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Fertility Transition and Business Transformation in Bangladesh: The Role of Female Employment, Human Capital, Digitalization and Accounting Information Systems

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ABSTRACT

The objective of this study is to examine the impact of economic growth, structural transformation, and female employment in influencing the fertility transition in Bangladesh, with an extended Business, Commerce and Accounting Information Systems (AIS) perspective. Methodology: This study collects data over 36 years from 1990 to 2025 and the time series analysis is performed using the unit root test and the ARDL bound co-integration test. The fertility rate is used as the dependent variable, and the independent variables are GDP per capita, female employment, agricultural value, industry value and service value added. Digitalization, human capital and accounting Information Systems are theoretical mechanisms, not newly estimated ARDL variables. Findings: A significant long-run relationship exists. GDP per capita is positively associated with fertility; female employment is negative in the short run; agriculture is negative in both periods; industry is insignificant long run; and services are positive short run but negative long run. Contribution: The study shows that investment in women's education, promotion of female employment and ensuring the sectorial growth, especially in services, leads to broader social developments. Overall, the study highlights the importance of gender empowerment and structural economic change, economic development by confirming the digitalization of firm, accountability and entrepreneurship in achieving sustainable fertility transition in Bangladesh. Implications: digital skills, cloud accounting, financial inclusion, secure data systems, childcare support and workforce analytics.

Keywords: Fertility Transition; Female Employment; Structural Transformation; Accounting Information Systems; Digitalization, Human Capital

Introduction

In recent decades, Bangladesh has seen a significant demographic transition, with the total fertility rate decreasing from 4.5 in 1990 to 3.2 in 2000 to 2.3 in 2020 (World Bank, 2024). This process of demographic transition has been accompanied by rapid economic growth, structural changes in the economy, significant rise of female labour force participation, poverty reduction, industrial expansion and the emergence of digitally connected economy. Since the 1990s, the economy of Bangladesh transitioned from an agrarian one to industrial and service-oriented as a result of rapid economic growth. The structure and behavior of families have also undergone significant changes along with significant changes in the economic structure. Historical and contemporary evidence shows that the relationship between women's labor force participation and fertility is shaped by the nature of the work environment and childcare facilities (Weller, 1977; Goldscheider, & Waite, 1991).

In preindustrial societies, non-mechanized agricultural activities allowed simultaneous child-rearing without affecting economic productivity. In these societies, children are regarded as consumption goods for their contribution to family farms or businesses, for their support to parents in old age, or for the growth of household productivity through the rearing of many offspring (Becker, 1960; Adsera, 2004). With industrialization, employment became increasingly centralized, and the workplace was generally situated far from home and schedules set by employers, making it difficult for women to balance work and childcare responsibilities (Degler, 1980; Cook, 1986; Stycos, 1965). Therefore, women aiming to enter the labor market frequently confront the challenge of either limiting their fertility or securing alternative childcare facilities. Unlike the earlier demographic transition, the fertility transition of Bangladesh increasingly reflect broader transformation in house-hold decision making, labor market participation, human capital development and economic digitalization.

The technique by which economic transformation affects fertility is through human capital development. Growing educational attainment, especially among women, has been an important component of the evolution in marriage patterns, reproductive preferences and investments in child quality. The movement of households from a quantity approach to a quality one when the economic returns to education and skills increase is explained by the human capital theory (Becker 1960). Low fertility, rising education (and healthcare), and increasingly remote childhoods mean that as parents spend more on their children from providing top-notch educational resources to ensuring a high rate of university attendance later on they are more likely to choose a bit less procreative force but better had. This has been reflected in the increase of female education, postponement of marriage, improved consciousness about reproductive health and higher rate of family planning methods acceptance as well as improved contribution to economic activities by the women. Thus, human capital accumulation is both a cause and effect of fertility transition changes to household/individual preferences and economic positions (Schultz, 1961).

Digitization, in recent years, has added a new dimension to the economic transformation of Bangladesh. An increasing availability of digital financial services, mobile connectivity, online education, e-commerce and access to information have transformed the ways in which households, businesses and individuals find economic opportunities. Through greater access to reproductive health information, greater participation of women into the labour market (a consequence of flexible employment opportunities), and reducing the information asymmetries at work, digital technologies can affect fertility decisions (Mammen, & Paxson, 2000). Digital transformation has also expedited the modernization of business practices by pushing firms to use more sophisticated management methods, data-driven decisions and accounting information systems (AIS). By embedding AIS within businesses, you can expect better financial visibility and operational performance-leading to more efficient resource allocation across the broader transition that is occurring-from informal household economy-driven activities towards formal & tech intensive enterprises.

The connection between business transformation and fertility transition is especially relevant for Bangladesh due to the continual changes in the perspective of household structures as well as in employment patterns with economic modernization. Now that digital technologies and accounting information systems are widespread in the early 21st century, there is greater demand for labour with education and skills; this stimulates more investment in education directed at producing labour supply responsive to that demand. For example, this process may indirectly affect fertility behaviour by raising the opportunity costs of childbearing, notably for more educated women entering formal employment. The expansion of modern

industries and the digital economy also opened up new opportunities for women to participate in entrepreneurship and join the workforce, making the link between economic participation and demographic transformation even more pronounced (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013: Armand, Richard, & Schenk, 2025). Therefore, the unprecedented human capital accumulation in Bangladesh since 1990 can only be understood as a wider process of economic transformation taking place along with labour market evolution and technological progress while confronting traditional demographic factors driving fertility transition.

