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Gender inequality and economic growth: An analysis of OECD countries

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Abstract

Purpose: This study explores the relationship between gender inequality and economic growth in OECD countries. It focuses on female access to education, labor market participation, and political representation. The study also examines how rural women's education and employment relate to agricultural growth.

Design/Methodology/Approach: The analysis uses a panel dataset covering 38 OECD countries from 1990 to 2021. Dynamic panel data models are estimated using the two-step Generalized Method of Moments (GMM), addressing issues such as endogeneity and autocorrelation. Three models are developed to examine aggregate GDP, disaggregated gender indicators, and agricultural value added. Robustness is tested through alternative specifications and fixed effects.

Finding: The results show that reducing gender gaps in education and political representation is positively associated with GDP per capita. Secondary education among women, in particular, has both direct and statistically significant effects. In agriculture-focused models, the employment and education of rural women are strongly linked to increases in agricultural value added. These findings support the idea that gender equality contributes to overall and sectoral economic performance.

Originality/Value: This research approaches gender inequality not only as a social issue but also as an economic factor linked to economic growth. By offering a comparative analysis of OECD countries, it contributes empirically to the existing literature. It emphasizes the macroeconomic outcomes of women's equal access to education, employment, and political life. The inclusion of sector-specific insights, particularly in agriculture, adds a distinct perspective to the analysis.

Keywords: Dynamic panel data, economic growth, education, gender inequality, labor.

Cinsiyet eşitsizliğinin ekonomik büyüme üzerine etkisi: OECD örneği

Özet

Amaç: Bu çalışma OECD ülkelerinde toplumsal cinsiyet eşitsizliği ve ekonomik büyüme arasındaki ilişkiyi araştırmaktadır. Kadınların eğitime erişimi, işgücü piyasasına katılımı ve siyasi temsiline odaklanmaktadır. Çalışma ayrıca kırsal kesimdeki kadınların eğitim ve istihdamının tarımsal büyüme ile ilişkisini de incelemektedir.

Tasarım/Metodoloji/Yaklaşım: Analiz, 1990-2021 yılları arasında 38 OECD ülkesini kapsayan dengeli bir panel veri seti kullanmaktadır. Dinamik panel veri modelleri, endojenlik ve otokorelasyon gibi konuları ele alan iki aşamalı Genelleştirilmiş Momentler Yöntemi (GMM) kullanılarak tahmin edilmiştir. Kişi başına GSYH, ayrıştırılmış cinsiyet göstergeleri ve tarımsal çıktıyı incelemek için üç model geliştirilmiştir. Modelin geçerliliği, alternatif spesifikasyonlar ve sabit etkiler yoluyla test edilmiştir.

Bulgular: Sonuçlar, eğitim ve siyasi temsilde toplumsal cinsiyet farklılıklarının azaltılmasının kişi başına GSYH ile pozitif ilişkili olduğunu göstermektedir. Özellikle kadınlar arasında ortaöğretimin hem doğrudan hem de istatistiksel olarak anlamlı etkileri vardır. Tarım odaklı modelde, kırsal kesimdeki kadınların istihdamı ve eğitimi, tarımsal katma değerdeki artışlarla güçlü bir şekilde bağlantılıdır. Bu bulgular, toplumsal cinsiyet eşitliğinin genel ve sektörel ekonomik performansa katkıda bulunduğu fikrini desteklemektedir.

Özgünlük/Değer: Bu araştırma, toplumsal cinsiyet eşitsizliğine sadece sosyal bir mesele olarak değil, aynı zamanda üretkenlikle bağlantılı ekonomik bir faktör olarak da yaklaşmaktadır. OECD ülkelerinin karşılaştırmalı bir analizini sunarak, mevcut literatüre ampirik olarak katkıda bulunmaktadır. Kadınların eğitime, istihdama ve siyasi hayata eşit erişiminin makroekonomik sonuçlarını vurgulamaktadır. Başta tarım olmak üzere sektöre özgü görüşlerin de dahil edilmesi analize farklı bir bakış açısı katmaktadır.

