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Identification of Factors Determining Female's Labour Force Participation in the World: A Factor Analysis Approach

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Abstract The objective of this study is to identify the factors that determine female labour force participation rates in 87 countries across different levels of development, namely developed, developing, and less developed over the period from 2015 to 2019. To achieve this, the study employs exploratory factor analysis to uncover the underlying factors that explain the determinants of female labour force participation. Exploratory factor analysis is a particularly suitable method, given the absence of a comprehensive, established theory in the literature regarding female labour force participation. Furthermore, this study addresses the theoretical gap by utilising a multidimensional dataset, which includes 20 observable variables covering potential determinants such as economic conditions, health, education, technological infrastructure, institutional frameworks, natural resources, and energy consumption. The findings from the exploratory factor analysis reveal several independent factors influencing female's labour force participation, including the level of development of the countries, their reliance on agriculture as a traditional mode of production, their dependence on strategic natural resources, and the extent of renewable energy consumption. The results from the regression analysis using these identified factors as independent variables demonstrate that the level of development and reliance on agriculture as a traditional mode of production have a positive effect on female labour force participation. In contrast, dependence on strategic natural resources is found to have a negative effect. However, the amount of renewable energy consumption did not show a statistically significant impact. These results have important implications for both academics studying gender and labour force dynamics and for policymakers aiming to design effective interventions to increase female labour force participation.

Keywords Female Labour Supply · Female Labour Force Participation · Exploratory Factor Analysis

Jel Codes C18, J21, J78, O3

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Identification of Factors Determining Female's Labour Force Participation in the World: A Factor Analysis Approach

Achieving gender equality and reducing existing social inequalities is a significant issue that necessitates a thorough examination of the factors influencing female participation in the labour force. In this regard, the identification of barriers to female participation in business life and the formulation of policy recommendations to overcome these barriers represent a pivotal step towards sustainable and inclusive development. While the historical background provides an important basis for understanding the roots of gender inequality, in the contemporary era, analysing the effects of this inequality on female's labour force participation and developing solutions has become a major necessity in terms of social justice and sustainable development goals. The disparities experienced by women in economic life have a long-standing history, dating back to the earliest days of human civilisation. With the Neolithic Revolution, sedentary life and agricultural production redefined gender roles and limited women's position in economic life. From this point of view, history began with the deterioration of gender equality to the detriment of women after the Neolithic Revolution. This is the date on which gender inequality began. However, the course of history is moving towards the ideal of a more just world in which women have equal rights with men, after women have become the second sex in almost all areas, including participation in the labour force (De Tocqueville, 2000). Toffler posits that three significant waves have characterised the evolution of human history. The initial wave corresponds to the Neolithic Revolution, marking the advent of agricultural production and sedentary life. The second wave is characterised by a period of mass production and industrialisation, typified by the Industrial Revolution. The third wave signifies the structure of the post-industrial society, characterised by technological and digital advancements. The aforementioned waves not only elucidate the transformation of modes of production and labour dynamics but also furnish an indispensable framework for comprehending the impact of these structural changes on women's roles in social and economic life (Toffler, 2008: 16). Consequently, historical and economic transformations have exerted a direct influence on the trajectory of the struggle for gender equality.

The way of life developed by primitive communal societies to meet their basic needs led to the emergence of the social division of labour. This period, often termed "primitive communism", was characterised by a predominant gender-based division of social labour (Bebel, 1976: 30; Haviland et al., 2008: 332). Within these communities, based on a hunter-gatherer economy, women were responsible for gathering activities, while men engaged in hunting. This division of labour was shaped by biological differences between the sexes (Aytaç et al., 2002: 18). Women's roles encompassed domestic responsibilities such as pregnancy, childbirth, and breastfeeding, while men specialised in hunting. This division of labour increases the productivity of the community (Şenel, 1995: 52). While the maternal and domestic roles of women were not negated by their gathering activities, their lives were made more challenging (Giddens, 2012: 369). The frequent presence of female figures in Palaeolithic cave paintings demonstrates that women were not only symbols of fertility

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but also played an active role in economic activities. This phenomenon indicates the elevated status of women within the community, both in terms of belief systems and economic activities (Michel, 1993: 25). In this period, before the development of private property and power structures, and with nomadic life being the dominant way of life, a matriarchal social order prevailed (Ertürk, 2008: 7).

The advent of the agricultural revolution, along with the domestication of animals and the development of agricultural tools, led to a reduction in the need for labour, consequently diminishing the significance of hunting. This shift redistributed gender roles, with men increasingly engaged in agricultural production and women dedicated to domestic chores and handicrafts. The dissemination of iron ploughs, a key innovation in agricultural technology, further solidified the position of men in agricultural production while simultaneously diminishing the economic importance of women (Suğur et al., 2006: 79). Property and inheritance systems operated in a manner that effectively prevented women from owning land and excluded them from decision-making mechanisms (Karkıner, 2006: 25). The development of the settled agricultural system subsequently facilitated the establishment of villages, trade in agricultural products, and the emergence of cooperatives and commercial networks (Gimpel, 1997: 40). The increasing need for security led to the emergence of the state concept. While slave labour was commonplace in agriculture and building projects in antiquity, the serfdom system came to the fore in the Middle Ages. While the serfs were tied to the land, both male and female serfs participated in production on equal terms. Although both male and female serfs were bound to the land, women nevertheless retained a low social status (Bloch, 1983: 299; Huberman, 2014: 15). The inheritance system, which favoured males, further restricted women's economic rights and perpetuated the patriarchal structure (Ecevit, 1994: 100-101).

From the 10th to the 15th century, agricultural productivity remained stable, and with surplus production, craftsmen organised around guilds. In this structure, the division of labour between professions such as farmers, merchants, craftsmen, and soldiers was established in society (Gimpel, 1997: 43). While the urban population and commercial volume increased, women participated in areas such as tailoring, shoemaking, baking, and beer production, but they could not be effective in the political field (Aytaç et al., 2002: 19). In the aristocratic and bourgeois classes, women had limited access to education and professional opportunities, being restricted to roles such as lineage continuation and property transfer (Kersey, 1980: 190). With the large-scale development of trade and fair economies, domestic production became widespread, and low labour costs and new production techniques supported the continuity of this system. While the monopolistic policies of the guilds prevented the establishment of new workshops, families turned to production within the home and relied on rural labour (Huberman, 2014: 18-32). As Marx indicated, the Industrial Revolution did not occur through a natural transition from the manufactory to the factory, but rather as a result of families seeking to produce in opposition to the monopoly and impositions of the guilds (Berg, 1994: 208). Braudel, who refers to the period between the 15th and 18th centuries as the "pre-industrial" era, divides it into four categories: scattered family workshops, interconnected scattered workshops, centralised manufactories, and mechanised large workshops (Braudel, 2017: 263-265). This period coincides with the emergence of modern industrial production standards and the shaping of modern gender identity definitions. While appropriate masculinity and femininity were defined in society, instead of defining them by sexual activity and especially the gender of a person's sexual partner, assumptions about acceptable behaviour in visible urban spaces became significant (Ezell, 1999: 629). Women, although limited, gained economic independence through professions such as teaching and participated in public political and social activities. However, these activities have generally been overlooked in historical writing (Ezell, 1999: 630).

Contemporary Dynamics of Female Labour Force Participation

The industrial revolution marked the first time women worked for wages in the modern sense (Özer and Biçerli, 2003: 56). Prior to this, women were economically dependent on men during the feudal era, but the industrial revolution significantly reduced this dependency. Women began to work outside the home, contributing to the development of gender-specific job sectors. They were no longer confined to agriculture but entered both the industrial and service sectors. However, due to lower educational qualifications, women were often seen as substitutes for male labour in many sectors, forced to work under poor conditions for low wages (Kocacık & Gökkaya, 2005: 196). Women migrating from rural areas to cities were employed in the textile industry, the leading sector of the time, working an average of 12 hours a day for low wages. The rise of mechanisation and the greater efficiency of female labour compared to male labour contributed to the concentration of female labour in this sector (Altan & Ersöz, 1994: 21). The development of production techniques, which made tasks more standardised and simpler, allowed women to be employed at lower wages, as they were easier to manage and adapted more readily to the work environment, which further increased their participation in the workforce (Yüksel, 2016: 9). However, changes in demand conditions during the 1960s affected mass production (Lipietz, 2001). The new mode of production, which emphasises flexibility, simplicity, variety, and quality, is known as the post-Fordist production model. Rapid technological advancements have had a significant impact on post-Fordist production and the restructuring of the labour market. Innovations such as automation systems, artificial intelligence, microchips, data storage systems, cloud computing, open-source software, coding, 3D printers, and similar technologies have substantially reduced the need for human labour in the production process. Female workers have been disproportionately affected by these changes, as the new production systems demand higher skill levels, leading to increased unemployment among women. In traditional and patriarchal societies, women often possess lower levels of human capital than men, which hinders their ability to acquire the skills required by the evolving labour market. Nevertheless, the growth of the service sector—a result of changes brought about by mass production—has led to a notable increase in female employment in this sector (Esping-Andersen, 1999). With the growth of the service sector, a white-collar workforce emerged, consisting of professionals specialised in their respective fields. While the white-collar segment of the labour market typically held skilled, well-paid, and secure jobs, the blue-collar segment, employed in the industrial sector, was often confined to low-skilled, low-paid, and precarious positions. As the service sector expanded, more women entered the labour force. However, they frequently had to settle for unskilled jobs in the informal sector. This situation contributed to gender-based occupational stratification, largely stemming from women's lower levels of education and limited occupational experience compared to men (Becker, 1962).