While research on accounting information systems has conventionally focused on firm-level concerns, the relevance of these systems to business formalization, productivity enhancement and digital transformation has led to a growing interest in their wider socioeconomic implications (Grande, Estébanez, & Colomina, 2011). Information-based management systems in place in firms increase the need for skills and therefore human capital with positive effects on investment (of human capital) and on professional employment. ' In particular, these economic changes affect the choices made within households in that they raise the opportunity cost of childbirth and lower preferences for having more children towards preferring higher-quality children (Becker & Lewis 1973; Galor & Weil 2000). Consequently, AIS-based business transformation could facilitate fertility transition indirectly via female employment, human capital accumulation and economic modernization.

However, the main focus of this paper is to analyze the contribution of the economic growth and structural change as well as women employed human capital, digital transformation and accounting information systems, in explaining on fertility transition in Bangladesh. Specifically, the analysis examines on sectoral transition of the country in terms of agriculture to industry and service pattern and how it is related to fertility rates over time. It explores how the increase of women's labour force participation has affected reproductive behaviour and family planning choices. By analysis the dynamics of fertility rate, the study aims to provide a deeper understanding of the socioeconomic factors associated with Bangladesh's fertility transition that help future demographic and development policymakers to take decisions related to human capital. However, this study has identified the following questions to conduct on the theme: i). How economic growth has contributed to the fertility transition in Bangladesh? ii). How do structural changes, in particular the structural change from agriculture to industry & services impact fertility? iii). What impact does women employment has on fertility in Bangladesh? iv) How human capital development influence the fertility transition and v) How do digitalization and accounting information systems influence the demographic behaviour and fertility transition?

While studies have addressed fertility determinants in Bangladesh, they mostly operate at the micro-level (education, contraceptive uptake, access to health care and household factors) (McNicoll, 1995; Islam et al., 2004; Bora et al., 2023). Much less attention has been devoted to the macroeconomic channels through which can connect fertility transition with structural transformation, female employment, human capital development, digitalization and business modernization. Understanding these relationships is important especially to Bangladesh where a demographic and economic transition is taking place together with opportunities for sustainable development as well as challenges. Finally, understanding of this relation is crucial as it will assist decision-makers to make better decision to take the advantages of the growing working-age population and to develop policies which fairly support male or female economic performance. Additionally, this investigation will add to the body of existing literature by integrating theories of demographic transition with relevant socio-economic

factors. In addition, the acknowledgment of the interaction between female workforce participation and fertility is very much needed in order to accomplish gender-appropriate Sustainable Development Goals (SDGs) as well which aim at contributing to economic development. Ultimately, the study can provide guidance for labor market, schooling and family planning policies in Bangladesh by pointing to how sector shifts and access to female employment opportunities influence fertility behaviour.

2. Literature Review

2.1 Demographic Transition, Structural Transformation and Fertility

Demographic Transition Theory proposes that fertility declines as societies experience improvements in income, mortality, education and social organization. The original paper reviews Notestein (1945), Heer (1966), Galor and Weil (1996), Becker (1960), Doepke (2004) and related studies. The demographic transition literature provides the foundation for understanding the decline in fertility as economies develop. Notestein's demographic transition framework links modernization with changes in mortality, fertility, family structure and economic behavior (Notestein, 1945). Becker's economic theory of fertility emphasizes the costs and benefits of children and the trade-off between the quantity and quality of children (Becker, 1960; Becker & Lewis, 1973).Evidence from developing countries confirmed this theory and shows that during the demographic transition, economic development plays a significant role in lowering fertility (Heer, 1966). According to Büttner et al., (2024), factors like the structural shift from the agriculture sector to the non-agriculture sector, rapid industrialization, the expansion of higher education among women, and economic expansion strongly correlate with faster fertility transitions. Galor & Weil (1996) explained that economic development initially boosts population growth but eventually leads to reduced fertility as the returns to human capital investment increase. These theories remain useful for Bangladesh because the country has moved from a predominantly agrarian economy toward manufacturing and services while fertility has fallen substantially. However, the Bangladesh experience also shows that economic growth does not automatically produce the same demographic response in every period(Bora et al., 2023; Islam et al., 2004).

2.2 Economic Development and Fertility Transition

The quantity-quality trade-off' theory developed by Becker (1960), suggested that with economic improvement, parents give value the quality of education for their fewer children which subsequently reduce fertility rate. In contrast, Heer (1966) used data from 41 countries during the 1950s and concluded that fertility increases with income but decreases with greater access to information and health improvements. The study suggests that investments in health and education can raise the fertility-reducing effects of economic growth. Heuveline (2001) examined whether fertility decline in developing countries was driven by economic development or by a natural process between fertility and mortality changes. Using data from the 1960s to 1990s, the study found that economic growth alone poorly explained fertility and mortality changes. However, a strong connection between fertility and mortality rate with economic growth helped to predict actual population growth trends. This suggests that both economic development and mortality-fertility links played key roles in the demographic transition.

2.3 Female Employment and Fertility

Becker's economic theory emphasizes the opportunity cost of time. As women's potential earnings increase, time spent outside paid employment for childrearing becomes more costly. Empirical research has found that the relationship between female employment and fertility can vary by institutional context. Becker's theory suggests that the costs and benefits of childbearing affect fertility decisions. Labour moving away from agriculture toward industry

and services, as economies grow and the structural change takes place, raises the opportunity costs of children, especially for women which reduces the fertility rate (Becker 1960). Similarly, Gehrke & Kubitza (2024) found that income decline in agriculture and high opportunity costs of rearing children are also employed to reason for fertility reduction when households shifted to the manufacturing sector. Wanamaker (2012) examined the case of South Carolina during 1881 to 1900, where the author investigates industrialization in nineteenth century fertility decline in the USA. The study found that the establishment of textile mills was associated with a 6 to 10% drop in fertility, mainly among migrant households. Factors such as higher child mortality, increased textile employment, and rising child-rearing costs contributed to this decline.

