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IMPACT OF DIGITALIZATION, ECONOMIC GROWTH AND BIRTH RATE ON FEMALE LABOR FORCE: EVIDENCE FROM KAZAKHSTAN

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ABSTRACT

The purpose of the research work is to determine impact of the economic growth, digitization indicators and birth rate on female labor force in the Kazakhstan. For this purpose, Autoregressive Distributed Lag (ARDL) method was used. Data were obtained from the WDI website for period 1994–2022. Individuals using internet, Mobile cellular subscriptions (MCS), ICT service exports were taken as indicators of digitalization, and GDP growth was taken as indicator of economic growth. As a result of ARDL model, Internet users are negatively linked to the female labor force both in the short and in the long term. Mobile cellular subscriptions have a positive influence on the female labor force only in the short term, and however, showed its insignificance in the long term. ICT service export and GDP growth has a positive effect on the female labor force both in the short term and in the long term. Fertility rate has a positive effect on female labor force in the short and long term. Research work includes review of world literature and, based on this, an econometric model for Kazakhstan was created, and further presents proposals on how women's employment can increase economic growth in Kazakhstan, also a comprehensive literature review and updated econometric model were developed. This research work carried can be used by other researchers for their regions of interest, and further recommendations can be considered in their case study.

Keywords: *female employment, economic growth, birth rate, digitalization, ARDL*

1. INTRODUCTION

Gender equality implies that people have equal rights in all areas regardless of gender in the labor market, the issue of gender equality also makes an impact, as women earn less than their male colleagues (Jayachandran, 2021). In the global context, women find work harder than men (ILO, 2022; Asongu and Odhiambo, 2018; Adaçay and Yildiz, 2023). Despite these barriers, worldwide employment among women is increasing (Esteban, 2024) women's participation in the labor market in many countries differs substantially from country to country, reflecting differences in economic growth, social norms, education levels, fertility rates, and access to childcare and other supportive services (Verick, 2018). Considering the higher the degree of development of the country, the higher the employment rate of women, we can conclude that the existence of opportunities for women to work in countries with high economic development

and growth is high. In such countries, the relatively high quality of life, access to education, and the development of technologies open the way to various forms of employment.

In Kazakhstan, for 2023, the labor force participation rate among females is 63.2% and among males is 74.5% (ILO, 2024). The Kazakh family regime in many ways resembles the regime common under socialism (Saraceno and Keck, 2010) and Kazakhstan has a leading position in gender equality in Central Asia (Meurs and et.al., 2021; Global Gender Gap Index, 2024). Also, Kazakhstan, one of the first Central Asian countries, established a national entity to promote gender equality. And gender equality and women's rights are protected at the Constitutional level (UN Women, 2024). When a child is born, a woman can sit on maternity leave for up to three years. Since in many ways, the Kazakh people adhere to traditional views, a woman has always been considered the "keeper of the hearth". After marriage, she can choose not to work, and after giving birth, a woman herself chooses how many years to sit on maternity leave. In many ways, a woman goes to work if there is a financial shortage in the family. However, despite this, there is an unequal distribution of wages in Kazakhstan between women and men (Kredina and et.al., 2023). With the advent of digitalization and new technologies, women have begun to combine motherhood with work (Mastilo et al., 2024). The growth of digitization has opened the door for distance learning and remote work. However, its impact is highly polarized between developed and developing countries. This was particularly evident during the pandemic (Jahan and Zhou, 2024). In countries with good labor protection, remote work offers better employment opportunities for women with children. In modern society, the concept of a "working mother" has become the norm. It is important to note that, not only will women's employment enhance the quality of life, but they will also be in a position to make decisions as an independent full-fledged consumer, and it is also important factor for economic growth. Furthermore, the conditions of maternity leave provided for by the legislation also contribute to women's desire to plan childbirth (Zhang, 2024). Choosing between career and motherhood is not unusual among women. Remote working enables women to work remotely and without full maternity leave.

For the development of society, it is essential that its citizens work, including women, to have equal opportunity, especially non-discrimination in wages (Shuangshuang and et al., 2023). Furthermore, another important role of women in every society is that of a mother. It can be quite difficult for a woman to choose between work and having a child. The choice of the first option ultimately leads to an exacerbation of the demographic problem in the country. Therefore, our view is that the development of digitalization affords women a more equal opportunity to balance these two choices. The authors aim to determine the impact of economic growth, digitalization and fertility on female employment. The article consists of the introduction, literature review, methodology and date, results and conclusion.