Anahtar kelimeler: Dinamik panel veri, ekonomik büyüme, eğitim, cinsiyet eşitsizliği, işgücü.

INTRODUCTION

Gender refers to the physiological and biological differences between males and females. Gender inequality, however, arises when these differences translate into systemic disadvantages in accessing rights, economic opportunities, and social participation. Unlike biological sex, gender inequality is shaped by sociocultural norms, varying across societies and over time (Risman, 2004). It reflects unequal power dynamics, leading to imbalanced distributions of status and resources (Lucal, 1999; Savaş, 2018). Persistent gaps in workforce participation, leadership representation, and political influence display these disparities. Women's underrepresentation in managerial roles and political decision-making indicates fixed power imbalances (Ridgeway, 2009).

Globally, women face lower educational attainment, limited healthcare access, and occupational segregation into lower-paid sectors. Despite comprising nearly half the world's population, systemic marginalization confines women to lower social statuses, restricting their access to essential services. In developing countries, particularly in South Asia, the Middle East, and North Africa, gender disparities in labor markets and household bargaining power remain pronounced (Klasen and Lamanna, 2009). For example, Nigerian women earned 60 cents for every dollar man earned in 2007, while Indian women earned 64 cents (WDR, 2012). Even industrialized economies exhibit gaps: female labor force participation and wages lag behind men's (Blau and Kahn, 2013). Structural barriers further limit women's entrepreneurship, with male-owned firms generating higher profits (Bardasi et al., 2011; Bruhn, 2009).

Disparities in physical and human capital access increase labor market inequalities. In Western Kenya, women's equal agricultural productivity contrasts with their limited access to farming inputs (Alene et al., 2008). Female-headed households in developing countries are less likely to own land, reducing agricultural output (FAO, 2011). Unpaid domestic labor, disproportionately borne by women, further restricts economic participation (Berniell, M.I., Sanchez, P.C., 2011). Institutional biases in markets and policies perpetuate these gaps (WDR, 2012).

International efforts, such as the UN's Sustainable Development Goals (SDGs), prioritize gender equality. SDG 4 (education), SDG 5 (gender equality), and SDG 8 (decent work) aim to destroy barriers to women's economic and political participation. However, progress remains uneven. While primary education gender parity has been achieved globally, secondary and tertiary enrollment gaps persist. The UNDP's Gender Inequality Index (GII) and the World Economic Forum's Global Gender Gap Index rank Nordic countries (e.g., Iceland, Norway) as leaders, while Turkey ranks 68th (GII) and 130th (Gender Gap Index), reflecting fixed disparities (UNDP, 2023; WEF, 2023).

The relationship between gender inequality and economic development is widely debated. Some studies link educational disparities to underutilized human capital, heavy growth (Altuzarra et al., 2021). Others argue that gender gaps in low-wage sectors enhance export competitiveness, potentially boosting economic growth (Busse and Spielmann, Christian, 2006). Political underrepresentation of women correlates with higher corruption and inefficient policies (Dollar and Kraay, 2003), though empirical evidence remains limited.

This study examines whether gender inequality hampers economic growth across 38 OECD countries (1990–2021), focusing on education, labor markets, and political representation. Grounded in neoclassical and endogenous growth theories, it assesses how misallocation of human capital and institutional biases affect productivity. Regression analysis of OECD and World Bank data reveals that reducing educational gender gaps by 1% correlates with a 0.3% GDP increase in developing OECD countries (Thévenon, et al., 2012). Rural women's land ownership and access to agricultural training explain 12% of productivity variation (Aguilar et al., 2015). Turkey's low political representation of women (18% in parliament) mirrors broader institutional challenges.

Hypotheses guiding this research include:

1. Gender inequality in education, employment, and politics negatively impacts economic growth.
2. These effects vary by a country's development level and institutional context.
3. Rural women's education and employment significantly influence agricultural productivity.

Policy recommendations include strengthening land rights for women, expanding vocational training, and enforcing gender quotas in governance. In agricultural economies, closing gender gaps in resource access could boost output by 5–7%, advancing SDG targets on poverty and food security (Croppenstedt et al., 2013; Huyer, 2016).