2.4 Human Capital and the Quantity-Quality Trade-Off

Becker and Lewis argue that families may substitute quality for quantity as the returns to education rise. Fewer children can permit greater investment per child. This is directly relevant to business because human capital is an input into productivity. A lower fertility rate can, under favourable conditions, permit higher investment per child in education, health and digital skills. Over time, this can strengthen the quality of the labour force available to firms. Thus, fertility transition may create a demographic pathway to productivity rather than simply a population decline. An empirical study of structural transformation in the US supported the theory and found that the decline in fertility in the early 1900s was linked to the shift from agriculture to manufacturing which was primarily influenced by the growth of human capital associated with structural changes (Ager, Herz, & Brueckner, 2020). Galor & Weil (1996) explained that economic development initially boosts population growth but eventually leads to reduced fertility as the returns to human capital investment increase. The Unified Growth Theory explains that technological progress, human capital formation, and structural shift from agriculture to industry gradually increased incomes and reduced fertility rates (Wanamaker, 2012).

2.5 Digitalization as a Business Mechanism

Digitalisation can help achieve growth and job creation, while also highlighting the need for connectivity and digital skills for inclusive benefits, according to World Bank[1]. The Internet usage rate in Bangladesh in 2024 is 53%, highlighting considerable progress and still a large gap. Digitalization needs to be seen as a facilitator and not a solution for everyone. Companies that have access to digital tools can leverage all kinds of sales, inventory, customer, payment and accounting information, while companies that do not have access to digital tools or skills could miss out on these benefits.

2.6 Accounting Information Systems

AIS has become particularly important, due to accounting information being at the intersection of finance and management. AIS can offer the managers with information for budgeting, pricing, inventory control, working-capital management, and profitability analysis and compliance. As the AIS function evolves to a more digital economy, it is increasingly linked to point-of-sale systems, e-commerce platforms, mobile payments, banking interfaces and cloud software. This helps to make the link between daily business matters and the strategic decision-making.

This argument is supported by evidence specific to the case of Bangladesh. Hosain (2019) study of Bangladeshi SMEs was conducted to understand the knowledge of accounting,

[1]World Bank. (2024). *Bangladesh digital finance and digital connectivity indicators*.

management support and performance of record-keeping and found that account knowledge has positive correlation with record keeping performance and organizational performance is also positive. The respondents comprised 803 individuals from 341 SMEs. This is significant as it demonstrates that capability related to AIS is not just an accounting problem. It can be related to profitability and thus is a part of Business and Commerce general discussion.

Cloud Accounting and e-accounting also seem to be emerging subjects of interest, according to recent research in Bangladesh. In a study of cloud accounting in 200 SMEs and interviews with 15 SME representatives in 2025, adoption of cloud accounting was explored from a technology-acceptance perspective and benefits and barriers to adoption were identified, including cost, technical capability and security. A 2026 study on adoption of e-accounting software in Bangladesh also suggests that mobile accounting software can help to reduce manual tasks and provide timely financial information. The results are in line with the broader hypothesis that digital accounting can enhance the information environment of SMEs, but causal claims need to be further validated using more robust longitudinal evidence.

2.7 AIS, Workforce Productivity and Female Employment

Digital accounting systems can change the skill composition of work. Routine data entry and manual reconciliation may decline, while demand for analytical accounting, financial interpretation, system administration and digital literacy can increase. This shift has implications for women entering or remaining in the labour market. If women receive training in accounting software, data analytics, digital payments and financial management, digitalization can create additional pathways into skilled employment and entrepreneurship. A recent Bangladesh study published in the Journal of Accounting & Organizational Change reports that technology-driven accounting systems positively affected workforce performance efficiency and operational efficiency, with workforce efficiency mediating the technology-performance relationship and workforce digital competency moderating the relationships. This evidence is particularly relevant to the present framework.

3. Research Gap and Conceptual Extension

In summary, existing literature demonstrates that economic growth, structural change in the economy and female labour force participation are all closely related to fertility transitions. Although increased income levels and structural change from agriculture to industrial and service sectors are generally associated with lower fertility rates (Bongaarts, 2003; Dyson, 2010), the relationship between female employments however is more complex. Particularly in formal employment opportunities, the higher work force participation encourages later childbearing or lower fertility (Becker, 1993; Rindfuss, Guzzo & Morgan, 2003). While others suggest that access to flexible or informal employment may allow women to combine work and motherhood (Mammen & Paxson, 2000). In the context of Bangladesh, through which economic growth and substantial structural changes interact with female employment patterns to influence fertility decisions remain insufficiently explored. Therefore, this study aims to fill this gap by analyzing how economic development, sectoral shifts, and changing patterns of women's employment collectively shape fertility behavior in Bangladesh today. Moreover, it also try to shows that due to the digitalization how economic transactions occur; AIS converts those transactions into decision-useful information; and improved information can support productivity, business performance and entrepreneurship. This is a conceptual bridge, not an assertion that AIS has already been statistically established as a determinant of fertility in the current dataset.

