverty, improving access to resources, and promoting overall well-being. Additionally, it is essential to consider the distribution of wealth and resources within a country, as disparities and inequalities can persist despite an overall increase in GDP per capita. Therefore, addressing disparities and ensuring equitable access to healthcare and social services are crucial for further reductions in infant mortality rates, regardless of GDP per capita levels.

India has seen socio-economic progress and changes, a decline in infant mortality, and an increase in life expectancy because of the economic reforms and opening up in the 1980s and 1990s. Because of these reforms GDP, per capita income and living conditions of the people increased and IMR decreased rapidly. That is the reason for inflation's mixed and meagre impact on IMR. Moreover, inflation brings both an income effect and a substitution effect. Income effect that leads to increased IMR instead, substitution effect may reduce IMR rather than increase it. According to several research, inflation during a recession has a stronger substitution impact than an increase in income, which lowers infant mortality (Ruhm, 2000; Miller & Urdinola, 2010). A positive influence in a few years cancels out the considerable negative link between the two in some other years. These results imply that in the link between CPI and infant mortality, the income effect dominates the substitution effect. Infant mortality is more severely impacted by relative income declines brought on by inflation.

Hence, it is crucial to address the underlying socio-economic factors that contribute to higher infant mortality rates. Policy interventions aimed at reducing income inequality, enhancing education, fostering employment opportunities, and promoting economic development are essential in mitigating the impact of inflation on vulnerable populations and improving overall infant health outcomes. Robust monitoring and evaluation systems should be established to assess the effectiveness of policies and interventions in mitigating the adverse effects of inflation on infant mortality rates. By implementing these policy implications, policymakers can work towards mitigating the adverse effects of inflation on infant mortality and improving overall maternal and child health outcomes. This calls for a comprehensive approach that combines economic stability, social protection, accessible healthcare, and socioeconomic development to address the underlying determinants of infant mortality in the context of inflation.

5. Conclusion

The findings of this study suggest that CPI inflation has a positive impact on infant mortality rates in India, while unemployment and GDP per capita have a negative impact. These results indicate the complex and nuanced relationship between economic factors and infant health outcomes. It highlights the importance of considering multiple factors and their interactions when analysing infant mortality rates. In India, particularly after the pandemic, CPI inflation is rising, limiting the use of health care owing to the income effect. The expense of living has risen as a result of rising prices, and the utilisation of healthcare services has grown more expensive. Furthermore, rising unemployment and a sluggish economy will have a negative impact on the country's people's standard of living. The cost of mother and child healthcare will consequently rise, which will discourage people from using prenatal, delivery, and postnatal care services, especially those in vulnerable groups of the population. Even though the association

between macroeconomic variables and the infant mortality ratio considered in this study are meagre but not negligible. The need for macroeconomic stability to achieve healthcare goals in emerging countries like India is therefore highlighted by this study. Without it, all programmes and policies would likely be less successful and fall short of their goals. So policymakers should prioritize effective management of inflation to minimize its negative impact on infant mortality rates. Measures such as price stability targeted social welfare programs, and support for vulnerable populations can help mitigate the adverse effects of inflation on healthcare access and affordability. Policies promoting inclusive economic growth and addressing income disparities can lead to improved maternal and child health outcomes. Investing in healthcare infrastructure, education, and social welfare programs can help mitigate the adverse effects of economic factors on infant mortality. Measures should be initiated towards introducing workplace support mechanisms and policies that facilitate antenatal and postnatal care for rural working women.

The study suggests investigating regional variations in the relationship between economic factors and infant mortality rates within India. Analysing sub-national data can uncover specific contextual factors and policy implications at the regional level. The study also suggests exploring potential mediating factors that link inflation, unemployment, and GDP per capita to infant mortality rates. A study also can be deliberated to assess the effectiveness of existing policies and interventions aimed at reducing infant mortality rates in the context of economic factors.