The presence of women in the economic sphere is measured by the female labour force participation rate. This rate is calculated as the ratio of the female labour force of working age to the total female population of working age and is typically expressed as a percentage in statistical reports. Countries such as the United Kingdom, France, Germany, Sweden, and Norway, where female labour force participation rates are high, also rank prominently in terms of economic development. In these countries, the gender gap in labour force participation rates is narrower compared to other nations. This indicates a direct correlation between increased female labour force participation and a country's level of development. Therefore, a high female labour force participation rate can be considered an indicator of a nation's economic advancement. Table 1 presents the changes over time in female labour force participation rates for a selection of representative countries.

Table 1

Changes over Time in the FLFP Rates of Representative Countries*

		1995	2000	2005	2010	2015	2019	2020	2023
Panel A									
Developed Countries	United States	57.61	58.86	58.20	57.60	56.00	56.88	55.70	56.51
	Germany	47.69	48.88	51.15	53.05	54.70	56.59	55.56	56.45
	France	48.17	49.07	50.35	51.37	51.64	51.25	50.62	52.78
	Canada	57.47	59.40	61.65	62.40	61.21	61.43	59.50	61.14
Panel B	Brazil	47.66	50.67	55.59	53.68	52.96	55.13	50.19	53.13
Developing Countries	India	28.49	30.52	30.14	28.78	26.97	26.46	25.95	32.68
	Russian Federation	53.57	54.62	55.04	55.96	55.55	54.95	54.81	54.45
	Türkiye	30.81	26.49	23.08	26.94	31.30	34.21	30.77	35.35
Panel C	Mozambique	87.12	85.76	83.42	80.87	78.11	78.34	77.60	78.41
Less Developed Countries	Zimbabwe	60.27	60.65	60.86	60.85	60.66	60.73	59.84	60.39
	Kenya	70.19	70.48	70.77	71.06	71.37	71.94	71.25	72.20
	Cameroon	77.76	77.93	78.08	70.49	67.04	67.18	66.54	67.29
World		50.47	50.65	49.80	48.83	48.19	47.96	46.75	48.67

Source: World Bank Databank

*The statistic displays the proportion of women aged 15 and over who are economically active relative to the total female population.

The female labour force participation rates of the representative countries in Table 1 generally exhibit an upward trend. However, by 2020, this trend either slowed down or declined compared to 2019 due to the COVID-19 pandemic. The data for 2023 indicate a recovery in female labour force participation rates, with some countries experiencing a rapid rebound while others showing a slower pace of recovery. The COVID-19 pandemic had a disproportionately negative impact on female employment, leading to a so-called "she-cession" (Bluedorn et al., 2023). She-cession is a term used to describe the economic situation during the COVID-19 pandemic, where women experienced a higher rate of job loss compared to men. This was due to factors such as the fact that contact-intensive sectors (hotels and restaurants, retail trade, leisure and entertainment, and social services), in which women are concentrated, were more severely affected by the crisis, the increased burden of childcare, and women's greater involvement in temporary and part-time work (Fabrizio et al., 2021). In the second quarter of 2020, approximately two-thirds of the 38 developed and emerging economies examined witnessed larger declines in female employment rates compared to men. However, this phenomenon, termed she-cession, was generally short-lived, persisting for an average duration of one or two quarters (Bluedorn et al., 2023).

The United Nations adopted 17 sustainable development goals in 2015 as a global call to action. The economic dimension of the global goal on gender equality aims to eliminate gender-based discrimination, abuse, and all forms of violence in the workplace by supporting females' participation in the labour force (United Nations, 2015). Efforts by national and international institutions and organisations to increase female employment and female labour force participation have been accompanied by a growing body of academic literature. The importance of female's labour force participation has been demonstrated through action plans, calls for action, legal regulations, research projects, and vocational training activities. In this context, developing and underdeveloped countries have recognised the significance of female participation in the labour force to achieve their development goals and close the development gap with developed

countries. Female's labour contributes to increased production opportunities and capacity, with positive effects on the national product, welfare, and development levels of countries.

This study analyzes the factors affecting female's labour force participation rate in 87 developed, developing, and less developed countries. The potential contribution of this study to existing literature is as follows: Unlike previous studies that examined a limited number of factors, this study uses a multidimensional dataset that covers potential determinants of female's labour force participation such as economy, health, education, technological infrastructure, institutional framework, natural resources and energy. The dataset covers a comprehensive set of exploratory variables that have not been previously addressed in existing literature. To the best of our knowledge, this is the first study to use exploratory factor analysis to examine the female labour force participation rate. This methodological approach facilitates the analysis of abstract and non-directly measurable factors through observable concrete variables, thus providing a deeper understanding of the factors affecting female's labour force participation. The use of exploratory factor analysis facilitated more comprehensive and reliable results by linking abstract variables with concrete data. This multidimensional and innovative approach makes a significant contribution to the existing literature. In addition to the categories that are commonly used in the empirical literature, the study also classifies studies on female's labour force participation or employment into micro- and macro-studies. This classification system is designed to offer researchers a comprehensive understanding of the findings of the studies.

"The remainder of this study is organised as follows: First, theoretical approaches to female labor supply and the empirical literature on the subject, including studies at both the micro and macro levels, are comprehensively reviewed. Subsequently, the data set employed in the research and the methodology adopted are presented in detail. This is followed by the application conducted in line with the chosen method and a discussion of the findings obtained. Finally, the main results and conclusions of the study are presented."

Literature Review

Theoretical frameworks on female's labour force participation seek to examine and analyse the underlying causes and consequences of inequalities and discriminatory practices observed between men and women in the labour market. Labour constitutes a fundamental component of goods and services production, and it is expected that the income derived from labour should correspond to individual performance. Wage differentials arising from variations in skills and occupational roles among individuals can be considered justifiable within the framework of income equity. However, when individuals receive unequal wages or income despite contributing equally and demonstrating comparable performance-due to factors such as gender, these disparities adversely affect females' participation in the labour market (Ölmezoğulları et al., 1999: 185-193). Women are among the groups subjected to discrimination in the labour market, and gender-based economic discrimination negatively impacts their participation in the workforce. Research findings that theoretically explain the discrimination women face in economic life are crucial for understanding the depth, dimensions, and effects of this issue, as well as for developing future strategies. In the literature, approaches to female's labour force participation are generally categorised under four main headings: the neoclassical approach, the institutional approach, the Marxist approach, and the feminist economics approach.

The neoclassical approach, in its analysis of the labour market, has developed solutions based on efficiency and productivity through mathematical methods. However, this approach has resulted in the neglect of social and institutional factors. Neoclassical analysis is grounded in rationality, objectivity, and mathematical modelling. According to this framework, the wage disparity between men and women and the low participation of women in the labour force are not fundamentally caused by gender differences but by the assumption that men are more productive in the labour market than women. This productivity gap arises from the fact that women, traditionally responsible for household chores and childcare, find it more difficult to engage in activities aimed at increasing human capital accumulation compared to men (Durmaz, 2016: 46). The institutionalist approach is one of the heterodox schools of thought that have been critical of neo-classical economic paradigms. This theoretical framework asserts that the political economy of contemporary societies is predicated on social stratification rather than on the pursuit of individual benefits. Contrary to the neo-classical approach, the institutionalist perspective posits that economic actors are not merely rational individuals; rather, they are institutional structures that give rise to macroeconomic policies and legal regulations. Institutional actors exert a form of influence over the decisions of individuals, operating on the premise of limited rationality (Hodgson, 2007: 12). Accordingly, this approach calls for the integration of other social science disciplines, including psychology, sociology, and anthropology, to facilitate more precise analyses of human and institutional behaviour. Marxist theory examines the layered structure of society shaped by capitalist production and the struggle between economic classes within a historical and cultural context. According to the Marxist approach, capitalism views female's labour as cheap and suitable for part-time work, while simultaneously adopting a patriarchal stance that expects women to remain at home and take on the responsibility of reproducing labour (Ecevit, 1985: 92). Marxist theory links women's subordinate position in society and the family to private property, arguing that in bourgeois families, women are dependent on men and are confined to roles such as bearing and caring for children. These roles are viewed as a reflection of the capitalist social structure, analogous to the strategies employed by the capitalist system in the labour market. According to the feminist approach, the root cause of females' lower participation in the labour market and the discrimination they face lies in patriarchy. Patriarchy is a social structure in which men play a dominant role in setting norms and establishing institutions, thereby legitimising male social and economic superiority based on gender (Moore & Ghilarducci, 2018: 34). The persistence of gender discrimination and conditions that negatively affect female's labour force participation under market conditions has led feminist economics to propose anti-market economic policies. These policies include laws against discrimination, equal pay for equal work, and state-provided childcare services (Conway, 2000: 15-20).

Theoretical studies aim to analyse the causes and consequences of gender-based discrimination in the labour market, which undermines social justice and has additional economic costs. Empirical studies reveal the determinants of female employment and provide findings on the accuracy and validity of theoretical approaches. Both types of studies are necessary to understand the effects, depth, and dimensions of discrimination that still exist today. Empirical literature contains a disproportionately higher number of micro-studies compared to macro-studies. Despite the small number of macro-studies compared to micro-studies, their contribution to literature is of greater importance, and this has led to the adoption of the macro-approach in practice. In this study, micro- and macro-studies were categorised to ensure integrity in the researchers' understanding of the subject.