2. LITERATURE REVIEW

2. 1. DIGITALIZATION AND FEMALE EMPLOYMENT

Positive trends such as the process of globalization and the development of technologies (Vlasenko, 2023), access to education, open new opportunities for female employment. The increasing level of digitalization allows women to work remotely from home or other convenient places, thereby increasing employment among women. The digital tools have essentially entered almost every sphere of the economy today, it is impossible to imagine any work without them (ILO, 2021). Digital technologies have opened new opportunities especially for women in developing countries (Rani and et al., 2022; Bustelo and et al., 2019; Khairunnisa et al., 2024) state that the skills in the fields of information and communication technologies (ICT) and science, technology, engineering and mathematics (STEM) yield significant positive returns for both men and women, but the male-dominated STEM returns are markedly favored by a significant gender gap. Almost half of young women studying look at the flexibility of their work schedule, not at the location and type of job (James, 2022). Jiang and et al. (2022) also found that more than one-third of women seeking work prefer the remote format to tradi-

tional employment. According to Chen et al. (2024), women's employment choices are, in fact, a trade-off between work, family and leisure. Having studied national employment platform, Mubarakov and et.al (2024) study results showed that online learning and skills development has a significant impact on gender equality. Genz and Schnabel (2023) examined new individual-level data for Germany and found that digitalization is not gender-neutral and that the introduction of digital technology in companies has a stronger impact on women in terms of shorter working days. According to authors, gender bias in technological progress is an important issue. Sturdy results of Ganeshan and Vethirajan (2021) are in line with those, and author showed that the trend toward more women entering the labor force is driven by flexible work, timings, and the internet-enabled work from home Ye and Cai (2024). Also, Xiao et al. (2022) and Lu and et al. (2023) findings prove that the probability of employment for women in the household is significantly increased by digital transformation. Yuanchen and et al. (2024) found that the digitalization effect is stronger in countries with fewer childcare resources, highlighting the potential of digitalization to alleviate the burden of childcare responsibilities for women and promote their participation in the labor market. Having studied these scientific works, the authors propose to test the following hypothesis:

H_0: Digitalization has a positive impact on women's employment in Kazakhstan.

2. 2. GDP AND FEMALE EMPLOYMENT

There are numerous works on this aspect that focus on the role of women in the development of the economy (Heckman, 1978; Hirway and Jose, 2011; Altuzarra et al., 2021). Mammen and Paxson (2000), Sanjucta (2010), Khalid and Zafar (2012) studied nexus between female labour force and economic growth and their results were in line with Goldin (1994). He found that the supply of women's labor and economic growth has a U-shaped relationship with the development of a country. As the development of a country is as follows women become more educated and have opportunities to diversify their activities (Sabree and Mustafa, 2023; Huseyn and Abasova, 2024). In developed countries, as Rodgers (2010) pointed out, the majority of women's work is in non-market activities – in the home or the informal sector. Altuzarra and et al. (2019) pointed out that the increase of female labor force is mainly due to the increase in education and the increasing diversity of economic activities. The nexus between female labor force and economic growth in 162 world countries over the period 1990–2012 was identified by Lechman and Kaur (2015). Although the high cross-country variability on the field is reported, the main findings support the hypothesis on U-shaped relationship between female labor force participation and economic growth. Furthermore, the U-shaped feminization hypothesis was not positively verified only in case of low-income countries. Studying this relationship in Southeast Asia countries for 1992 to 2020 years, Sulaiman and et al. (2023) observed positive long-term effects of female labor participation, female longevity, female education, domestic investment and foreign direct investment on economic growth. Verick (2018) found that women participate in the labor force in developing countries due to poverty and as a coping mechanism in response to shocks, in this regard it is important to educate young girls and ensure their proper educational status beyond secondary level, and opportunities for the benefit of training.

According to above-cited, following hypothesis will be tested:

H_1: Economic growth has positive effect on women's employment in Kazakhstan

2. 3. FEMALE EMPLOYMENT AND FERTILITY

The relationship between female employment and fertility has become a historically relevant topic, and it has been studied by many authors around the world (Stycos and Weller, 1967;