While the study provides valuable insights into the relationship between economic factors and infant mortality rates in India, it is important to acknowledge certain limitations that may impact the interpretation and generalizability of the findings. The study relies on available data sources, and any potential inaccuracies or biases in the data used for variables such as infant mortality rates, CPI inflation, unemployment rates, and GDP per capita could affect the reliability of the results. The study's time series design limits the ability to establish causality between the economic factors and infant mortality rates. Other unobserved or confounding variables that influence both the economic factors and infant mortality rates may not have been fully accounted for. Additionally, the study's focus on India may restrict the generalizability of the findings to other countries or regions with different socioeconomic contexts. Furthermore, the study may not have considered all relevant factors that influence infant mortality rates, such as healthcare access, quality of healthcare services, education, and cultural factors. Lastly, the study's reliance on aggregate data at the country level may overlook variations and heterogeneity within subpopulations or regions. These limitations highlight the need for further research to address these concerns and enhance the understanding of the relationship between economic factors and infant mortality rates.

6. References

Akinlo, A. E., & Odusanya, A. I. (2016). Effects of food prices on under-five and infant mortality rates in Sub-Saharan Africa. *African Journal of Economic Review*, *4*(1), 101-112.

Alderman, H., & Behrman, J. R. (2004). *Estimated economic benefits of reducing low birth weight in low-income countries*. Health, Nutrition and Population (HNP) Discussion Paper. The World Bank. Retrieved February 25, 2024 from https://www.unscn.org/web/archives_resources/files/Estimated-economic_benefits_of_redu_290.pdf.

Baird, S., Friedman, J., & Schady, N. (2011). Aggregate income shocks and infant mortality in the developing world. *The Review of Economics and Statistics*, *93*(3), 847-856. https://doi.org/10.1162/REST_a_00084

Bourne, P. A. (2012). Under-five mortality, health and selected macroeconomic variables: The Children behind the digits. *Epidemiology, 2*(2), 2-8. https://doi.org/10.4172/2161-1165.1000115

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society: Series B (Methodological)*, 37(2), 149-192. https://doi.org/10.1111/j.2517-6161.1975.tb01532.x

Christian, P. (2010). Impact of the economic crisis and increase in food prices on child mortality: Exploring nutritional pathways. *The Journal of Nutrition*, *140*(1), 177-181. https://doi.org/10.3945/jn.109.111708

Cnattingius, S., & Haglund, B. (1992). Socio-economic factors and feto-infant mortality. *Scandinavian Journal*

of Social Medicine, 20(1), 11-13. https://doi.org/10.1007/BF02730932

Cutler, D., Deaton, A., Lleras-Muney, A. (2006). The determinants of mortality. *Journal of Economic Perspectives*, *20*(3), 97-120. https://doi.org/10.1257/jep.20.3.97

Dehejia, R., & Lleras-Muney, A. (2004). Booms, busts, and babies' health. *Quarterly Journal of Economics,* 119(3), 1091-130.https://doi.org/10.1162/0033553041502216

Fledderjohann, J., Vellakkal, S., Khan, Z., Ebrahim, S., & Stuckler, D. (2016). Quantifying the impact of rising food prices on child mortality in India: A cross-district statistical analysis of the District Level Household Survey. *International Journal of Epidemiology*, *45*(2), 554-564. https://doi.org/10.1093/ije/dyv359

Kessner, D. M., Singer, J. E & Kalk, C. W. (1973). Infant death: An analysis by maternal risk and health care. *Contrasts in Health Status,* Institute of Medicine and National Academy of Sciences, Washington DC.