Micro-studies have found that female's labour force participation rate is determined by various factors, including marital status, education level, husbands' income level, fertility level, availability of childcare

services, patriarchal systems in society, and religious and cultural values. Education has a significant and positive impact on females' participation in the labour force. This includes increased productivity, social benefits, intergenerational redistribution, and income equality (Schultz, 1993). Key studies on this subject include Leibowitz et al. (1988); Connelly (1992); Averett et al. (1997), and Anderson & Levine (1999). Recent studies include Kimmel & Powell (2006), Falzone (2010), Steiber & Haas (2012), Doss et al. (2014), Addabbo et al. (2016), An & Kazuyo (2018), and Pattnaik & Lahiri-Dutt (2020). Table 2 presents micro-level empirical studies on the determinants of female labour force participation, which complement the pioneering studies mentioned above.

Table 2

Empirical Studies at the Micro Level

Study	Period and Sample	Methodologies	Results
de Laat and Sevilla-Sanz (2011)	1970-2005, 23 Organisation for Economic Co-Operation and Development (OECD) countries	Cohort Analysis and Probit Model	Men's increased involvement in household production increases female's labour force participation.
Bilijan Et al. (2013)	70 observations between 1996 and 2005 in Croatia and 15 EU countries	Cohort Analysis	Although the employment rates of women in part-time jobs are increasing, they face more challenges in securing full-time employment compared to men.
Hall and Zoega (2014)	The World Values Survey covers 5 Nordic countries.	Covariance Analysis	The primary factors influencing female labour force participation are cultural and value-based considerations.
Uunk (2015)	The 2008 European Values Survey covers 33 countries in Europe	Multilevel Logit Model	The probability of individual female's labour market attachment is significantly positively and independently affected by a country's egalitarian gender role attitudes.
Arrazola and Hevia (2016)	1994-2000-2006 the European Living Conditions Survey was conducted, Spain	Probit Model	The data indicates that Spanish women tend to have higher reservation wages and lower offer wages compared to men, which could be a contributing factor to the low participation of female in the labour market.
Atasoy (2017)	2013 Türkiye Demographic and Health Survey, Türkiye	Probit and Logit Models	In traditional cultures, women are less likely to participate in the labour force and find employment, particularly in the services sector and among regular/wage earners.
Alam Et al. (2018)	2010 census data for Indonesia	Logit Model	In urban areas, married Hindu women are 31% more likely to work than married Muslim women. In rural areas, married Confucian women are 31% less likely to work than married Muslim women.
Islam Et al. (2020)	The 2009-2016 World Bank Entrepreneurship Survey covers 126 developed and developing countries and 46,000 firms	Decomposition Analysis	In the manufacturing sector, firms managed by women have lower capital and labour costs than those managed by men.
Klasen Et al. (2021)	Household surveys are suitable for deriving most of the variables used by Klasen and Pieters (2015) in 8 low- and middle-income non-OECD countries	Probit Model	The constraints that shape female labour force participation are largely country specific. However, it can be concluded that rising levels of education and falling fertility rates have consistently increased the rate of female labour force participation.

Alvi (2023)	From 1983 to 2012, the India National Sample Survey and the India Human Development Survey were conducted every five years, each covering 100,000 to 120,000 households	Decomposition Analysis	The research indicates that poverty and economic distress are the primary drivers of higher labour force participation among Hindu women. Additionally, the study finds that increasing incomes decrease female labour force participation across all groups.

Source: Compiled by the authors.

Among the macro-level empirical studies in the literature, the largest group focuses on the relationship between economic development, progress, growth, and female labour force participation. These studies use female labour force participation as an explanatory variable in econometric models. Hill (1983), Mincer (1985), Pampel & Tanaka (1986), Psacharopoulos & Tzannatos (1989), Schultz (1991), Goldin (1995), Tansel (2002), and Tam (2011) are all authors who have contributed to this topic. Some studies (Hill, 1983; Mincer, 1985; Pampel & Tanaka, 1986; Psacharopoulos & Tzannatos, 1989) have examined the relationship between development and female labour force participation. They found that female labour force participation rates are higher in high-income and low-income countries than in middle-income countries. The high female labour force participation in underdeveloped countries can be attributed to the fact that women can still find a place in agriculture, while in developed countries, women are already working in the industrial sector. However, in countries with intermediate levels of development, the transition from agriculture to industry has made it difficult to employ women in both sectors. Similarly, previous studies have highlighted that females' participation in the labour force is low during the initial stages of economic growth. Additionally, it has been observed that female's labour force participation follows a U-shaped pattern with increasing economic growth (Goldin, 1995; Özdamar Giovanis et al., 2018).

In contrast, there are few macro-studies that use econometric models to explain female's labour force participation and include economic growth as an explanatory variable. Some examples of such studies include Galor & Weil (1996), Klasen (1999), Cavalcanti & Tavares (2007), Klasen & Lamanna (2009), and Torçun (2018). Klasen's (1999) findings suggest that female's increased participation in the labour force, particularly in the formal sector, has a positive impact on economic growth. Additionally, Klasen & Lamanna (2009) and Galor & Weil (1996) found that wage discrimination has a negative effect on economic growth. Torçun (2018) found that the interaction term between the female labour force participation rate and savings variables does not close the investment-savings gap, which does not lead to economic growth. Table 3 presents macro-level empirical studies on the determinants of female employment, which complement the pioneering studies mentioned earlier.

Table 3

Empirical Studies at the Macro Level

Study	Period and Sample	Methodologies	Results
Kneip and Bauer (2007)	1960-2005, 18 EU countries	Time Series Analysis	As the risk of divorce increases, female labour force participation also increases.
Bloom Et al. (2009)	1960-2000, 97 developed and developing countries	Panel Data Analysis	The research indicates a positive correlation between education and female labour force participation.
Mishra and Smyth (2010)	1980-2005 and 1995-2005, 28 OECD countries	Panel Data Analysis	There exists an inverse relationship between the rate of female labour force participation and the total fertility rate.

Önder and Önder (2012)	1980-2009, Türkiye	Time Series Analysis	The participation of women with higher levels of education in the labour force increases, indirectly impacting long-term economic growth.
Lee and Lee (2014)	1971-2009, Japan	Time Series Analysis	Long-term equilibrium relationships were discovered between the rate of female labour force participation, birth rate, and childcare status.
Siah and Lee (2015)	1970-2010, Malaysia	Time Series Analysis	The data indicate that mortality rate changes have a significant and positive long-term impact on fertility rates.
Belke and Bolat (2016)	1991-2014, 148 developed and developing countries	Panel Data Analysis	Econometric research supports the validity of the U-hypothesis, which suggests a non-linear relationship between female labour force participation and economic development.
Özdamar Giovanis Et al. (2018)	1991-2014, 31 developing and less developed countries	Panel Data Analysis	Research has not found evidence to support the idea that increased female labour force participation has a positive impact on domestic savings.
Sikirić (2021)	2005-2015, 28 EU countries	Panel Data Analysis	It is emphasised that part-time work can place women in a financially subordinate position to men, weaken their bargaining power at home, affect their future retirement, and prevent them from fully utilising their work and intellectual capacities.
Irandoust (2023)	1991-2021, 17 Arab countries	Panel Data Analysis	Female labour force participation is affected by both structural and cyclical factors related to job opportunities.

Source: Compiled by the authors.

This study aims to address a significant lacuna in the extant literature by offering a multidimensional perspective on female's labour market participation. Previous macro-studies have largely confined their assessments of the female labour force participation rate to a limited number of factors, based their analyses primarily on some EU or OECD countries. In contrast, the present study distinguishes itself by incorporating 20 observational variables representing multiple dimensions, including the economy, health, education, technology, institutional structure, and energy. Furthermore, the intangible variables obtained using the exploratory factor analysis method were evaluated in a regression model in which the female labour force participation rate was designed as the dependent variable. This methodological approach enabled the analysis of abstract and non-directly measurable factors through observable concrete variables, thus providing a deeper understanding of the factors affecting female labour force participation. The study's original contribution lies in its use of exploratory factor analysis, a novel approach in the field, to explore female labour force participation. Additionally, it incorporates a comprehensive set of variables that have not been previously considered in the related literature. The employment of this method has yielded more comprehensive and reliable results by associating abstract variables with concrete data. This multidimensional and innovative approach makes a significant contribution to the existing literature.

Methodology and Data

Research Method: Factor Analysis

Factor analysis is a multivariate analysis technique that aims to identify some meaningful factors from a large set of observable variables that are believed to be interrelated. Technically, it is an analysis developed to obtain some independent factors by examining the covariance structures of a group of variables (Johnson & Wichern, 2007). This analysis reveals new structures by manipulating the number of variables and examining the relationships between them. It is assumed that all variables are interrelated, and those

with stronger correlations are combined using the correlation matrix to form factors. The size of the factor loadings is analysed to comment on the factors (Seber, 1984).