Cramer, 1980; Smith-Lovin and Tickamyer, 1981; Van den Broeck and Maertens, 2015; Esencan and et al., 2021; Shen and et al., 2022). In many cultures, the role of women as mothers is special and women's education plays an important role in raising future generations. In addition to economic development, the economic role of women in society has also increased in importance. Both parental care and financial resources are vital for a child's cognitive development (Agostinelli and Sorrenti, 2018). For these two things to be equal, the completeness of the family and its working are of major importance. Brewster and Rindfuss (2000) studied relationship between women labor participation and fertility rate in 21 developed countries and found that the countries with the lowest fertility levels are those with relatively low levels of female labor force participation and that countries with higher fertility levels tend to have relatively high labor force participation rates. This comparative analysis argues that in some countries women have found the way to combine work and child-rearing, while in others they have not. Thus, when explicating the relationship between fertility and female employment, the social, economic, and political contexts in which women make decisions about their work and fertility must be considered. Using the hierarchical Bayesian model, Hilgeman and Butts (2009) attempted to answer in family countries of Southern and Eastern Europe the birth rate is so low. The relationship between individual attributes, aggregate female labor force participation, child care enrollment, family leave, and individual fertility in 20 developed countries was examined by authors. Results show that full-time female employment and country-level employment reduce expected fertility, but the positive association between child care services and fertility suggests that child care services may partially mitigate the decline in fertility. In USA, increases in female employment and falling fertility rates have often been associated with rising female wages. However, the long-term birth rate is relatively stable. Christian (2012) model revealed that the secular increase in male household production and the decline in time spent by women at home were more than twice as pronounced. The author considers that the increase in male household production and marketization are key reasons for not reversing the fertility rate further. Fluchtmann and et al. (2023) observed 26 OECD countries to investigate a causal relationship between labor market outcomes and family policy with fertility trends for 2002–2019. The results indicated that employment of both partners, complex state systems of support for families, the tax system, rising housing costs are critical factors when deciding to have (another) child. Choi and et al. (2024) examined the relationship between female employment and fertility in Korea. They identified the differences in the utilization rates of homecare allowances, childcare support payments, parental leave and reduced working hours depending on income level, employment conditions, size of company and the age of the child in the research. The authors argue that in Korean society, the dynamic between women's employment and childbirth forces women to choose one of the two. The authors argue that a deeper understanding of the unintended effects of stratification will help identify policy combinations that support family functioning and the self-fulfillment of both partners, as parents and as workers.

According to above-cited, the following hypothesis will be tested:

H_2: in short run birth rate has negative impact on female employment, in long term female employment rate and birth rate has positive correlation in Kazakhstan.

3. METHODOLOGY

3. 1. DATA

This study analyzes the impact of digitalization factors and economic growth and fertility rate on Female Labor Force (FLF) in the Republic of Kazakhstan. The study consists of data from 1994 to 2022, which were obtained from the World Data Institute (WDI), ourworldindata.org.

In this study, individual internet usage, Mobile cellular subscriptions, ICT service exports, GDP growth, Fertility rate are the explanatory variables.

The definitions and measurements of all indicators are given in Table 1 below.