5. Materials and methods

5.1 Data source and Variable description

The data on fertility rate, GDP per capita, female employment, agriculture value, industry value added, and service value added is collected from work bank from 1990 to 2025 by following previous authors (Islam, Islam, & Chakroborty, 2004;Bloom, Canning, & Sevilla, 2003; Aggarwal, 2021;Brewster & Rindfuss, 2000). Such a long period assists in the analysis of the long-run relationship between variables. In this context, the study use GDP per capita value as a proxy for economic development (Islam, Islam, & Chakroborty 2004). Agriculture value added, Industry value added & service value added predicts structural transformation (Aggarwal, 2021; Ayon, 2018).

The author uses log transformations which help to stabilize the variance and address the potential issues of heteroscedasticity (Wooldridge, 2016; Gujarati, 2002). A brief description of the variables is given in Table 1:

Table 1: Variable Description

Variable Name	Synonym	Definition	Source
Fertility Rate	LF	The fertility rate (births per woman) is the number of children a woman would have had if she had survived to the end of her childbearing years and gave birth each year at the current rate for that age group (World Bank, 2024).	World Bank
GDP per capita	LY	GDP per capita is the abstraction of a country's economic output broken down to per person. It indicates the average income or economic output per individual and is commonly used to compare living standards or economic prosperity between nations (World Bank, 2024).	World Bank
Female Employment	LE	Female employment refers to the participation of women in the labor force, including all forms of paid work in both formal and informal sectors, as well as self-employment activities. It assesses the degree of women's participation in productive economic activities either for wages, profit, or family gain (ILO, 2024).	World Bank
Agriculture Value added	LA	Agriculture Value Added (in current US$) Agriculture value added is the net output of the agricultural sector after adding up all outputs and subtracting intermediate inputs. This comprises agricultural activity with regard to the growing of crops and the rearing of livestock, forestry, fishing and hunting. This represents the share of GDP held by a sector and does not account for value-added services within the agricultural sector (World Bank, 2024).	World Bank
Industry value added	LI	Industry value added, on the other hand, measures the net output of an industry after subtracting intermediate inputs. It covers manufacturing, mining, construction, electricity, water and gas	World Bank

		sectors. It captures sectoral contributions to a country`s GDP and indicates the production of goods and services, related with the specific industry (World Bank, 2024).	
Service value added	LS	Services value added refers to the net output of the services sector after deducting the value of intermediate inputs. It includes a wide range of activities such as trade, transport, financial services, education, health care, and public administration. This indicator measures the services sector's contribution to a country's GDP (World Bank, 2024).	World Bank

Source: Authors Compilation

5.2 Data Analysis Method

The study performs the time series analysis using a data from 1990 to 2025. The stationary of data is checked to avoid the false regression results (Raihan et al., 2022). As a result, it was necessary to complete the unit root tests in order to find out the order of integration of each variable before estimating. The study utilized the following tests of stationarity: the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979; Hasan, Hossain, & Hasan, 2024), the Dickey-Fuller generalized least squares (DF-GLS) test (Elliott, Rothenberg, & Stock, 1996) and Phillips-Perron (P-P) test (Phillips & Perron, 1988) to measure the stationarity. The study utilized the ARDL technique (Pesaran, Shin, & Smith, 2001) to examine long-term cointegration among the variables after the unit root test. In contrast to conventional time series methodologies that prioritize only short-term analysis, ARDL distinguishes short-run dynamics from long-run equilibrium and assesses how the relationships between variables may evolve. The time-series regression equation is given below:

$$LF_t = \beta_0 + \beta_1 LY_t + \beta_2 LE_t + \beta_3 LA_t + \beta_4 LI_t + \beta_5 LS_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Here, LF_tstands for total Fertility rate births per woman at time t, LY_t stands for GDP per capita which indicates economic growth, LE_t stands for female employment to population ratio at time t, LA_t, LI_t, LS_tstands for agriculture value added, industry value added, service value added which indicates structural change. The selected variables capture key economic and social factors influencing fertility transitions which are theoretically linked to fertility behavior (Galor, 2012; Becker, 1960).

5.3 Data Analysis and Discussions

The descriptive statistics of the main variables of this study are shown in Table 2. Here the 36-year mean of LF, LG, LE, LA, LI, and LS are 1.004, 6.76, 3.20, 23.74, 24.046 24.93. The standard deviation values suggest that LI and LS exhibit greater variability over the sample period, while LE and LF show relatively less fluctuation. Overall, the relatively small standard deviations imply that most variables remain stable around their mean values. Results also indicate that all variables exhibit relatively low skewness values, suggesting that the data are approximately symmetric. Additionally, with kurtosis values below 3, all variables display platykurtic behavior, indicating flatter peaks and lighter tails than a normal distribution. The Jarque-Bera test probabilities confirm that the variables do not significantly deviate from normality.

Table 2: Descriptive Statistics

Statistic	Fertility Rate	GDP Per Capita	Female Employment	Agriculture Value	Industry Value	Services value
Mean	1.004668	6.756189	3.203144	23.74306	24.04577	24.92682
Median	0.981574	6.687274	3.081601	23.74202	23.99616	24.89593
Maximum	1.542443	7.570443	3.844707	24.33931	25.48025	25.88461
Minimum	0.646056	6.125240	2.773426	23.11829	22.77479	24.09651
Std. Dev.	0.274884	0.454918	0.305146	0.387762	0.817144	0.538888
Skewness	0.317621	0.330883	0.725059	0.014326	0.153390	0.153595
Kurtosis	1.810768	1.796386	2.501617	1.588155	1.832325	1.737171
Jarque-Bera	2.726708	2.829934	3.526845	2.991192	2.186369	2.533652
Probability	0.255801	0.242934	0.171457	0.242934	0.335147	0.281724
Sum	36.16804	243.2228	115.3132	243.2228	865.6478	897.3656
Sum Sq. Dev.	2.646441	7.243250	3.258998	7.243250	23.06250	10.93443
Observations	36	36	36	36	36	36

Notes: This table shows the summary of descriptive statistics for all variables used in the analysis, including fertility rate (LF), GDP per capita (LG), female employment (LE), agriculture value added (LA), industry value added (LI), and service value added (LS). All variables have been transformed into their natural logarithmic form and the data span the period from 1990 to 2025.