Multivariate statistical analyses involve expressing many interrelated variables with some mathematically derived factors that provide the least loss of information. This approach simplifies the explanation of the relationship between variables that are thought to be related to each other in large and multidimensional data. The factors obtained in this stage of the analysis can be used in subsequent stages, such as regression, correlation, and decomposition (Kline, 1994). In the factor analysis, the variables are ranked by weight according to their importance. The next stage of the analysis is then initiated. In this study, exploratory factor analysis is employed, as it is a method that aims to obtain new and meaningful factors based on the relationships between variables. This analysis is particularly useful in cases where the factor structure is not predetermined in the dataset and an exploratory approach is required. Exploratory factor analysis enables the identification of latent constructs without imposing a preconceived structure, making it especially suitable for research contexts where theoretical guidance is limited or the dimensionality of the data is unknown. The objective of this study is to ascertain the dimensions in which the factors affecting female labour force participation are grouped and to analyse the effects of these factors on the female labour force participation rate. Therefore, exploratory factor analysis is a method that is particularly well-suited to the nature and purpose of this research.

However, it is important to note that while exploratory factor analysis is effective for uncovering the underlying factor structure, it does not provide evidence regarding the generalizability or validity of this structure in other samples or contexts. For this reason, confirmatory factor analysis should be conducted following exploratory factor analysis to test whether the identified factor structure holds in an independent sample or aligns with theoretical expectations. Confirmatory factor analysis allows for the statistical evaluation of the model fit and the verification of hypothesised relationships among the observed variables and latent constructs. As emphasised in the literature, "Exploratory factor analysis is used for the exploration of factor structures, whereas confirmatory factor analysis is necessary for confirming and testing the adequacy of these structures. These two analyses should be used sequentially, and the findings obtained from the exploratory factor analysis should be validated through the confirmatory factor analysis in an independent sample" (Brown, 2015).

Factor analysis establishes linear relationships between concrete-observational variables $z_1, z_2, \ldots, z_p$ and abstract-fictional variables and abstract-fictional variables $F_1, F_2, \ldots, F_p$ through loading values $z_j = a_{j1} \cdot F_1 + a_{j2} \cdot F_2 + \ldots + a_{jp} \cdot F_p$. The equations of factor analysis can be understood as a regression of concrete variables on abstract variables. Since creating *p* number of factors for *p* number of dependent variables is not a gain in terms of simplicity, the linear relationship between dependent variables and factors is established as follows for $m < p$: $z_j = a_{j1} \cdot F_1 + a_{j2} \cdot F_2 + \ldots + a_{jm} \cdot F_m + \varepsilon_j$, $j = 1, 2, \ldots, p$ (Harman, 1967). A comparable scenario applies to the principal component analysis (PCA). Principal components with eigenvalues of at least one are considered significant according to Equation 1 of the principal components model; the number of these principal components is indicated by *m* .

$$\xi i = t_{i1} \cdot z_1 + t_{i2} \cdot z_2 + \ldots + t_{ip} \cdot z_p, \quad i = 1, 2, \ldots, m. \tag{1}$$

The most important stage of factor analysis in terms of research is the naming and interpretation of the factors obtained. In naming and interpreting the factors, it is necessary to consider the observed variables

that are strongly affected by them and to ask what would affect them so strongly. Once the naming and interpretation is complete, the explanation of the variable of interest now manifests itself as the interpretation of a regression equation.

Data

This study aims to identify the factors that contribute to female employment on a global scale. The study used data on 20 variables from 87 countries for the period of 2015-2019. The selected time frame was due to the limited availability of data, particularly for recent years. To avoid excluding countries with little missing data, we took five-year averages of the relevant years to obtain the maximum number of observations. This ensures that the analysis includes as many countries as possible, despite the missing data.

Factor analysis is used to identify the independent variables that are assumed to be independent in the panel data analysis, but the level of independence could not be determined to ascertain whether they were truly independent or fictitious. Although the number of omitted variables in the factor analysis method used in the study is small, it neglects country-specific unobservable unit effects, such as religious and cultural factors, which are particularly important in studies using the panel regression method. However, the fact that most of the observed variables used to derive the factors have structural magnitude and do not change over time, and the remaining variables have small variances, makes the problem of omitted variable bias less problematic and thus prevents the construction of an incorrect model.

The countries used in the analysis are as follows: United States of America, Armenia, Spain, Mongolia, Sri Lanka, Germany, Estonia, Sweden, Moldova, Saudi Arabia, Argentina, Morocco, Switzerland, Mozambique, Chile, Albania, Philippines, Italy, Namibia, Tanzania, Australia, Finland, Japan, Niger, Thailand, Austria, France, Cameroon, Nicaragua, Tunisia, Bangladesh, Gabon, Canada, Norway, Türkiye, Bahrain, Ghana, Kazakhstan, Pakistan, Uganda, Belgium, Guatemala, Kenya, Panama, Ukraine, Brazil, South Africa, Colombia, Paraguay, Uruguay, Botswana, Croatia, Costa Rica, Peru, Jordan, Bulgaria, India, Latvia, Poland, Vietnam, Czechia, Netherlands, Lithuania, Portugal, Greece, China, Republic of Honduras, Luxembourg, Romania, Zambia, Denmark, Iraq, Hungary, Russian Federation, Zimbabwe, Dominican Republic, United Kingdom, Malaysia, Senegal, El Salvador, Iran, Mexico, Slovakia, Indonesia, Ireland, Egypt, and Slovenia. As can be seen, in selecting the countries, an effort was made to create a balanced dataset, since they are in different geographical regions of the world and have, as far as possible, different economic levels. Table 4 shows the variables used in the application. Data on the variables were obtained from several sources: World Bank Databank (WB); PRS Group-International Country Risk Guide (ICRG); International Labour Organisation (ILO); and United Nations Development Program (UNDP).

In this study, the factor analysis method was used to obtain factors to explain the determinants of female employment. To test the suitability of the data for factor analysis, the correlation matrix was calculated, and the Kaiser-Meyer-Olkin (KMO) criterion and Bartlett test statistics were used. PCA was used as a factor extraction method. With the help of PCA, the factors were derived by revealing the maximum variance in the dataset. To determine the number of factors, the total variance ratio and eigenvalue statistic were analyzed, respectively. As a rotation method, quartile method was selected from the orthogonal rotation methods.

Table 4

Variables Used in the Application

Symbol	Variable	Description	Source
HATST	Harmonised student test scores	It measures the relative performance of countries on international student achievement tests based on a harmonised database of scores obtained on internationally standardised student achievement tests in various subject areas.	WB
TOWPC	Total wealth per capita	Produced capital is calculated as natural capital, human capital, and net foreign assets divided by the population. Values are measured at market exchange rates in constant 2018 U.S. dollars.	WB
GDPPC	Gross Domestic Product (GDP) per capita	GDP is divided by the population at mid-year. It is measured at market exchange rates in constant 2015 U.S. dollars.	WB
AGVAL	Agriculture value added to GDP	Agriculture includes forestry, fishing, crop production, and animal production. It is expressed as a percentage of GDP.	WB
INVAL	Industry value added to GDP	This variable reports the contribution of industrial production, including construction, to the overall GDP. The percentage of GDP is used as the unit of measurement.	WB
CORRU	Level of corruption	It assesses corruption in the political system. High scores are given to countries with low levels of corruption.	ICRG
BURQU	Bureaucratic quality	Countries with weak bureaucracies tend to score low due to the potential for government changes to disrupt policy formulation and administrative functions.	ICRG
INPRO	Investment profile	This is an evaluation of investment risk factors that are not addressed by other political, economic, and financial risk components.	ICRG
UINON	Online shopping	The percentage of female respondents over the age of 15 who reported using the internet to make an online purchase in the last 12 months.	WB
UMOIN	Use of the internet or mobile money	Percentage of female respondents aged 15+ with a financial institution account or mobile money account who reported using their mobile phone or the internet to make payments, make purchases, or send or receive money through their financial institution account in the past 12 months.	WB
AGDER	Age dependency ratio	The ratio of dependents to the working-age population is presented as the number of dependents per 100 working-age individuals.	WB
MAMOR	Maternal mortality rate	It is represented by 100,000 live births in a year, regardless of the duration and location of the pregnancy.	WB, UNDP
FERRA	Total fertility rate	The total fertility rate indicates the average number of children a woman would give birth to if she were to live to the end of her childbearing years and experience the age-specific fertility rates of the given year.	WB
ADOFE	Adolescent fertility rate	The adolescent birth rate is defined as the number of births per 1000 women aged 15–19 years each year.	WB, UNDP
EMAGF	Female employment rate in the agriculture sector	This indicator measures the proportion of employed women who work in agriculture, hunting, forestry, and fishing activities. It is expressed as a percentage.	WB, ILO
OILRE	Ratio of oil rents to GDP	Oil rents are defined as the gap between the value of crude oil production at regional prices and the total production costs, expressed as a percentage of GDP.	WB

Symbol	Variable	Description	Source
NACPC	Natural capital per capita	The total natural resource rents refer to the combined value of oil, natural gas, coal, mining, and forest rents, all measured in constant 2018 US dollars and divided by the total population.	WB
RECON	Renewable energy consumption	Terajoules of energy obtained and consumed from all renewable sources such as hydro, solid, biofuels, wind, solar, liquid biofuels, biogas, geothermal, marine, and waste.	WB
LFPRF*	Female labour force participation rate	The statistic displays the proportion of women aged 15 and over who are economically active relative to the total female population.	WB, ILO

*It was used as a dependent variable in the regression analysis but was not included in the exploratory factor analysis.
Source: Compiled by the authors.

Application and Discussion

Application

Before proceeding to the exploratory factor analysis in this study, we examined whether the variables to be used in the analysis met the assumption of normality. For this purpose, skewness and kurtosis values were calculated for each variable, and the findings are presented in Table 5. In the literature, it is stated that skewness and kurtosis values within the range of ±2 are considered acceptable for normal distribution (Tabachnick & Fidell, 2019).