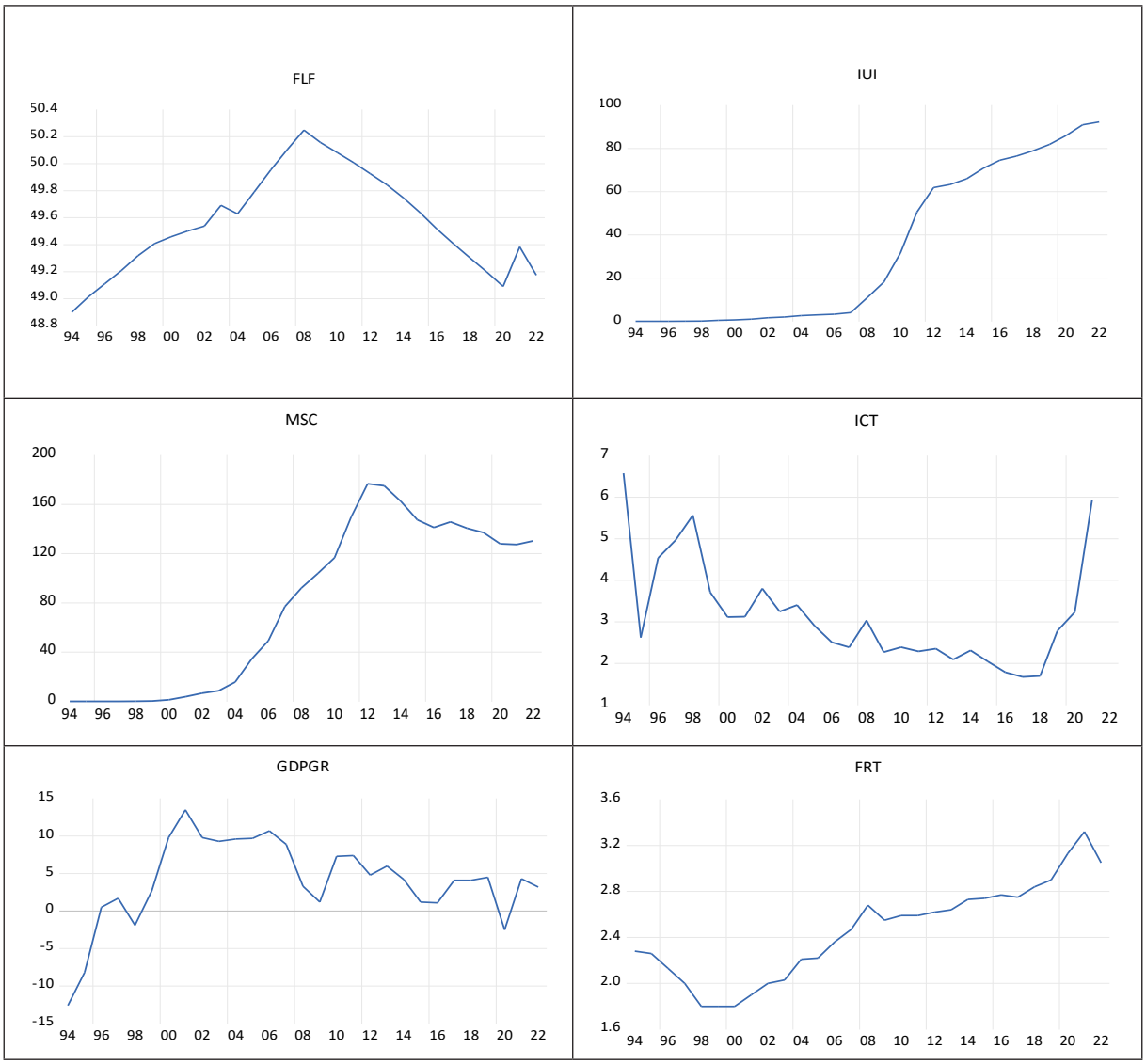
Table 1. Model Variables and sources

Variables	Definitions	Sources
FLF	Female labor force (% of total labor force)	World Development Indicators (WDI)
IUI	Individuals using internet	World Development Indicators (WDI)
MCS	Mobile cellular subscriptions (per 100 people)	World Development Indicators (WDI)
ICT	ICT service exports (% of service exports, BoP)	World Development Indicators (WDI)
GDPgr	GDP growth (annual %)	World Development Indicators (WDI)
FRT	Fertility rate, total (births per woman)	World Development Indicators (WDI)

Source: compiled by authors

The dynamic change of all indicators presented in the table in the period 1994–2022 is depicted in the following graph:

Figure 1. Evolution of all variables for Kazakhstan (1994–2022)



Source: compiled by authors

As you can see in Figure 1, Female labor force (% of total labor force) increased steadily from 1994 to 2008. Later, in 2020, it will decline. The number of individuals using the internet grew steadily from 1994 to 2008, and then began to increase rapidly. The volume of ICT service exports decreased from 1996 to 2018, and then experienced a sharp increase. Changes in the graph can be attributed to the impact of the global financial crisis that began in 2008. Fertility rate in 2018 also started to rise. The sharp change in the variables in the graph in 2020 can be explained by the sharp decrease in production and the increase in prices caused by the COVID-19 pandemic. After the crisis, thanks to the implementation of effective measures to successfully overcome and restore the market situation in the Republic of Kazakhstan, Mobile cellular subscriptions, Individuals using internet, ICT service exports increased. This can be attributed to remote work in many areas. Female labor force decreased slightly from 49.38 to 49.17%, and Fertility rate decreased slightly from 3.32 to 3.05.

It is clear from the analysis of the graph presented in Figure 1, that the variables under study are suitable for analysis. The graph shows clear, consistent and stable time patterns indicating changes in the variables suitable for further study.

3. 2. METHODS

Based on the results of the literature review discussed in the previous section, we examine the relationship between female labor force (FLF) and explanatory factors in the Republic of Kazakhstan in the period 1994–2022. In this case, the FLF is determined as follows:

$$FLF = f\,(IUI,\ MCS,\ ICT,\ GDPgr,\ FRT) \qquad (1)$$

where all of their definitions and measurements are given in the Table 1 below.

In the course of the study, based on the results of the ADF test, it was established that the studied variables are stationary at the level of I (0) or first differences I (1) (Table 4), only in the case of 1st difference without Intercept and trend. Therefore, the ARDL methodology is used, the order of integration of variables is considered to determine the suitability of the ARDL model for the study, and a maximum of one lag is selected by a special test (Table 6).

The linear ARDL model was estimated using first difference, respectively, and long-run and short-run analyses of the relationship between the variables were conducted. All independent variables were not confirmed to be causally related to changes in the dependent variable according to the ARDL linear model. Based on the results of the Granger causality test using the first difference (Table 5), a linear ARDL model was estimated and a long-run and short-run analysis of the relationship between the variables was performed.