Source: Authors' Calculation

Table 3 shows the results of the pairwise correlation coefficient among the variables of this study. The diagnostic results reveal the existence of multicollinearity among the variables. However, in time series models such as the ARDL framework, multicollinearity is often expected due to the inclusion of lagged variables, which are naturally correlated. Multicollinearity in this context is not inherently problematic unless it leads to significant distortions in the signs, magnitudes, or statistical significance of the estimated coefficients (Nkoro & Uko, 2016).

Table 3: Correlation Matrix of the Variables

Variables	LF	LG	LE	LA	LI	LS
Fertility rate	1					
GDP Per Capita	-0.963***	1				
Female Employment	-0.842***	0.875***	1			
Agriculture value	-0.987***	0.989***	0.860***	1		
Industry value	-0.978***	0.997***	0.873***	0.993***	1	
Services value	-0.9789***	0.997***	0.872***	0.996***	0.999***	1

*Notes:****, **, * indicates the level of significance at 1%, 5%, and 10% level. Here, the fertility rate is indicated by LF, GDP per capita is indicated by LG, female employment is indicated by LE, agriculture value added is indicated by LA, industry value added is indicated by LI and service value added is indicated by LS. All variables have been transformed into their natural logarithmic form and the data span the period from 1990 to 2025.

Source: Authors' Calculation

Table 4 displays the results of unit root test for ADF, DF-GLS and P-P tests. The result indicates that all variables are non-stationary at their log levels. But after the first difference all variables are very significant in all tests so they become stationary. This suggests that the variables are **integrated of order one, I(1) and** we can proceed with our analysis using the **ARDL framework,** which enables us to explore both the short-term and long-term relationships among the variables over time. Confirming the stationarity of the variables ensures the reliability of our econometric modelling, allowing us to derive meaningful insights and make well-informed decisions.

Table 4: Result of Unit Root Test

Variables	ADF		DF-GLS		P-P	
	Log levels	Log first difference	Log levels	Log first difference	Log levels	Log first difference
Fertility rate	-0.9504	-3.7396**	-1.0878	-3.853***	-9543	-3.7818**
GDP Per Capita	-1.9587	-39245**	-1.4276	-3.8317***	-1.8876	-3.9394**
Female Employment	-3.4568*	-4.2719***	-3.5640**	-4.3411***	-2.1083	-2.8478*
Agriculture value	-1.6026	-3.6090**	-1.8262	-2.9761**	-1.1829	-3.7667**
Industry value	-0.6311	-6.2759***	-0.5531	-6.2980***	-0.6271	-6.4228***
Services value	-3.3897*	-4.3148***	-1.2163	-3.3779*	-3.3897*	-4.0691**

Notes: ***, **, * indicates the level of significance at 1%, 5%, and 10% level. Here, the fertility rate is indicated by LF, GDP per capita is indicated by LG, female employment is indicated by LE, agriculture value added is indicated by LA, industry value added is indicated by LI and service value added is indicated by LS. All variables have been transformed into their natural logarithmic form and the data span the period from 1990 to 2025.

Source: Authors' Calculation

The optimal lag length was determined using several selection criteria, including the LogL, LR, FPE, AIC, SC, and HQ statistics. Results suggest that all criteria consistently indicated lag 4 as optimal. Following the standard practice of selecting the lag length based on the majority rule across these criteria, lag 4 was chosen for the ARDL model estimation. In the final model specification, one lag was applied to the dependent variable, while up to four lags were included for the regression. This approach ensures that the model adequately captures the dynamic structure of the data while avoiding problems of over-parameterization (Lütkepohl, 2005).

Table 5: Lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	302.8208	NA	3.54E-16	-18.5513	-18.2765	-18.4602
1	620.5544	496.4588	8.32E-24	-36.1597	-34.2359	-35.5220
2	664.8702	52.6251	6.38E-24	-36.6794	-33.1067	-35.4951
3	728.2147	51.4674	2.52E-24	-38.3884	-33.1667	-36.6576
4	875.0900	64.2579*	2.07e-26*	**-45.3181***	**-38.4475***	**-43.0407***

Notes: * indicates lag order selected by criterion. LR: Likelihood Ratio (Sequential modified LR test statistic all at 5% level), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion and HQ, Hannan-Quinn Information Criterion.

Source: Authors' Calculation

As for the long-run relationship of the models; the ARDL bound test is applied ((see Table 6). From the ARDL bounds test results, it is concluded that long-run relationships exist between variables. The estimated F-stat (16.44033) exceeds the critical upper bound (I(1)) at all levels of significance. Since the calculated F-statistic exceeds even the maximum critical value, it must reject null hypothesis, a long-run relationship does not exist. This indicates that the cointegration relationship exists between such variables, suggesting a long-run stable relation among the variables. This indicates that any fluctuations or adjustments in one variable will exert a lasting influence on the others over time and policy implications should consider both immediate and long-term effects.