The results indicate that the assumption of normality is satisfied for 10 variables, whereas it is not satisfied for the remaining 10 variables. This was considered in the selection of the analysis method, and PCA, which is less sensitive to the normality assumption in factor extraction, was therefore preferred. The main reason why PCA is less sensitive to the assumption of normality is that it constructs principal components based solely on the covariance or correlation matrix of the variables. In other words, the goal of PCA is to identify the linear components that best explain the total variance in the data; therefore, the normality of the variable distributions is not a strict requirement in this process. As a result, PCA results are generally considered reliable even when the variables are not normally distributed (Jolliffe & Cadima, 2016).

Before conducting exploratory factor analysis, it is imperative to assess the suitability of the data for factor analysis, i.e., to evaluate the validity of applying factor analysis. In this context, it is necessary to examine the KMO criterion, the Bartlett's test statistic, the anti-image matrix, the communalities, and the residual matrix (Hair et al., 1998; Field, 2024). When the correlation matrix is equal to the unit matrix, it indicates that there is no relationship between the observational variables. In this case, all the observational variables are independent, and factor analysis is unnecessary because linear relationships cannot be established between them. The correlation matrix coefficients and significance levels indicate that the observational variables are appropriate for factor analysis. At the 0.00 significance level, Bartlett's test statistic was calculated as 1903.965, leading to the rejection of the null hypothesis that the correlation matrix is equal to the unit matrix (Hair et al., 1998). The next stage involved using the KMO sampling adequacy measure to determine if there were enough observational variables. The KMO value of 0.868 indicates that the sample size is sufficient for factor analysis (Kaiser, 1974). Table 6 displays the results of the KMO criterion and Bartlett's test statistics.

Table 5

Skewness and Kurtosis Values for Assessing the Normality of Variables

		Statistic	Std. Error			Statistic	Std. Error
CORRU	Skewness	0.689	0.258	AGDER	Skewness	1.559	0.258
	Kurtosis	−0.585	0.511		Kurtosis	2.636	0.511
BURQU	Skewness	0.386	0.258	AGVAL	Skewness	1.624	0.258
	Kurtosis	−0.838	0.511		Kurtosis	2.878	0.511
INPRO	Skewness	0.431	0.258	EMAGF	Skewness	1.389	0.258
	Kurtosis	0.242	0.511		Kurtosis	0.837	0.511
MAMOR	Skewness	2.222	0.258	FERRA	Skewness	1.888	0.258
	Kurtosis	4.429	0.511		Kurtosis	3.958	0.511
HUCPC	Skewness	1.676	0.258	GDPPC	Skewness	1.926	0.258
	Kurtosis	1.967	0.511		Kurtosis	3.763	0.511
TOWPC	Skewness	1.795	0.258	INVAL	Skewness	0.812	0.258
	Kurtosis	2.723	0.511		Kurtosis	0.952	0.511
UMOIN	Skewness	0.768	0.258	OILRE	Skewness	4.628	0.258
	Kurtosis	−0.422	0.511		Kurtosis	24.168	0.511
UINON	Skewness	0.831	0.258	RECON	Skewness	4.610	0.258
	Kurtosis	−0.643	0.511		Kurtosis	22.545	0.511
HATST	Skewness	−0.151	0.258	NACPC	Skewness	5.072	0.258
	Kurtosis	−1.162	0.511		Kurtosis	31.394	0.511
ADOFE	Skewness	1.408	0.258	LFPRF	Skewness	−1.098	0.258
	Kurtosis	2.027	0.511		Kurtosis	0.511	0.511

Source: Calculated by the authors.

Table 6

Results of the KMO Criterion and Bartlett's Test Statistic

KMO measure of sampling adequacy		0.868
Bartlett's test of sphericity	Chi-square	1903.965
	Degrees of freedom	171
	Significance level	0.000

Source: Calculated by the authors.

The anti-image correlation matrix was examined as another indicator of suitability for factor analysis. The anti-image matrix displays the partial correlations of each variable with other variables, with particular emphasis on the Measure of Sampling Adequacy (MSA) values on the diagonal. MSA values allow for the individual assessment of each variable's suitability for factor analysis.

Table 7

Anti-image Correlation Matrix

	1 CORRU	2 BURQU	3 INPRO	4 MAMOR	5 HUCPC	6 TOWPC	7 UMOIN	8 UINON	9 HATST	10 ADOFE	11 AGDER	12 AGVAL	13 EMAGF	14 FERRA	15 GDPPC	16 INVAL	17 OILRE	18 RECON	19 NACPC
1	**0.91**[a]	0.26	−0.4	−0.01	−0.10	−0.04	−0.12	−0.15	0.28	0.21	−0.03	0.18	−0.13	0.02	0.05	−0.00	0.28	0.27	−0.08
2	−0.26	**0.96**[a]	−0.05	−0.01	−0.07	0.04	−0.04	−0.04	0.05	0.26	−0.17	−0.04	0.06	0.08	−0.17	−0.06	−0.02	−0.12	0.09
3	−0.40	−0.05	**0.90**[a]	0.00	−0.07	0.07	0.17	0.01	−0.16	−0.09	−0.13	−0.22	0.30	0.03	−0.15	−0.13	0.09	−0.09	−0.17
4	−0.01	−0.01	0.00	**0.93**[a]	0.11	−0.03	−0.33	0.14	0.00	−0.26	−0.15	−0.12	−0.13	−0.23	−0.08	0.00	0.11	−0.16	0.00
5	−0.10	−0.07	−0.07	0.11	**0.89**[a]	−0.71	−0.12	−0.17	−0.02	−0.27	0.11	0.07	0.03	−0.09	−0.00	0.19	−0.02	−0.18	0.26
6	−0.04	0.04	0.07	−0.03	−0.71	**0.85**[a]	−0.06	0.02	0.09	0.14	−0.22	−0.13	0.02	0.19	−0.53	−0.14	0.01	0.02	−0.41
7	−0.12	−0.04	0.17	−0.33	−0.12	−0.06	**0.89**[a]	−0.34	−0.26	0.04	0.08	0.13	−0.09	−0.10	0.18	−0.00	0.05	0.10	−0.09
8	−0.15	−0.04	0.01	0.14	−0.17	0.02	−0.34	**0.92**[a]	−0.41	0.06	−0.11	−0.16	0.19	0.01	−0.10	−0.10	−0.05	−0.30	0.00
9	0.28	0.05	−0.16	0.00	−0.02	0.09	−0.26	−0.41	**0.89**[a]	0.25	−0.25	0.08	−0.09	0.32	−0.05	−0.06	0.066	0.28	−0.00
10	0.21	0.26	−0.09	−0.26	−0.27	0.14	0.04	0.06	0.25	**0.92**[a]	−0.18	0.07	0.00	−0.10	0.00	−0.09	0.13	0.15	−0.01
11	−0.03	−0.17	−0.13	−0.15	0.11	−0.22	0.08	−0.11	−0.25	−0.18	**0.72**[a]	0.28	−0.24	−0.70	0.30	0.44	−0.13	0.13	0.24
12	0.18	−0.04	−0.22	−0.12	0.07	−0.13	0.13	−0.16	0.08	0.07	0.28	**0.85**[a]	−0.56	−0.33	0.24	0.36	0.06	0.06	0.02
13	−0.13	0.06	0.30	−0.13	0.03	0.02	−0.09	0.19	−0.09	0.00	−0.24	−0.56	**0.86**[a]	0.11	−0.17	−0.24	0.05	−0.26	0.00
14	0.02	0.08	0.03	−0.23	−0.09	0.19	−0.10	0.01	0.32	−0.10	−0.70	−0.33	0.11	**0.83**[a]	−0.23	−0.36	−0.08	0.03	−0.17
15	0.05	−0.17	−0.15	−0.08	−0.00	−0.53	0.18	−0.10	−0.05	0.00	0.30	0.24	−0.17	−0.23	**0.89**[a]	0.18	−0.08	0.208	0.22
16	−0.00	−0.06	−0.13	0.00	0.19	−0.14	−0.00	−0.10	−0.06	−0.09	0.44	0.36	−0.24	−0.36	0.18	**0.58**[a]	−0.37	−0.06	0.02
17	0.28	−0.02	0.09	0.11	−0.02	0.01	0.05	−0.05	0.06	0.13	−0.13	0.06	0.05	−0.08	−0.08	−0.37	**0.62**[a]	0.08	−0.49
18	0.27	−0.12	−0.09	−0.16	−0.18	0.02	0.10	−0.30	0.28	0.15	0.13	0.06	−0.26	0.03	0.20	−0.06	0.08	**0.16**[a]	0.02
19	−0.08	0.09	−0.17	0.00	0.26	−0.41	−0.09	0.00	−0.00	−0.01	0.24	0.02	0.00	−0.17	0.22	0.02	−0.49	0.02	**0.62**[a]

Source: Calculated by the authors. a: Measure of sampling adequacy.