In a linear autoregressive distributed lag ARDL model, the procedure determines the presence of cointegration between sample variables. The bounds test focuses on the long-term relationships, and the results of the bounds test are presented in Table 7.

Thus, the ARDL structure of Model 1 is expressed in Equation 2:

$$\Delta FLFt = \beta_0 + \sum_{k=1}^{m} \beta_1 \Delta FLF_{t-k} + \sum_{k=0}^{n} \beta_2 \Delta IUI_{t-k} + \sum_{k=0}^{p} \beta_3 \Delta MCS_{t-k} +$$

$$\sum_{k=0}^{q} \beta_4 \Delta ICT_{t-k} + \sum_{k=0}^{s} \beta_5 \Delta GDPgr_{t-k} + \sum_{k=0}^{t} \beta_6 \Delta FRT_{t-k} +$$

$$\gamma_1 IUI_{t-1} + \gamma_2 MCS_{t-1} + \gamma_3 ICT_{t-1} ++ \gamma_4 GDP_{t-1} + \gamma_1 FRT_{t-1} + \varepsilon_1 \qquad (2)$$

where, operator **Δ** represents the differencing operation.

4. EMPIRICAL RESULTS AND DISCUSSION

4. 1. DESCRIPTIVE STATISTICS

This study used descriptive statistics, correlation matrix, and ARDL model to test the hypothesis. Descriptive statistics provide insight into various aspects of a data set. The descriptive statistics results presented in Table 2 show pooled mean (spread) such as mean and median, as well as measure of spread and variation (standard deviation minimum, maximum, skewness, and Jarque-Bera statistic) for each variable used in our model.

Table 2. Values of descriptive statistics of the displayed series

Values	FLF	IUI	MCS	ICT	GDPgr	FRT
Mean	49.57760	31.46633	76.50087	3.156613	4.089286	2.432500
Median	49.52727	7.510000	84.52378	2.845028	4.250000	2.510000
Maximum	50.24881	90.92400	176.7856	6.578210	13.50000	3.320000
Minimum	48.89931	0.000521	0.002388	1.672948	-12.60000	1.800000
Std. Dev.	0.370504	35.24456	67.72493	1.288478	5.744262	0.409386
Skewness	0.081894	0.475545	0.041951	1.221565	-0.989987	0.098835
Kurtosis	2.047454	1.445429	1.312381	3.684801	4.208184	2.258529
Jarque-Bera	1.089865	3.874807	3.330948	7.510810	6.276673	0.686994
Probability	0.579881	0.144078	0.189101	0.023391	0.043355	0.709285
Sum	1388.173	881.0572	2142.024	88.38517	114.5000	68.11000
Sum Sq. Dev.	3.706373	33538.83	123840.0	44.82473	890.9068	4.525125
Observations	28	28	28	28	28	28

Source: Author` s calculation

In the descriptive statistics, the mean value of the FLF indicator is 49.57760%, the median value is 49.52727%, and the standard deviation is 0.370504, which indicates relatively stable values. The Jarque-Bera statistic value is 1.089865, the probability of association is 0.579881, which is greater than 0.05, so we can conclude that the series is evenly distributed. The median of IUI is 31.46633 and the standard deviation is 35.24456. The standard deviation for all other indicators is also greater than 0.10. The Jarque-Bera statistic of 1.089865 approaches the probability of 0.579881, which means that the hypothesis of a null normal distribution of FLF is supported at the 5% level of significance. In Table 2, we see that for all indicators except GDPgr, the skewness coefficient of the time series is greater than zero, that is, they are right-skewed. The kurtosis value for all indicators shows that the distribution is almost normal, without excessive kurtosis. Deviations from the average level of IUI and MCS are 35.24456 and 67.72493, respectively. This maximum deviation from the average is an indicator of macroeconomic instability in the country and is increasing, which affects economic activity. Over the study period, the Fertility rate in Kazakhstan ranges from 1.800 to 3.32 with average values of 2.432 and standard deviation of 0.409386, respectively.

4. 2. CORRELATION MATRIX

Table 3 consists of several significant relationships between variables including pairwise correlation analysis. It depicts the Pearson correlation between each pair of all variables in a given study.