Table 6: Result of ARDL bound test

Test statistics	Value	Significant Level	I(0)	I(1)
F-statistics	16.44033	10%	2.26	3.35
K	5	5%	2.62	3.79
		2.5%	2.963	4.18
		1%	3.41	4.68
***Notes*: This table demonstrates the ARDL bound test results at 10%, 5%, 2.5% and 1% significance levels to show the long-run correlation between fertility rates and other variables such as economic growth, female employment, agricultural value added, industry value added and service value added.**				

Source: Authors' Calculation

The results from the ARDL model presented in Table 7 provide insights into both the long-run and short-run relationships between the dependent variable (LF) and the independent variables (LY, LE, LA, LI, LS). The result indicates that LY has a positive and significant impact on LF both in the short run and long run. On the other hand, LE shows no significant impact in the long run but shows a negative association with LF in the short run which is significant at a 1% level. Similar results are shown in the case of LI where Long run relation is insignificant, but short run relation is negative and significant at a 1% level. The result also indicates that an increase in LA leads to a decrease in LF both in the short run and long where the short-run result is significant at 1% level and the long-run result is significant is 10% level. On the contrary, LS positively and significantly impacts LF in the short run whereas, it negatively and significantly impacts LF in the long run.

Table 7: ARDL long-run and short-run estimation

Variables	**Long Run**			**Short Run**		
	Coff.	**T-statistics**	**P-value**	**Coff.**	**T-statistics**	**P-value**
GDP Per Capita	2.5541***	7.7198	0.0002	1.0038***	5.1726	0.0021
Female Employment	0.0177	0.0250	0.9911	-0.0639***	-7.5289	0.0003
Agriculture value	-0.8150*	0.2689	0.0790	-0.3561***	-7.7671	0.0002
Industry value	0.0049	0.4249	0.5056	-0.5142***	-6.9851	0.0004
Services value	-2.0636**	0.9762	0.0231	0.6509**	2.8118	0.0307
Constant	-	-	-	31.2099***	13.43864	0.0000
ECM(-1)	-	-	-	-0.5772***	-13.4478	0.0000

R^2	0.9857
Adjusted R^2	0.9596
Note: ***, **, * indicates the level of significance at 1%, 5%, and 10% level. This table shows the long-run and short-run relationship between the fertility rates (LF) and other variables such as economic growth (LY), female employment (LE), agricultural value added (LA), industry value added (LI) and service value added (LS).	

Source: Authors' Calculation

The results of the diagnostic tests are shown in Table 8 which confirms the reliability of the estimated model. The Jarque-Bera test indicates that the residuals are normally distributed, while the Breusch-Godfrey LM test shows no evidence of serial correlation (Hasan, Hossain, & Hasan, 2024). The Breusch-Pagan-Godfrey test suggests that there is no heteroscedasticity, confirming that the residuals have constant variance. Additionally, the Ramsey RESET test indicates that the model is correctly specified. Based on these results, the model is stable and suitable for further economic analysis (Wooldridge, 2016; Gujarati, 2002; Greene, 2003).

Table 8: Diagnostic Test of the model

Diagnostic tests	Coefficient	P-value	Decision
Jarque-Bera test	0.5381	0.7641	Normal Residual Distribution
Breusch-Godfrey LM test	1.0424	0.4896	No serial correlation exists.
Breusch-Pagan-Godfrey test	1.5429	0.3669	No heteroscedasticity exists
Ramsey RESET test	0.4811	0.5378	The model is properly specified.
Notes: This table shows the results of diagnostic testing of the model for the Jarque-Bera test to identify the normal distribution of data, the Breusch-Godfrey LM test for serial correlation, the Breusch-Pagan-Godfrey test for heteroscedasticity, and Ramsey RESET test for model specification.			

Source: Authors' Calculation

The finding suggests a positive and significant impact of economic growth on the Fertility rate which indicates that rising income levels are associated with higher fertility rates in Bangladesh. The result is consistent with the statement of Becker (1960) who posited that, in developing economies, rising income can initially increase fertility due to improved child survival and cultural preferences. However, the result is contradicted by the statement of Becker & Lewis (1973). According to them, an increase in family income often leads to a trade-off between having more children and investing more in each child's quality. The study also finds that female employment reduces the fertility rate in the short run which means that the high involvement of women in the labor market is a significant factor in reducing the fertility rate in Bangladesh. This finding is alien to the finding of(Blau & Robins, 1988; Rindfuss, Guzzo, & Morgan, 2003; D. E. Bloom et al., 2009). The result also indicates that as agriculture production increases, the fertility rate declines, perhaps because modernization reduces the traditional need for bigger families in agricultural societies (Galor & Weil, 1996).

Similarly, in the short run, industrialization is associated with a decrease in fertility rates which indicates that structural economic changes lead to a shift in preferences toward having smaller families. It may occur because as a country becomes more industrialized, there is greater access to employment opportunities for women, which delays marriage and motherhood, hence further lowering fertility rates. (Engelhardt & Prskawetz, 2004). However, in the short run, the services sector might temporarily boost income and security, slightly increasing fertility rates while in the long run, and an expansion of services leads to

lower fertility, likely due to urbanization, greater access to education, healthcare, and women's empowerment (Bloom et al., 2009).

The service-sector result also deserves attention. Services include finance, education, health, trade, transport and public administration. Many of these activities are information-intensive and can be digitally enabled. The negative long-run service coefficient may therefore be associated not only with urbanization and education but also with a changing organization of work. As services become more information-driven, demand for accounting, analytics, digital marketing, customer data and financial technology can grow. This strengthens the case for linking demographic studies with AIS and business research.