As shown in Table 7, the MSA values on the diagonal of the anti-image matrix range from 0.58 to 0.96, excluding the RECON variable (renewable energy consumption). Although the renewable energy consumption observational variable does not exhibit characteristics suitable for factor analysis, it was included in the analysis to examine its effect on the female labour force participation rate. Because only the observational variable related to renewable energy consumption is clustered under this hypothetical variable, the name of the observational variable was directly used in naming the hypothetical variable. However, it was found that the renewable energy consumption hypothetical variable has a negligible effect on the female labour force participation rate, which is the dependent variable). Given that the MSA values for all variables are above 0.50, it is appropriate to include each variable in the factor analysis (Kim, 1978). Furthermore, the low values of the off-diagonal elements of the anti-image matrix indicate that there is no multicollinearity problem among the variables, and factor analysis can be reliably applied.

The communalities table, which is an important output of the factor analysis, shows how well each variable is explained by the extracted factors. The communality value represents the proportion of a variable's variance accounted for by the factors and ranges from 0 to 1. High communality values indicate that the variable is well represented by the factors, while low values suggest that the variable is not sufficiently explained by them (Hair et al., 1998).

Table 8

Communalities

	CORRU	BURQU	INPRO	MAMOR	HUCPC	TOWPC	UMOIN	UINON	HATST	ADOFE	AGDER	AGVAL	EMAGF	FERRA	GDPPC	INVAL	OILRE	RECON	NACPC
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Extraction	0.841	0.798	0.666	0.896	0.924	0.920	0.713	0.893	0.690	0.830	0.875	0.759	0.782	0.936	0.864	0.690	0.824	0.937	0.740

Source: Calculated by the authors. Extraction method: Principal Component Analysis

According to the communalities values presented in Table 8, the majority of the variables have high communality values. The variables with the highest communality values were RECON (0.937), FERRA (0.936), HUCPC (0.924), and TOWPC (0.920). This indicates that a large proportion of the variance in these variables is explained by the factors and that these variables represent the factor structure well. On the other hand, the variables with the lowest communality values were INPRO (0.666), HATST (0.690), and INVAL (0.690). Although the communality values of these variables are lower compared to the others, they are still at an acceptable level (above 0.60). This suggests that these variables are substantially explained by the factors but are not represented as well as the other variables.

The residual matrix obtained from the factor analysis was examined to assess the extent to which the model could reproduce the original correlation matrix. Each cell in the residual matrix represents the difference between the original correlation and the correlation estimated by the model. The magnitude of these differences is considered an indicator of the model's fit to the data (Kline, 2016).

Table 9

Residual Matrix

	1 CORRU	2 BURQU	3 INPRO	4 MAMOR	5 HUCPC	6 TOWPC	7 UMOIN	8 UINON	9 HATST	10 ADOFE	11 AGDER	12 AGVAL	13 EMAGF	14 FERRA	15 GDPPC	16 INVAL	17 OILRE	18 RECON	19 NACPC
1		0.02	0.04	-0.00	-0.02	-0.01	-0.04	-0.03	-0.08	-0.01	-0.01	0.00	0.01	0.00	-0.02	0.04	-0.03	-0.00	0.01
2	0.02		-0.00	-0.00	-0.02	-0.02	-0.05	-0.03	-0.04	-0.02	0.02	0.00	0.00	0.01	-0.00	0.03	0.02	-0.01	-0.03
3	0.04	-0.00		-0.00	-0.02	-0.03	-0.13	-0.04	-0.06	0.03	-0.00	0.04	-0.04	0.01	-0.02	0.04	-0.03	0.05	0.01
4	-0.00	-0.00	-0.00		-0.01	-0.01	0.03	-0.00	0.02	-0.00	-0.02	-0.04	-0.03	-0.01	-0.00	0.02	-0.01	-0.00	-0.00
5	-0.02	-0.02	-0.02	-0.01		0.05	-0.04	-0.01	-0.05	0.04	-0.02	-0.00	-0.01	-0.00	0.04	-0.01	0.00	0.00	-0.01
6	-0.01	-0.02	-0.03	-0.01	0.05		-0.05	-0.02	-0.05	0.02	-0.02	0.01	0.00	-0.01	0.06	-0.02	-3.304E-5	-0.00	0.01
7	-0.04	-0.05	-0.13	0.03	-0.04	-0.05		0.05	0.12	-0.02	-0.01	-0.02	0.02	-0.02	-0.08	0.04	-0.01	-0.04	-0.03
8	-0.03	-0.03	-0.04	-0.00	-0.01	-0.02	0.05		0.08	-0.00	0.02	0.01	0.00	0.00	-0.03	0.02	0.01	-0.01	-0.03
9	-0.08	-0.04	-0.06	0.02	-0.05	-0.05	0.12	0.08		-0.04	0.05	0.01	0.07	-0.01	-0.06	0.03	0.02	-0.03	-0.03
10	-0.01	-0.02	0.03	-0.00	0.04	0.02	-0.02	-0.00	-0.04		-0.02	-0.07	-0.07	-0.01	0.02	0.02	-0.02	0.04	-0.01
11	-0.01	0.02	-0.00	-0.02	-0.02	-0.02	-0.01	0.02	0.05	-0.02		-0.07	-0.03	0.02	-0.04	0.00	0.03	0.04	-0.04
12	0.00	0.00	0.04	-0.04	-0.00	0.01	-0.02	0.01	0.01	-0.07	-0.07		0.05	-0.02	0.00	-0.04	0.01	-0.05	0.07
13	0.01	0.00	-0.04	-0.03	-0.01	0.00	0.02	0.00	0.07	-0.07	-0.03	0.05		-0.05	0.01	0.02	0.00	-0.08	0.01
14	0.00	0.01	0.01	-0.01	-0.00	-0.01	-0.02	0.00	-0.01	-0.01	0.02	-0.02	-0.05		0.00	0.02	-0.00	0.02	-0.02
15	-0.02	-0.00	-0.02	-0.00	0.04	0.06	-0.08	-0.03	-0.06	0.02	-0.04	0.00	0.01	0.00		-0.00	0.01	-0.00	-0.02
16	0.04	0.03	0.04	0.02	-0.01	-0.02	0.04	0.02	0.03	0.02	0.00	-0.04	0.02	0.02	-0.00		-0.10	-0.05	-0.16
17	-0.03	0.02	-0.03	-0.01	0.00	-3.304E-5	-0.01	0.01	0.02	-0.02	0.03	0.01	0.00	-0.00	0.01	-0.10		0.01	-0.08

	1 CORRU	2 BURQU	3 INPRO	4 MAMOR	5 HUCPC	6 TOWPC	7 UMOIN	8 UINON	9 HATST	10 ADOFE	11 AGDER	12 AGVAL	13 EMAGF	14 FERRA	15 GDPPC	16 INVAL	17 OILRE	18 RECON	19 NACPC
18	−0.00	−0.01	0.05	−0.00	0.00	−0.00	−0.04	−0.01	−0.03	0.04	0.04	−0.05	−0.08	0.02	−0.00	−0.05	0.01		0.01
19	0.01	−0.03	0.01	−0.00	−0.01	0.01	−0.03	−0.03	−0.03	−0.01	−0.04	0.07	0.01	−0.02	−0.02	−0.16	−0.08	0.01	

Source: Calculated by the authors. Extraction Method: Principal Component Analysis. Residuals are computed between the observed and reproduced correlations. **There were 29 (16.0%) nonredundant residuals with absolute values greater than 0.05.**

Upon examination of the residual matrix in Table 9, most the residual values are below 0.10 in absolute value. Notably, most residual correlations between variables were below 0.05. This suggests that the factor model largely explains the relationships between the variables successfully. However, some cells (e.g., −0.13 between UMOIN and INPRO; −0.16 between INVAL and NACPC) showed residuals exceeding 0.10 in absolute value. These higher residual values indicate that the model does not adequately explain the relationships between these specific variable pairs. Overall, considering the distribution and magnitude of the residual values, the model's explanatory power can be deemed adequate for general validity.

Table 10 displays the eigenvalues and variance explanation percentages of the factors, which are determined by Kaiser's eigenvalue criterion. According to Table 6, the variance explanation percentages of the first four principal components with eigenvalues greater than 1 are 50.54, 14.89, 10.65 and 5.89, respectively. The cumulative variance explanation percentages of the 4 principal components are 81.98%. In other words, all 4 principal components could explain 81.98% of the total variance. This is also indicative of the scale's validity. Considering that the fictional variables are the standardised forms of the principal components, 4 fictional variables were obtained according to Kaiser's eigenvalue criterion.

Table 10

Eigenvalues and Variance Explanation Percentages of Factors

Principal component	Eigenvalues	Percentage	Cumulative percentage	Loading squares sum after rotation	Percentage	Cumulative percentage
1	9.60	50.54	50.54	8.13	42.79	42.79
2	2.82	14.89	65.43	4.19	22.07	64.87
3	2.02	10.65	76.08	2.12	11.17	76.04
4	1.12	5.89	**81.98**	1.12	5.93	81.98
5	0.67	3.53	85.51			
6	0.51	2.71	88.23			
7	0.41	2.18	90.42			
8	0.35	1.88	92.30			
9	0.32	1.73	94.03			
10	0.26	1.37	95.41			
11	0.18	0.96	96.37			
12	0.15	0.81	97.18			
13	0.13	0.72	97.90			
14	0.11	0.62	98.53			
15	0.09	0.50	99.03			
16	0.06	0.35	99.39			

Principal component	Eigenvalues	Percentage	Cumulative percentage	Loading squares sum after rotation	Percentage	Cumulative percentage
17	0.05	0.30	99.69			
18	0.04	0.21	99.91			
19	0.01	0.08	100.00			

Source: Calculated by the authors.