Gender inequality remains a universal challenge. No country achieves full gender parity, and development does not linearly reduce disparities (Perrons, 1995). For agricultural economies, rural women's limited access to education, land, and technology stifles productivity. Addressing these gaps requires targeted policies, such as land titling programs and gender-sensitive agricultural training. By integrating gender equality into economic planning, governments can unlock human capital, fostering sustainable growth. This study indicates the urgency of transforming gender equality from a moral imperative into an economic catalyst, particularly in Turkey and similar contexts.

There is a substantial body of literature examining the relationship between gender inequality and economic growth. These studies address the topic from both microeconomic and macroeconomic angles. This section focuses exclusively on macroeconomic studies, in line with the objective of this research. The exclusion of micro-level analyses is based on two considerations. First, while such studies offer insight into specific mechanisms and contexts, their focus on individual countries limits the generalizability of their findings. Second, many of these works are not easily incorporated into theoretical growth models.

Macroeconomic studies in this area fall into three broad categories. The first group examines how economic growth can reduce gender inequality. The second group investigates the mutual interaction between gender inequality and economic growth. The third group explores the impact of gender inequality on productivity and output at the aggregate level.

The first group explains how rising national income may reduce gender disparities, especially in labor market participation. Several mechanisms are suggested. (Becker and Lewis, 1973) argue that, as income rises, families shift their focus from child quantity to quality, investing more in education per child. When a country reaches a certain income threshold, fertility rates decline, enabling greater educational investments and facilitating women's entry into the labor force.

Greenwood et al. (2005) propose that technological progress reduces the time women spend on unpaid domestic work. With the adoption of household appliances, more women can participate in paid employment. Their model shows that as the relative prices of appliances decline, households are more likely to substitute capital for labor in domestic production. This explanation is extended in the work of (Attanasio et al., 2004; Jones et al., 2003; Olivetti, 2006; Rendall, 2010) who also consider the role of technological change in expanding women's labor market opportunities. Goldin and Katz (2002) and Albanesi and Olivetti (2009) point out advancements in healthcare and their effect on female labor participation.

Doepke and Tertilt (2009) offer a different perspective. In their model, men decide on women's legal rights. Although men may resist granting rights to their wives, they support rights for women generally, as this benefits their daughters. This dynamic evolves with technological progress, which increases the returns to human capital and incentivizes greater investment in daughters' education. Fernández (2009) builds on this logic with a focus on property rights and the gradual expansion of women's legal and economic status.

The second group of studies, particularly Galor and Weil (1996) presents a two-way relationship. In their framework, economic growth reduces fertility and alters labor demand in favor of cognitive over physical skills. As cognitive tasks become more valuable, women's relative wages rise, encouraging their participation in the labor market. This leads to lower fertility rates and higher capital per worker, which further accelerates growth. (Lagerlof, 2003) supports this view with a model in which social expectations and discriminatory norms form a coordination game. As human capital becomes more central to economic performance, families gradually move toward more gender-equal educational investments, reinforcing long-term growth.

The third group explores the adverse effects of gender inequality on total productivity. Esteve-Volart (2008) demonstrates that excluding women from managerial roles lowers the average quality of management and reduces human capital accumulation. This reduces innovation and technological progress. The exclusion of women from formal employment altogether confines their abilities to unpaid household work, lowering aggregate productivity.

Cavalcanti and Tavares (2008) incorporate wage discrimination into a growth model that includes fertility, savings, and labor supply. They show that a 50 percent increase in the gender wage gap could lower per capita income by one-quarter. Cuberes, and Teignier (2012) drawing on a Lucas-type talent allocation model, simulate those excluding women from management reduces output per worker by 12 percent, while excluding them entirely from the labor force lowers per capita income by 40 percent. Their region-specific estimates show the highest losses in the Middle East and North Africa.

Hsieh et al. (2019) develop a model that measures productivity loss from occupational frictions. Using U.S. Census data, they estimate that reducing gender and racial disparities explained 17 to 20 percent of the U.S. output growth between 1960 and 2008. This result points out how reducing inequality can have measurable macroeconomic benefits.