The AIS extension also changes the policy interpretation of productivity. Productivity should not be viewed only as output per worker. In digital firms, productivity also depends on the quality and timeliness of information. Poor records can produce poor decisions even when a firm has motivated employees. A reliable AIS can help managers understand whether sales growth is generating cash, whether inventory is moving efficiently, whether costs are rising faster than revenue and which products or customers generate sustainable margins.

At the same time, the paper should not overstate the benefits of digitalization. Not everyone has access to the Internet and the quality of broadband service varies, as well as digital competencies among groups. A digital accounting system may also pose cybersecurity, privacy and data-quality risks. Thus, digital transformation should be supported by training, internal control, data governance and inexpensive infrastructure. The object should be valuable digital data, not just additional software.

6.1 Digitalization and AIS as a Business Transmission Mechanism

The new contribution starts with an indispensable empirical limit. The original ARDL findings are relationships between fertility, income, female employment and sectoral structure. They don't value the impacts of digitalisation or AIS. But there are signs of a digitally connected economic environment in Bangladesh. According to World Bank data[2], 53% of the population is internet users in 2024. A significant platform for digital business activity, but at the same time, almost half of the population did not use the Internet based on that indicator. Digital transformation is thus a productivity opportunity as well as an inclusion challenge.

Bangladesh Bank[3]'s statistical system now covers a wide variety of digital financial activities including internet banking, mobile financial services, cards, e-commerce transactions and QR-code transactions and agent banking. Licensed payment service providers and payment system operators (PSO), as well as licensed mobile financial service providers (MFSPs), also contribute to the growth of digital payments, as observed in the central bank's Financial Stability Report 2024. This institutional structure is important to AIS as it has the potential to convert any formal digital transaction into a structured financial record. When linked with accounting software, transaction information can be utilized for reconciliation, cash-flow forecasting, sales analysis and internal control.

The business pathway can be summarized as follows: Demographic change impacts labour supply and household demand; the change of female employment induces changes in the types and skills of workers available for the economy; Structural change pushes firms into

[2]World Bank. (2024). *Bangladesh digital finance and digital connectivity indicators*.
[3]Bangladesh Bank. (2026). *National payment data archive and financial activity statistics*.

more complex services and industrial activities; Digitalization leads to an increase in the amount and speed of electronically recorded transactions; AIS transforms transactions into financial and managerial data; and better information can result in better operational decisions. The end results can include increased productivity, increased cost control, increased profitability, inventory control, and informed entrepreneurship. The pathway is particularly important for SMEs. Small businesses are likely to have small management teams and poorly kept records. A cloud or mobile accounting system can integrate sales data, expenses, inventory and payment information and is inexpensive. The value isn't just a quickened bookkeeping procedure. The information can be used to determine profitable products, overdue receivables, cash shortages, and seasonal demand and abnormal expenses for an owner. Digital accounting can also help women-owned businesses keep better track of their business records, especially since they could manage their work from different locations and time periods.

Bangladesh specific empirical evidence was supported by the AIS-business link. Few study revealed high positive correlation between accounting knowledge and record keeping performance and organizational performance. More recent studies on technology-based accounting systems in Bangladesh find that it has a positive impact on workforce performance efficiency, operational efficiency, which is mediated by workforce efficiency and moderated by digital competency. In sum, these studies point to the need for technology plus. The business value relies on people's capacity to apply information and how willing management is to take action based on the information.

This is an important link with female labour force participation and fertility. Women's employment opportunities may expand if there is a greater demand for skilled administrative/ accounting, financing and analytical tasks because of the increasing digitization of accounting and business systems. With greater flexibility in work, some women may also find it easier to balance with their families. Meanwhile, rising employment opportunity can boost the opportunity costs of childbearing. The demographic and business impacts could thus be complementary, but the impact in each direction and its magnitude would need more basic firm-level evidence.

6.2 Digitalization and Accounting Information Systems as an Extended Business Mechanism

Digitalisation should be considered as a connection between macroeconomic transformation and performance at the firm level. Bangladeshi businesses are moving towards a more service-oriented economy and as more women enter the workforce, there is a growing need for information to be delivered on time. In a traditional environment, it can be challenging to consolidate transactions, track performance and give real-time information, using manual accounting. Digital accounting and AIS can minimize the limitations by systematically recording transactions and generating reports for managers. For instance, a small retailer can use a digital point-of-sale system to track customer transactions, inventory and sales. An enterprise can integrate payroll with employee records and accounting. Production, purchasing, inventory, and cost information can be integrated into a system used by a manufacturer. Billing, customer information, and financial reporting can be integrated into a service organization. In all, digitalization can lead to structured information that can aid in managerial decisions.

The connection to fertility transition is indirect but meaningful. As women become more involved in remunerative work, businesses must have efficient employment relations systems.

Digital payroll, attendance and benefits systems can cut down on administrative tasks. Some occupations may be more flexible when it comes to digital communication and collaboration tools. Though these technologies do not solve the problem of childcare or separation of work and family, they can lessen some organizational obstacles. Entrepreneurship can also be included in AIS. The lack of book keeping of revenues and expenses and inventory and cash flow monitoring is a common problem among new entrepreneurs. Digital accounting systems offer some level of financial visibility and enhance quality of information for business owners. Good records can also make the entrepreneur better able to prepare budgets, determine profitability and contact financial institutions. Hence, AIS can be viewed as an enabler infrastructure for formalization and growth of businesses.