Table 3. Correlation Matrix

	FLF	IUI	MCS	ICT	GDPGR	FRT
FLF	1.0000	-0.0465	0.3628	-0.5099	0.5692	0.1199
IUI	-0.0465	1.0000	0.8876	-0.3603	-0.0834	0.8734
MCS	0.3628	0.8876	1.0000	-0.5700	0.0447	0.8507
ICT	-0.5099	-0.3603	-0.5700	1.0000	-0.3885	-0.3014
GDPGR	0.5692	-0.0834	0.0447	-0.3885	1.0000	-0.1498
FRT	0.1199	0.8734	0.8507	-0.3014	-0.1498	1.0000

Source: Author` s calculation

Correlation results showed that two digital economy variables IUI (-0.0465) and ICT exports (-0.5099) have negative relationship with Kazakh FLF, while the rest of the explanatory variables have positive relationship. The correlations of all series variables do not exceed 0.9. Overall, the correlation analysis provides preliminary evidence of the relationship between the indicators. These results indicate that the data are suitable for time series analysis and can be used to study the relationship between independent variables and Female Labor Force (FLF) in Kazakhstan.

4. 3. UNIT ROOT TEST

In order to consider long-term relationships between variables, it is necessary to determine whether they are stationary. In order to test levels or differences of time series variables for stationarity, the augmented Dickey-Fuller (ADF) unit root tests were performed. At I(0), some variables may be used, while other variables should be stationary at first difference I(1). ADF test describes four possible ways (with intercept, intercept, without trend and intercept). As shown in Table 4, the ADF results show that many of the study series are not stationary at Level. But only in the case of first difference without Intercept and trend, the variables are stationary. Therefore, the ARDL cointegration technique is the best way to estimate or test the long-run relationship between research variables.

Table 4. ADF unit root tests

Vari-ables	Intercept			Trend and intercept			None		
	Level	First diff.	Order of Integra-tion	Level	First diff.	Order of Integra-tion	Level	First diff.	Order of Integra-tion
FLF	-1.933 (0.313)	-1.810 (0.368)	>I(1)	-1.001 (0.928)	-4.795*** (0.004)	I(1)	-0.4048 (0.7936)	-1.867* (0.060)	I(1)
IUI	-0.172 (0.931)	-2.639* (0.098)	I(1)	-2.654 (0.262)	-2.599 (0.284)	>I(1)	0.630 (0.846)	-2.001** (0.045)	I(1)
MCS	-1.383 (0.576)	-2.176 (0.219)	>I(1)	-2.119 (0.513)	-2.204 (0.468)	>I(1)	-0.258 (0.584)	-2.004** (0.045)	I(1)
ICT	-3.241** (0.028)	-1.884 (0.334)	I(0)	2.062 (1.000)	-2.330 (0.404)	>I(1)	-1.114 (0.234)	-1.961** (0.049)	I(1)
GDPgr	-3.588** (0.013)	-5.28*** (0.0002)	I(0)	-3.603** (0.048)	-5.590*** (0.0006)	I(0)	-2.099** (0.037)	-5.395*** (0.000)	I(0)
FRT	-0.093 (0.941)	-3.599** (0.013)	I(1)	-2.968 (0.158)	-3.530* (0.056)	I(1)	1.185 (0.935)	-3.528** (0.001)	I(1)

Notes:1) *, **, *** denote statistically significant at the 10%, 5% and 1% levels, respectively p-value is inside brackets

Source: Author` s calculation

The unit root results are consistent with the main assumptions that require the use of the ARDL model test to confirm the existence of long-run relationships between the Kazakh FLF and the significant explanatory factors proposed in the study.

4. 4. GRANGER CAUSALITY TEST

To enhance the rigor of the robustness check, pairwise Granger causality analysis was also used to determine the causal relationships between the variables in this study as shown in Table 5.

For the study of the causal relationship between selected variables and the level of FLF, the Granger test is used to test the null hypothesis that changes in the dependent variable are not causal (Noncausality).

Table 5. Noncausality tests in the sense of Granger for the vector autoregressive (1) (1994-2022)

Direction of causality	F-statistic	Prob.
ΔFLF		
ΔIUI does not Granger Cause ΔFLF	1.32157	0.2880
ΔMCS does not Granger Cause ΔFLF	0.37628	0.6909
ΔICT does not Granger Cause ΔFLF	0.52991	0.5967
ΔGDPgr does not Granger Cause ΔFLF	2.94131	0.1748

Source: Authors' analysis results

The study revealed a causal relationship of ΔIUI, ΔMCS, ΔICT, ΔGDPgr, and ΔFRT to ΔFLF.

4. 5. CO-INTEGRATION TEST

The ARDL bounds testing procedure is used in this study to examine the long-term relationship between FLF, IUI, MCS, ICT, GDPgr, and FRT in the Republic of Kazakhstan. To investigate the long-term association of variables with, the ARDL method was chosen using a small sample size. Before the cointegration test can be conducted, it is important to determine the lag length criterion. The lag length criterion is determined based on LR, FPE, AIC, SC, and HQ. Table 6 presents the results of the selected lag. As can be seen in Table 6, the chosen lag length is 1 because it has more stars and was used throughout the study.