Empirical research has tested these theoretical models using growth regressions. Most findings indicate a negative relationship between gender inequality and economic growth (Akbulaev and Aliyeva, 2020; Baerlocher et al., 2021; Blackden and Bhanu, 1999; Hill and King, 1995; Klasen, 2000; Minasyan et al., 2019). A few studies report the opposite, particularly in export-led economies where wage inequality has been associated with competitive advantages (Çağatay and Ozler, 1995; Seguino, 2000a, 2000b). However, such cases often reflect short-term gains rather than sustainable development.

Recent improvements in data availability have enabled robust cross-country comparisons. Studies using panel and time series methods (Agénor and Canuto, 2015; Altuzarra et al., 2021; Kennedy et al., 2017; Kovalenko and Töpfer, 2021; Litmeyer et al., 2022) confirm that gender inequality in education and employment is consistently associated with lower growth.

In Turkey, the relationship between gender inequality and growth has received growing attention. Palaz (2005) finds that educational attainment increases women's labor participation and social status. However, in rural areas, many women work as unpaid agricultural laborers, limiting the impact of education. Urban women benefit more due to access to formal employment. İnce (2011) shows that improvements in female education positively affect GDP and reduce fertility. Önder and Önder (2012) emphasize that increased educational access leads to greater economic participation. Yumusak et al. (2013) argue that gender inequality in education negatively affects growth, while higher education levels increase women's labor market activity.

Most studies focus on specific aspects of inequality. However, isolating one dimension may lead to biased results. To address this, the present study incorporates multiple indicators, including education, employment, and political representation, into a unified framework. It aims to analyze how gender inequality affects growth across OECD countries using updated data and a multidimensional approach.

DATA AND METHODS

Data

Data on the variables used in the models were obtained from the World Bank and UNDP databases for the years 1990-2021. Table 1 presents the variables included in the models. We chose the variables in the models based on their theoretical and empirical relevance to the study's objectives. We selected key independent variables like secondary education enrollment, labor market participation, and political representation to represent various dimensions of gender inequality. We chose dependent variables like GDP growth and agricultural value-added to measure the overall and sector-specific economic impacts. We included agricultural employment among rural women to emphasize their critical role in economic productivity, particularly in agriculture. Tertiary education enrollment was not included in the analysis because data for many countries and years are missing in the WDI database. Including this variable would have reduced the number of observations and weakened the panel structure of the model. Also, the UNDP's Gender Inequality Index uses only primary and secondary education data. Among these, secondary education is the most relevant for capturing women's skills and participation in the labor market. For these reasons, we focused on primary and especially secondary education, which offer more complete and comparable data across countries and over time.

Table 1. Variables and Databases used in the Analysis

Variables	Description	Symbol	Source
Gross domestic product	GDP per capita ($1000) (constant 2015)	GDP	World Development Indicators
Gross capital formation	Investment as a percentage of GDP (%)	INV	World Development Indicators
Population	Population growth rate (%)	POP	World Development Indicators
Gender inequality index	Gender inequality index	GII	UNDP
Total imports and exports	Total trade as a percentage of GDP (%)	OPEN	World Development Indicators
Women's representation rate	Proportion of seats held by women in the national parliament (%)	SEATS	World Development Indicators
Enrollment in primary school	Female school enrollment rate (%)	EDPRIM	World Development Indicators
Secondary education enrollment	Female school enrollment rate (%)	EDSEC	World Development Indicators
Female labor participation	Female-male labor participation rate (%)	RLFP	World Development Indicators
Agricultural value added	Agricultural value added ($1000) (constant 2015)	AGDP	World Development Indicators
Female employment in agriculture	Female-male employment rate in agriculture (%)	FLAB	World Development Indicators
Female population	Population, female (% of total population)	FPOP	World Development Indicators

Methodology

This study examines the impact of gender inequality on economic growth across 38 OECD countries from 1990 to 2021 using dynamic panel data models. To address endogeneity and unobserved heterogeneity, we employ the Generalized Method of Moments (GMM) estimator, which leverages lagged variables as instruments. Static panel models (e.g., OLS, FE) are avoided due to their limitations in capturing dynamic economic relationships (Jiang and Khan, 2023; Khan et al., 2021).