But, digital adoption can also present problems. Benefits can be mitigated by software costs, training needs, cyber security concerns, connectivity issues and lack of organizational adoption or data governance. Thus, the impact of digitalization is dependent on the level of readiness of the organization. The human capital, in particular, is important. Staff needs to know how to use software as well as how to understand and apply the information for decisions. This can result in a great research opportunity in the areas of demographic economics and AIS. Future research could investigate if firms with more female employment are more likely to implement digital accounting system, if the implementation of digital accounting system contributes to productivity and if the digital financial information has a positive influence on female owned enterprises. These questions would expand the current macro level research to a micro level research of Business and commerce.

6.3 Implications for Business Performance, Productivity and Entrepreneurship

The findings on female employment are particularly relevant to business organizations. From a business perspective, greater female participation changes the composition of the available workforce and increases the importance of organizational systems that reduce administrative burden and support flexible, information-intensive work. Digital payroll, attendance, accounting, procurement, sales, inventory and customer-management systems can help firms coordinate a more diverse workforce. Such systems may also support women entrepreneurs by reducing transaction and record-keeping costs.

The business relevance becomes stronger when structural change is considered. Agriculture, industry and services do not use information in the same way. Agricultural households traditionally rely more on production and household labor, whereas industrial and service businesses require increasingly formal records, financial controls, supply-chain information, customer data and performance indicators. Therefore, the transition identified in the original model can be interpreted as a transition in the information requirements of the economy. AIS becomes an important organizational infrastructure for converting business transactions into usable information for planning, control, budgeting, and taxation, investment and performance evaluation. Recent Bangladesh-focused research also reports that human capital, infrastructure and technology, strategic innovativeness and resistance to change influence SME digitalization. This supports the argument that digital transformation is not only a technology issue. It also depends on employee skills, managerial capability and organizational readiness. Thus, female employment, human capital and AIS can be studied jointly in future research as part of the wider business transformation process.

7. Integrated Conceptual Framework

The integrated framework of this paper proposes four connected stages. Stage one is demographic change. Fertility transition changes household size, dependency patterns and the

future composition of the labour force. Stage two is workforce and structural transformation. Female employment, education and the movement from agriculture toward industry and services alter the skills and time allocation of workers. Stage three is digital business transformation. Internet access, digital payments, cloud systems, e-commerce and mobile technologies change how businesses transact and store information. Stage four is organizational performance. AIS transforms transaction data into reports that support budgeting, control, productivity improvement, profitability analysis and entrepreneurial decisions.

Pathway	Expected business implication
Fertility transition → human capital	Potentially higher investment per child and future skill quality
Female employment → workforce transformation	Higher female labour supply, skills and household income
Structural change → formalization	Greater need for accounting, compliance and managerial information
Digitalization → AIS integration	Faster and more traceable transaction information
AIS → decision quality	Improved budgeting, costing, cash-flow and performance monitoring
AIS + digital skills → productivity	Less manual work and better allocation of resources

8. Recommendations

a. Bangladesh should develop women-centered digital business skills programs that combine accounting, cloud accounting, digital payments, e-commerce, cybersecurity and basic data analytics to improve women's employment and entrepreneurial opportunities.
b. Bangladesh should develop a national demographic and business data framework linking fertility, female employment, digital adoption, enterprise performance, entrepreneurship and sectoral employment.
c. Firms should introduce family-friendly employment policies, including flexible working arrangements, childcare support and predictable working hours, to improve women's workforce participation and retention.
d. Affordable Accounting Information Systems should be promoted among SMEs through low-cost solutions that integrate accounting, VAT, taxation, payroll, inventory and mobile-payment functions.
e. Digital payment platforms should be better integrated with accounting systems to reduce manual bookkeeping and improve transaction recording, reconciliation, financial transparency and cash-flow management.
f. Businesses should strengthen workforce analytics by integrating AIS and human-resource information to monitor recruitment, retention, payroll costs, training, absenteeism and productivity.
g. Digital accounting records should be used to improve access to finance for SMEs by providing reliable business information for credit assessment while ensuring privacy and cyber security.
h. Government agencies and business-support organizations should provide integrated training for women entrepreneurs covering accounting, taxation, digital marketing, e-commerce, payment systems and financial planning.
i. Greater attention should be given to data quality and cybersecurity through access controls, authentication, regular backups, audit trails and employee training.

j. Firms should increasingly integrate financial, workforce, sales, inventory and operational information through AIS to improve productivity, planning and evidence-based decision-making.
k. Future research should develop firm-level and panel datasets to examine whether digitalization and AIS mediate or moderate the relationships among female employment, productivity, business performance and entrepreneurship.
l. Further research should examine whether digital employment and flexible work arrangements reduce the family-work trade-off for women or, alternatively, increase work intensity and employment insecurity.

9. Conclusion

This study examined Bangladesh's fertility transition and the roles of economic growth, structural transformation and female employment during 1990 to 2025. The ARDL analysis identifies a stable long-run relationship among the variables. GDP per capita is positively associated with fertility in both the short and long run, while female employment is negative and significant in the short run but insignificant in the long run. Agricultural value added is negative in both periods, industrial value added is negative in the short run but insignificant in the long run, and services value added are positive in the short run and negative in the long run. The broader contribution is to connect these demographic findings with Business, Commerce and AIS. Fertility transition affects the future workforce and household economic organization, while female employment expands the economically active workforce. Structural transformation also increases the importance of information-intensive industries and services, creating greater demand for reliable business information and efficient systems. Digitalization and AIS can provide a practical bridge between demographic transformation and firm-level performance. However, these variables were not estimated in the current ARDL model and should therefore be treated as potential transmission mechanisms for future research.

10. References

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