Ko, Y. J., Shin, S. H., Park, S. M., Kim, H. S., Lee, J. Y., Kim, K. H., & Cho, B. (2014). Effects of employment and education on preterm and full-term infant mortality in Korea. *Public Health*, *128*(3), 254-261. https://doi.org/10.1016/j.puhe.2013.12.010

Lin S. J. (2006). The effects of economic instability on infant, neonatal, and postneonatal mortality rates: Evidence from Taiwan. *Social Science and Medicine, 62*(9), 2137-2150. https://doi.org/10.1016/j.socscimed.2005.10.013

Liu, Y. H., Chang, W. S., & Chen, W. Y. (2019). Health progress and economic growth in the United States: The mixed frequency VAR analyses. *Quality and Quantity: International Journal of Methodology*, *53*(4), 1895-1911. https://doi.org/10.1007/s11135-019-00847-z

Maital, S., & Barzani, E. (2020). The global economic impact of COVID-19: A summary of research. *Samuel Neaman Institute for National Policy Research*, 1-12. https://www.neaman.org.il/EN/The-Global-Economic-Impact-of-COVID-19-A-Summary-of-Research

Miller, G & Urdinola P B. (2010). Cyclicality, mortality, and the value of time: the case of coffee price fluctuations and child survival in Colombia. *Journal of Political Economy, 118*(1), 113-155. https://doi.org/10.1086/651673

O'Hare, B., Makuta, I., Chiwaula, L., & Bar-Zeev, N. (2013). Income and child mortality in developing countries: A systematic review and meta-analysis. *Journal of the Royal Society of Medicine*, *106*(10), 408-414. https://doi.org/10.1177/0141076813489680

Paxson, C., & Schady, N. (2005). Child health and economic crisis in Peru. *The World Bank Economic Review, 19*(2), 203-223. https://doi.org/10.1093/wber/lhi011

Pérez-Moreno, S., Blanco-Arana, M. C., & Bárcena-Martín, E. (2016). Economic cycles and child mortality: A cross-national study of the least developed countries. *Economics and Human Biology, 22*, 14-23. https://doi.org/10.1016/j.ehb.2016.02.005

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326. https://doi.org/10.1002/jae.616

Reserve Bank of India. (2023). *Table No. 37: Major economic indicators*. Retrieved 2023, February 23 from https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/37T_13092024A58CDBB95F7D41058617E263117697E2.PDF

Romaniuk, P., Poznańska, A., Brukało, K., & Holecki, T. (2020). Health system outcomes in BRICS countries and their association with the economic context. *Frontiers in Public Health*, 8(80), 1-11. https://doi.org/10.3389/fpubh.2020.00080

Ruhm, C. (2000). Are recessions good for your health? *Quarterly Journal of Economics*, *115*(2), 617-650. https://doi.org/10.1162/003355300554872

Sen, A. (1998). Mortality as an indicator of economic success and failure, *The Economic Journal*, *108*(446), 1-25. https://doi.org/10.1111/1468-0297.00270

Weeks, W. B., & Weinstein, J. N. (2017). Per-capita medicare expenditures, primary care access, mortality rates, and the least healthy cities in America. *American Journal of Medicine*, *130*(1), 101-104.

Wodon, Q., & Zaman, H. (2010). Higher food prices in Sub-Saharan Africa: Poverty impact and policy responses. *World Bank Research Observer*, *25*(1), 157-176. https://doi.org/10.1093/wbro/lkp018

World Bank. (2023). *Unemployment, total (% of total labor force) (modeled ILO estimate) - India*. World Development Indicators. Retrieved 2023, February 22 from https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?locations=IN

World Bank. (2023). *GDP per capita (current US$) - India*. World Development Indicators. Retrieved February 22, 2023, from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=IN

World Bank. (2023). *Mortality rate, under-5 (per 1,000 live births) – India* [Data]. Retrieved 2023, February 23 from https://data.worldbank.org/indicator/SH.DYN.MORT?locations=IN

Yaya, S., & Bishwajit, G. (2019). Burden of acute respiratory infections among under-five children in relation to household wealth and socioeconomic status in Bangladesh. *Tropical Medicine and Infectious Disease*, *4*(1):36. https://doi.org/10.3390/tropicalmed4010036