Once the fictional variables have been obtained, they can be named meaningfully to complete the factor analysis. However, in this case, due to the PCA, one variable was clustered into two fictional variables simultaneously, which made it difficult to interpret and name the fictional variables. To ensure a consistent and meaningful interpretation of the fictive variables, we applied the quartile rotation method, which is an orthogonal rotation method, to these variables.

Because of the factor analysis conducted on the data obtained in the study, four main factors were identified. In order to assess the internal consistency of the factors and the overall scale, Cronbach's alpha coefficients were calculated. The Cronbach's alpha coefficient for the entire scale, which encompasses all variables, was found to be [0.416]. This value indicates that the scale, in general, possesses a high level of internal consistency. Additionally, the Cronbach's alpha coefficients calculated separately for each factor were determined as [0.418] for Factor 1, [0.618] for Factor 2, and [0.734] for Factor 3. These results demonstrate that each factor also exhibits an acceptable level of reliability. The Cronbach's alpha coefficients obtained for both the overall scale and the identified factors indicate that the scale and its subdimensions are reliable. To evaluate the discriminant validity of the scale, an independent samples t-test was conducted between the top 27% and bottom 27% groups based on the total scores. The analysis revealed a significant difference in the total scores between the top group (N=23, M=2,444,624.81, SD=2,307,920.15) and the bottom group (N=23, M=125,714.25, SD=48,006.70) ($t(44) = 4.818$, $p<0.001$). The mean difference between the groups was 2,318,910.56, with a 95% confidence interval ranging from 1,348,836.12 to 3,288,984.99. Levene's test indicated unequal variances ($F=20.181$, $p<0.001$); however, the significance level remained consistent under both the assumption of equal variances and the assumption of unequal variances. In both cases, a statistically significant difference between the top and bottom groups was observed. These findings suggest that the scale has a high ability to discriminate between individuals with high and low scores, indicating adequate discriminant validity.

The matrix of the loads obtained after the rotation process is shown in Table 11. Loads that are below an absolute value of 0.65 are not shown in Table 11. This is because the loads that show a correlation can only be considered statistically significant at a confidence level of 95% when this value is exceeded (Işık et al., 2004).

Table 11

Post-rotation Loadings Matrix

Variables	Factor 1	Factor 2	Factor 3	Factor 4
HUCPC	0.957			
TOWPC	0.953			
GDPPC	0.923			
UINON	0.912			
CORRU	0.895			
BURQU	0.862			
UMOIN	0.831			
INPRO	0.803			
HATST	0.714			
AGDER		0.912		
MAMOR		0.882		
FERRA		0.879		
ADOFE		0.735		
EMAGF		0.699		
AGVAL		0.660		
OILRE			0.894	
NACPC			0.813	
INVAL			0.756	
RECON				0.966

Source: Calculated by the authors.

Table 11 shows the results of the exploratory factor analysis method, which yielded four fictitious variables. The first of the fictitious variables obtained by the exploratory factor analysis method was named "Indicator of the Level of Development of Countries," the second as "Indicator of Reliance on Agriculture as a Traditional Mode of Production," the third as "Indicator of Reliance on Strategic Natural Resources," and the last as "Renewable Energy Consumption Indicator".

The fit of the model obtained from the confirmatory factor analysis to the data was comprehensively evaluated using various fit indices and comparative model tests. The analysis results are summarised and interpreted below.

Table 12

Model -data Fit

Model Tests				
Label	X^2	df		*p*
User Model	750	147		<0.001
Baseline Model	13207	171		<0.001
Fit Indices				
		95% Confidence Intervals		
SRMR	RMSEA	Lower	Upper	RMSEA *p*
0.216	0.217	0.202	0.233	<0.001

Model Tests	
User Model and Baseline Model	Model
Comparative Fit Index (CFI)	0.954
Tucker-Lewis Index (TLI)	0.946
Bentler-Bonett Non-normed Fit Index (NNFI)	0.946
Relative Noncentrality Index (RNI)	0.954
Bentler-Bonett Normed Fit Index (NFI)	0.943
Bollen's Relative Fit Index (RFI)	0.934
Bollen's Incremental Fit Index (IFI)	0.954
Parsimony-normed Fit Index (PNFI)	0.811

Source: Calculated by the authors.

As presented in Table 12, the model appears to have room for improvement in terms of the absolute fit indices (SRMR and RMSEA), whereas it demonstrates a notably strong performance with respect to the comparative fit indices (such as CFI, TLI, IFI, etc.). Although the significance of the chi-square test suggests that there may be certain deficiencies in the model's absolute fit, the high values of the comparative fit indices indicate that the model achieves a substantial improvement over the baseline model. Therefore, it can be concluded that the model generally exhibits an acceptable and robust fit although some additional modifications may be required to enhance its absolute fit.

After confirming that the factor structure and reliability are acceptable, it is necessary to calculate the Average Variance Extracted (AVE) value for each factor. Based on the post-rotation loading matrix presented in Table 11, the AVE values for each factor are provided in Table 13. According to Table 13, since the AVE values are above 0.50, it can be stated that the factors have an acceptable level of internal consistency (Fornell & Larcker, 1981). The AVE value for Factor 4 is quite high (0.933). This is because there is only one observed variable clustered under this factor.

Table 13

Average Variance Extracted Value for each Factor

Factor	AVE
Factor 1	0.731
Factor 2	0.611
Factor 3	0.681
Factor 4	0.933

Source: Calculated by the authors.

The naming of these 4 independent fictitious variables (factors) has been done for now, but the reasons for the naming will be discussed together with the main purpose of this study, which is to obtain the quantitative values of the 4 independent factors affecting the female labour force participation rate by the regression method. To determine the significant independent variable(s), we analyse the quantitative values of the independent variables presented in Table 14 from the regression analysis. Upon analysing Table 11, it is evident that factor F1 has a significant and positive effect on LFPRF at a 95% confidence level. Similarly, factor F2 has a significant and positive effect on LFPRF at a 90% confidence level. On the other hand, factor F3 had a significant and negative effect on LFPRF at a 95% confidence level, while factor F4 did not have any statistically significant effect on LFPRF. Equation 2 for prediction can be derived from Table 14.

$$(\widehat{LFPRF}) = 58.865 + 8.649F_{1i} + 2.706F_{2i} - 5.136F_{3i} - 0.716F_{4i} \quad (2)$$

Table 14

Regression Model Results

	Beta Forecaster	Standard Error	Standardise Beta Forecaster	t	p	Confidence Interval Lower Bound	Confidence Interval Upper Bound	Collinearity Statistics	
								Tolerance	VIF
Constant	58.865	1.441		40.847	0.000**	55.998	61.732	1.000	1.000
F1	8.649	1.449	0.516	5.967	0.000**	5.766	11.533	1.000	1.000
F2	2.706	1.449	0.161	1.867	0.066*	−0.178	5.589	1.000	1.000
F3	−5.136	1.449	−0.306	−3.543	0.001**	−8.019	−2.252	1.000	1.000
F4	−0.716	1.449	−0.043	−0.494	0.623	−3.600	2.167	1.000	1.000
Dependent Variable: LFPRF								1.000	1.000

Notes: **significant at 0.95 confidence level; *significant at 0.90 confidence level

Source: Calculated by the authors.

According to the prediction equation, an increase of 1 point in Factor 1 is expected to increase the LFPRF score by 8.649 points. The interpretation of the prediction equation in terms of standard deviation is that a 1 standard deviation increase in Factor 1 will increase the LFPRF by 0.516 standard deviations. In the next section of the study, the factors will be interpreted and named, and the findings of the established regression model will be evaluated. Exploratory factor analysis aims to summarise the relationships between variables by revealing a smaller number of independent factors. In this process, it minimises the multicollinearity problem by ensuring that the factors are unrelated to each other (Costello & Osborne, 2005; Fabrigar & Wegener, 2012). The presented analysis results support this characteristic of the exploratory factor analysis and demonstrate that there is no multicollinearity problem among the factors.

Discussion

The first fictitious variable (Factor 1) obtained through the exploratory factor analysis method has been named the indicator of the Level of Development of Countries. Institutional development is measured by the level of corruption (CORRU), bureaucratic quality (BURQU), and investment profile (INPRO); economic development by per capita wealth (TOWPC) and GDP per capita (GDPPC); technological development by the number of women using mobile money, financial accounts (UMOIN), and the internet (UINON); and human capital by the present value of women's lifetime earnings (HUCPC), and the increase in student test scores (HATST). These indicators are considered reflections of economic development in the economics literature. In other words, a country's level of development can be seen as a reflection of female's labour force participation decisions. As seen in Equation 2, the level of development of countries is designed as a quantity that changes in the same direction as the female labour force participation rate. Accordingly, a 1 unit change in the level of development of countries results in an 8.649 unit change in the same direction in the female labour force participation rate. In economically developed countries, there is a strong correlation between the increase in income, wealth, and wages per woman and the rise in female's labour force participation. Increases in income, wealth, and wages increase female's labour supply through the substitution effect. These countries not only foster economic development but also prevent discrimination in the labour market through institutional infrastructure and legal regulations, implementing policies that promote gender

equality and increase labour force participation. Additionally, social networks and the widespread use of advanced technology are other important factors that support females' participation in the labour force.