Table 6. Selection order criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-346.3937	NA	377409.2	27.03028	27.27222	27.09995
1	-207.5981	213.5316*	62.16035*	18.27678*	19.72843*	18.69480*
2	-169.4738	43.98952	28.82961	17.26722	19.92858	18.03359

Source: Authors' analysis results

4. 6. RESULTS OF LONG- AND SHORT RUN RELATIONSHIP

In the study, the linear ARDL model (Equation 2) was estimated using the first difference of the ADF test results, and to conduct a long-run and short-run analysis of the relationship between the variables, the results are presented in the following table.

The results of the cointegration F-test for ARDL (Table 7) show that the obtained F-statistic 6.099844 exceeds the upper limit of 4.21 and is statistically significant at the 10 and 5 percent significance levels. The results indicate that the selected variables are cointegrated and in the case of Kazakhstan, there is a long-run relationship between them.

Table 7. Results of cointegration test

Model	F Statistics	Critical Bounds	Decision
ARDL	6.099844	2.93-4.21	Cointegration
Critical bounds are reported at 1% (***) and 10% (**) level of significance			

Source: Authors' analysis results

As long as the selected variables are cointegrated in the long run, we proceed to the next step, which requires estimating the long-run and short-run coefficients. Given that the ARDL model was estimated using first differences, we can estimate how a 1-unit change in the explanatory variables influences the dependent variable in both the long and short run.

Table 8. ARDL estimation FLF (1994-2022)

Dependent Variable: Δ FLF				
Variable	Coefficient	Std.Error	t-Statistic	Prob.
Short Run				
FLF(-1)*	-0.018479***	0.005679	-3.254119	0.0058
FRT**	0.208618*	0.118365	1.762492	0.0998
GDPgr **	0.008354*	0.004481	1.864158	0.0834
ICT(-1)	0.137687***	0.033127	4.156317	0.0010
IUI(-1)	-0.003211	0.001836	-1.749483	0.1021
MCS(-1)	0.001404	0.000946	1.484547	0.1598
ΔFLF(-1)	-0.310144	0.284957	-1.088388	0.2948
ΔICT	0.058945**	0.022400	2.631527	0.0197
ΔICT(-1)	-0.025049	0.017799	-1.407360	0.1811
ΔIUI	-0.011340*	0.005505	-2.059971	0.0585
ΔIUI(-1)	-0.009273	0.006617	-1.401466	0.1829
ΔMCS	0.005370**	0.002366	2.269139	0.0396
Long Run				
FRT	11.28971**	3.941529	2.864299	0.0125
GDPgr	0.452088*	0.236052	1.915205	0.0761
ICT	7.451158***	1.904697	3.911992	0.0016
IUI	-0.173781*	0.087132	-1.994447	0.0660
MCS	0.075990	0.055824	1.361241	0.1949
1) coefficients are statistically significant at ***1%, **5%, *10% level of significance				

Source: Author` s calculation

In Kazakhstan, in the long run, Individuals using internet is negatively correlated with Female labor force with a coefficient of 0.173781, ceteris paribus. The results indicate that GDPgr is positively correlated with FLF with a coefficient of 11.28971, all other things being equal. ICT service exports and Fertility rate, total also have a positive effect on Female labor force in the long run with the corresponding coefficients of 7.451158 and 11.28971.

The obtained empirical data (8 table) indicate that in Kazakhstan in the short term the number of Individuals using internet (ΔIUI) negatively and significantly correlates with Female labor force also in the short term with a coefficient of -0.011340. It is noteworthy that the growth of Mobile cellular subscriptions and ICT service exports have a positive effect on Labor force in the short term, with the corresponding coefficients of 0.005370 and 0.058945. It is noteworthy that GDP growth (0.008354) and Fertility rate (0.208618) have a positive correlation in the short term.

Moreover, the negative effect of the lag variable Fertility rate FLF(-1) in the period t-1 on the labor force level in the short term (0.018479) was confirmed, while the positive (0.137687) dependence of the ICT(-1) ICT service exports indicator was confirmed. And the growth of Internet users with a coefficient of 0.0093 is negatively associated with the level of female labor force.

4. 7. DIAGNOSTIC TESTS

Diagnostic Tests are very important to ensure the stability of the non-linear ARDL model. Among them are serial correlation, normality and heteroscedasticity tests. The null hypothesis of no serial correlation, homoscedasticity or normality cannot be rejected for this model. This indicates that the model is free from serial correlation and heteroskedasticity.