We first test variable stationarity using Levin-Lin-Chu and Im-Pesaran-Shin panel unit root tests. After confirming non-stationarity at levels, first-differencing achieves stationarity. Pedroni's cointegration test rejects a long-run equilibrium, prompting the use of GMM.

Arellano-Bond's GMM is applied to address autocorrelation and heteroscedasticity. The model uses lagged endogenous variables as instruments, ensuring exogeneity. Key assumptions include zero-mean errors, absence of higher-order serial correlation, and homoscedasticity. Arellano-Bond tests confirm first-order autocorrelation (AR1) in differenced residuals and no second-order correlation (AR2), validating instruments. Hansen's J test verifies instrument exogeneity.

System GMM was also considered to improve estimator efficiency, particularly in the presence of persistent explanatory variables. By combining equations in levels and first differences, and limiting the number of instruments to avoid overfitting, the model yields reliable estimates. Coefficients are interpreted as dynamic effects, with lagged dependent variables capturing adjustment processes over time.

Robustness of the results was evaluated through fixed effects models and alternative specifications. The direction and significance of the key variables remained stable, indicating that the findings are not sensitive to the choice of estimation strategy or additional controls. This strengthens confidence in the observed link between gender inequality and economic outcomes across different contexts.

The use of dynamic panel techniques is especially relevant for gender-related variables, which often evolve gradually and reflect long-term structural conditions. Incorporating lagged values allows the models to better capture these dynamics and their cumulative effects on economic performance.

Overall, methodological design supports the generation of robust and policy-relevant results. The consistency of findings across different estimators and model setups suggests that reducing gender inequality can contribute meaningfully to economic growth. In the interconnected context of OECD countries, this also points to potential benefits from coordinated regional policies.

Model specifications

Three models were developed to address distinct hypotheses.

Model 1: Aggregate Growth and Gender Inequality

Adapted from Karoui and Feki (2018), this dynamic model evaluates GII's impact:

$$LGDP_{it} = c + \sigma \, LGDP_{i,t-1} + \beta_1 LINV_{it} + \beta_2 LPOP_{it} + \beta_3 GII_{it} + \varepsilon_{it} \quad (1)$$

where i = 1...... N, t = 1...... T and ε_{it} is the random error term. i denotes countries (OECD countries consisting of 38 countries) and t denotes time. Since the model is a dynamic model, one lagged value of the dependent variable, economic growth, is also included in the model. The lagged value of GDP is included to account for the dynamic nature of economic growth and to control for path dependence over time. Investment as a percentage of GDP (LINV) is a standard determinant in neoclassical and endogenous growth models, capturing the role of capital accumulation in economic expansion. Investment (LINV) has a positive impact on economic growth. Population growth rate (POP) is added to reflect demographic pressures and potential labor force effects, which may have either positive or negative implications depending on resource allocation and employment absorption. The Gender Inequality Index (GII) serves as the key explanatory variable, representing multidimensional gender disparities in education, labor market participation, and political empowerment. Higher GII values reflect greater inequality, which is expected to constrain growth by limiting the full utilization of human capital, lowering productivity, and reducing inclusive policy outcomes.

Model 2: Disaggregated Gender Effects on Economic Growth

$$LGDP_{it} = \alpha + \beta_1 LGDP_{i,t-1} + \beta_2 LINV_{it} + + \beta_3 LOPEN_{it} + \beta_4 LSEATS_{it} + \beta_5 LEDPRIM_{it} + \beta_6 lnEDSEC_{it} + \beta_7 LRLFP_{it} + \beta_8 Regions_{it} + \varepsilon_{it} \quad 2$$

where LGDP is GDP per capita; LINV is gross capital formation (% of GDP); LOPEN is total imports and exports (% of GDP); LSEATS is the share of seats held by women in the national parliament (%); LEDPRIM is primary school enrollment; LEDSEC is secondary school enrollment; and LRLFP is the female-to-male labor force participation rate. This model extends the analysis by disaggregating gender inequality into its fundamental dimensions to examine their individual effects on economic growth. The dependent variable remains the logarithm of GDP per capita (LGDP), capturing a country's overall economic performance. The lagged dependent variable ($LGDP_{t-1}$) accounts for inertia in economic growth processes. Gross capital formation (LINV) is included as a proxy for investment, which plays a central role in capital accumulation and long-term productivity. Trade openness (LOPEN), measured by the ratio of total imports and exports to GDP, reflects a country's integration into global markets and its potential to benefit from international trade, which may reinforce or mitigate gender disparities.