The subsequent ranking of countries is typically determined by the weighting of factor scores, a process that is commonly conducted through the use of factor analysis. The factor scores calculated for each country were determined according to the effect of factor loadings on the observational variables. Equation 3 is the one that is used for obtaining factor scores.

$$F_i = w_1X_1 + w_2X_2 + \cdots + w_jX_j \quad (3)$$

Here, F_i denotes the score of country i for the specified factor, and w_j is the weight of the j-th observational variable. The rank function constructed according to the quantitative values (factor scores) of the first factor shows that the top five countries are: Norway (2.74), Switzerland (2.37), the USA (2.22), Sweden (2.22), and Australia (2.14); the last five countries are: Nicaragua (-1.08), Moldova (-1.05), Armenia (-0.99), Egypt (-0.97), and El Salvador (-0.92). The findings indicate that the Factor 1 variable obtained through factor analysis can serve as an indicator of a country's level of development.

When table 11 is analysed, changes in observational variables such as age dependency ratio (AGDER), which is demographic in nature; maternal mortality rate (MAMOR), total fertility rate (FERRA), and adolescent fertility rate (ADOFE), which are related to health; female employment in the agricultural sector (EMAGF) and the share of the agricultural sector in GDP (AGVAL), which are economic in nature, affect the traditional agriculture-based mode of production of countries in the same direction, and increases or decreases in these observational variables shape the perceptions in the economics literature on whether countries are agriculture-based economies or not. Therefore, the second of the fictitious variables (Factor 2) obtained through the exploratory factor analysis method is named the Indicator of Reliance on Agriculture as a Traditional Mode of Production. The indicator of dependence on agriculture as a traditional mode of production, similar to the indicator of the level of development of countries, is designed as a quantity that varies in parallel with the labour force participation rate of women. According to the quantitative value of this factor in Equation 2, a 1 unit change in the indicator of dependence on agriculture as a traditional mode of production results in a 2.706 unit change in the same direction in the female labour force participation rate. When ranking countries based on the quantitative values of factor 2, the top five were Niger (4.09), Tanzania (3.04), Uganda (2.84), Mozambique (2.66), and Cameroon (2.38). The bottom five are Bahrain (-1.24), Ukraine (-0.96), Russia (-0.94), Croatia (-0.82), and Thailand (-0.82). The findings suggest that factor 2 can be considered an indicator of reliance on agriculture as a traditional mode of production. Among these countries, common characteristics include a patriarchal social structure, low levels of education, high unemployment rates, low industrial development, low use of contraceptive methods, early marriages, high maternal mortality rates, and the employment of women in the agricultural sector as unpaid family workers or for low wages. The underdeveloped industrial and service sectors in these countries have resulted in agriculture becoming the dominant sector, with a higher share in GDP than any other sector. The limited education opportunities available to women in these societies restricts their employment options to agricultural work. This phenomenon is commonly referred to as the 'feminisation of agriculture" in economic literature (Tamang et al., 2014). As such, even though the agricultural sector is a sector with low marginal product productivity in countries based on agriculture as a traditional mode of production, it has a bidirectional effect on determining the female labour force participation rate in traditional societies.

The third fictitious variable (Factor 3) obtained through the factor analysis method is named the Indicator of Reliance on Strategic Natural Resources. The strategic natural resource dependence indicator was named considering its strong relationship with the observational variables presented in Table 11. According to Table 11, the changes and magnitudes in the per capita natural capital (NACPC), obtained by dividing the rents from all natural resources (such as oil, natural gas, minerals, coal, and forests) by the population, including the share of oil rents in GDP (OILRE), provide information on the extent to which a country relies on strategic natural resources when analysing and evaluating its economy. The information provided by this table helps to evaluate the extent to which a country relies on strategic natural resources when considering its economy. The interaction between changes in the first two observational variables in Table 11 and the strategic natural resource dependence in a country's economy creates the perception, in economic literature, that the country's economic structure is based on strategic natural resources to the extent of the magnitude of these variables. As can be seen from Equation 2, the quantitative value of the third factor has a negative sign. A one unit change in the strategic dependence on natural resources indicator causes a change of 5.136 units in the opposite direction in the female labour force participation rate, in absolute value. Based on the quantitative values of the third factor, the top five countries were Saudi Arabia (5.52), Iraq (4.70), Gabon (2.51), Iran (1.94), and Norway (1.86). Meanwhile, the bottom five countries are Greece (-0.94), Luxembourg (-0.81), Pakistan (-0.79), Portugal (-0.75), and Kenya (-0.73). countries with strategic natural resources, other than Norway, tend to have a traditional patriarchal social structure. Religious and cultural factors often play a dominant role in preventing women from participating in the labour market in these countries. In these countries, women have been excluded not only from working life but also from many areas of the public sphere. The similarity between developed countries such as Norway and the other countries mentioned above, in terms of having strategic natural resources, has been effective in establishing strong relationships with the indicator of strategic natural resource dependence, which affects the share of the industrial sector in the GDP variable.

The fourth and final fictional variable (Factor 4) obtained through factor analysis was designated the Renewable Energy Consumption Indicator. Given that only the observational variable of renewable energy consumption was clustered under this construct variable, the name of the observational variable was directly used in the naming of the construct variable. A renewed examination of Equation 2 reveals that the fictitious variable of renewable energy consumption exerts negligible influence on the dependent variable of female labour force participation rate (given that the statistical confidence level (p) of 0.377 is exceedingly low).

Conclusion

Technological advances have reduced the time between structural transformations in production and labour markets. Consequently, it has become imperative for the labour force and working life to adapt to these changes. In this context, it is imperative to expeditiously implement policies that enhance the labour force participation of women, a demographic that faces numerous disadvantages. In this study, the factors affecting the female labour force participation rate, as well as the direction and magnitude of their impact, were statistically analysed. Through factor analysis, abstract variables were made meaningful using concrete data, and quantitative values related to the female labour force participation rate were subsequently calculated using regression analysis. In analysing the factors determining female labour force participation rates, variables from not only economic and demographic categories but also health, education, energy, technology, human capital, political, and institutional categories were considered. This comprehensive

approach enabled multidimensional findings and facilitated a holistic perspective on the issue. Therefore, the policy recommendations presented below should be seen as complementary rather than substitutive.

As the first factor, the level of development of countries is a determining factor in female's labour force participation. Low wage and income levels as indicators of underdevelopment emphasise the importance of wage improvements and supportive policies. For sustainable female employment, job-oriented, technology-based, and continuous learning training programs need to be expanded. These programs will increase women's access to skilled jobs, reduce gender-based occupational segregation, and contribute to economic development. In the long term, effective education policies will support political and economic stability by strengthening the institutional infrastructure. The second factor determining the female labour force participation rate is the indicator of a country's traditional mode of production based on agriculture. Although this factor contributes positively to the increase in the said rate, the level of development of countries based on agriculture as a traditional mode of production remains low, as the name of the factor suggests. The low level of development and patriarchal structure result in women being exposed to low-paid, precarious, and intensive working conditions in agriculture. With migration from agriculture, these problems persist in urban areas, and females' participation in the labour force is constrained. It is imperative to register women in agricultural employment, ensure their social security rights, and enhance occupational health and safety measures. The implementation of age-specific policy designs, the initiation of birth control awareness-raising programs, and the effective execution of gender-balanced development policies in rural areas have been identified as additional measures that could contribute to the resolution of these issues. The third factor determining the female labour force participation rate is the indicator of strategic natural resource dependence. In economies where natural resources are of strategic importance, it is noteworthy that the share of natural resource rents in GDP is high and that there is a presence of capital-intensive industry. While the adoption of old technologies transferred from industrialised countries has increased the marginal productivity of labour in these economies, the service sector has not developed, and the agricultural sector has lagged behind due to geographical and technological limitations. The reinforcement of a patriarchal structure by religious and cultural values has further limited females' participation in the labour force. These structural impediments have culminated in the under-representation of women, even within the agricultural and industrial sectors. Economies dependent on strategic natural resources are at risk of sustainability with the propagation of renewable energy sources. Measures to address this problem should be taken without delay. A contemporary interpretation of patriarchal cultural and religious norms, coupled with the elimination of discriminatory practices, is imperative to enhance female participation in the labour force. Achieving these objectives necessitates a transformation of social attitudes to align with the outlined goals.

The absence of a holistic theory in the literature for determining the female labour force participation rate highlights certain limitations of this study. First, although the observational variables exhibited structural significance, the quantitative values obtained from the regression analysis caused omitted variable bias, leading to the establishment of only correlation relationships. Second, the restriction of panel data analysis to the EU and OECD countries, along with the inherent characteristics of the independent variables in the factor analysis, prevented the use of this method. The application of factor analysis was instrumental in addressing concerns regarding the independence of the variables in the context of panel data analysis. This approach helped avoid erroneous findings and provided valuable insights for future theoretical frameworks. However, due to the absence of variables representing religious and cultural factors and the exclusion of country-specific unit effects, the quantitative values of the factors were calculated with bias.

In subsequent studies, the factors determining the female labour force participation rate can be examined in different dimensions by using the factor analysis method. This will increase the amount of preliminary information required for the formation of a theory at this rate. The method is advantageous in that it allows the researcher to engage in creativity and the ability to make philosophical interpretations, which will be very useful in formulating a theory about what can increase female's labour force participation. Furthermore, if religious and cultural values are concretised as observational variables and rendered measurable, causal relationships related to the female labour force participation rate can be examined using panel data analysis, a sophisticated technique. Given the macro-level approach of this study, it is imperative to cross-reference its findings with those of the micro-level studies. Consequently, micro-level studies to be conducted in the future can examine the micro-foundations of the findings.

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