Table 9 shows the results of diagnostic studies. LM statistic is 0.359385, probability value is 0.7060. As a result, we accept the null hypothesis in this analysis and conclude that there is no serial correlation in the model. Heteroscedasticity tests revealed an F-statistic of 0.695581 and a probability of 0.7304, both exceeding the 0.05% significance level, indicating that the model was homoscedastic. The model accepts the null hypothesis of the normality test and concludes that the residuals are normally distributed, as evidenced by an F-statistic of 1.284786 and a probability value of 0.526032, both of which have a significance level > 5%. Finally, all diagnostic tests for the Langrage multiplier serial correlation test, the Jarque-Bera normality test, and the heteroskedasticity test were successful, indicating the stability of the model.

Table 9. Short-run diagnostics

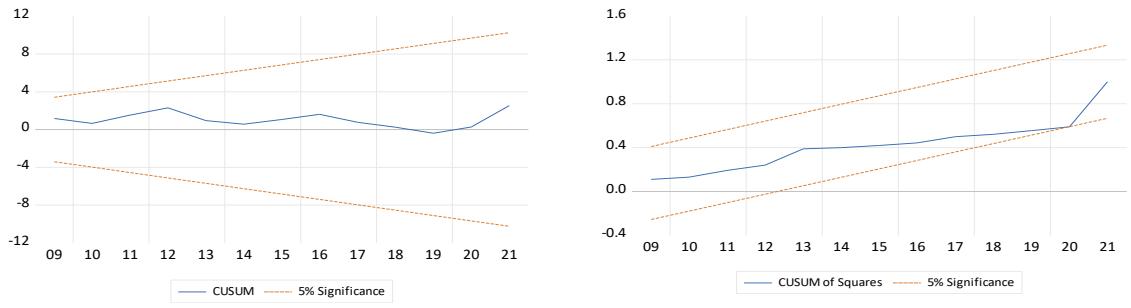
Test	F-statistics	P-value
Serial correlation	0.359385	0.7060
Heteroskedasticity	0.695581	0.7304
Jarque-Bera	1.284786	0.5260

Source: Author` s calculation

4. 8. STABILITY TESTS

The CUSUM and CUSUM Squares tests are used to test whether the coefficients of the estimated models remain constant over time, an indicator of the model stability.

Figure 2. CUSUM and CUSUM squares tests



Source: Author` s calculation

The results of the stability test of CUSUM and CUSUMSQ are shown in Figure 2. At the level of 5% of significance tests, the significance of not exceeding the critical thresholds indicates that the model is stable. This test is also used to study long-term dynamics of the regression.

5. CONCLUSION

The aim of this research is to determine the impact of digitization, economic growth, and birth rate on female employment in Kazakhstan. For the research work, data for the period 1994-2022 was collected. The authors tested the model using Unit Root Test, Granger causality test, Co-Integration Test and Stability test. The research indicates that individuals using internet have a negative relationship with the female labor force in both the short and long term. One other digitalization variable, ICT service exports and fertility rate, have a positive relationship in both the short and long term. In the long term, the coefficient for Mobile cellular subscriptions is insignificant, but in the short term, the growth of MCS has a positive effect on female labor force. Thus, the three hypotheses proposed by the authors, including H0, are partially confirmed. Indeed, digitalization has a positive effect on employment among women at a certain level. It has been confirmed that economic growth has a positive impact on female employment in Kazakhstan. According to hypothesis H2, short-term birth rates have a negative effect on female employment, but long-term female employment rates and birth rates have a positive correlation in Kazakhstan. Hypothesis H2 was also fully confirmed. Both short and long term, female employment is positively impacted by fertilization.

Policy implications. In Kazakh society, a woman is especially respected as a mother, and her role as a mother is also of great importance. In addition to studying and working, women try to create a family and become mothers for that reason. Although women may give up their jobs to become mothers, they don't give up their motherhood to work.

Family values have a high place in the society, it is a normal situation in Kazakh society for parents to take care of their grandchildren or help their close relatives to take care of children. Our view is that this is likely to result in a positive impact of the birth rate on women's employment. Economic growth has a positive impact on women's employment in many developing and developed countries. We consider that it is better to raise the demographics and maintain employment among women, as well as to promote economic growth, to create conditions for pensioners, to support businesses started by women, and to start short-term microcredit programs. The trend towards digitization is universal. Remote work is now more possible thanks to digitization, which leads to more opportunities for self-employment and for women to balance family and work. Consequently, to encourage women labor force to work remotely, a significant reduction in the price of telephone lines in rural areas was implemented. In remote rural areas, it is very important to improve the quality of the Internet.

6. DECLARATIONS

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