To capture gender-specific institutional and human capital factors, we include the proportion of parliamentary seats held by women (LSEATS) as a proxy for political empowerment. Greater female representation in political institutions may lead to more inclusive and growth-enhancing policies. Primary (LEDPRIM) and secondary (LEDSEC) female school enrollment rates reflect different stages of educational attainment, which are crucial for human capital development. While primary education is foundational, secondary education is more strongly associated with labor market participation and productivity gains. Lastly, the female-to-male labor force participation rate (LRLFP) measures gender disparities in access to economic opportunities. Including this variable allows the model to account for how labor market inequalities influence growth.

Model 3: Rural Gender Dynamics

Focused on Hypothesis 3, this model assesses rural gender dynamics:

$$LAGDP_{it} = \alpha + \beta_1 LAGDP_{i,t-1} + \beta_2 LFPA_{it} + + \beta_3 LPOP_{it} + \beta_4 LEDPRIM_{it} + \beta_5 lnEDSEC_{it} + \varepsilon_{it} \quad 3$$

In this model, $LAGDP_{it}$ represents agricultural value added, $LFPA_{it}$ denotes the female to men labor participation rate in agriculture, LFPOPit shows the female population, $LEDPRIM_{it}$ indicates the female primary school enrollment rate, and $LEDSEC_{it}$ represents the female secondary school enrollment rate. The dependent variable, agricultural value added (LAGDP), serves as a proxy for sector-specific economic output and reflects productivity trends in the agricultural sector. The lagged dependent variable (LAGDPt-1) captures the dynamic structure of agricultural development. The female-to-male agricultural labor participation rate (LFPA) is included to measure gender disparities in rural employment. Given that women play a central role in agriculture in many OECD countries particularly in family farming and informal labor, greater gender equality in employment is expected to enhance efficiency and output. The female population share (LFPOP) captures demographic pressures in rural labor supply; however, higher female population without corresponding access to education or employment may dilute productivity, hence the anticipated negative sign. To assess the role of human capital, we include female enrollment rates at both the primary (LEDPRIM) and secondary (LEDSEC) levels. Education enables rural women to adopt improved farming practices, access extension services, and participate in value chains beyond subsistence agriculture. While primary education provides basic literacy and skills, secondary education is more strongly linked to technology adoption, financial inclusion, and engagement in non-traditional agricultural sectors.

To reveal the impact of gender inequality on economic growth in different countries, Regions dummy variable is included in the model. OECD countries have different levels of development. Consequently, we group countries into developed and developing categories. Finally, we group countries into Asian, European, and American groups to measure the effect of being in different regions. These different groupings facilitate the analysis of the impact of gender inequality on growth.

RESULTS

This study examines the relationships between economic growth, agricultural value-added, and gender inequality in OECD countries using dynamic panel data methods. Three models were analyzed using both the Two-Step Difference GMM and Two-Step System GMM techniques. The models incorporate key economic and social indicators such as GDP, gender inequality, female employment rate, investment rate, population growth rate, trade openness, education levels, and the female population. These analyses aim to understand the impact of these variables on economic growth and agricultural value-added, ultimately contributing to policy development.

The descriptive statistics of the data used in the study reveal the basic characteristics of the variables included in the analysis. GDP shows a wide variation, reflecting the economic disparities among OECD countries. The value-added of the agricultural sector reflects the differences in agricultural production capacity among countries. The gender inequality index averages at a low 0.183, indicating generally low gender inequality in OECD countries. A lower value for this index indicates greater gender equality within a country. Education-related variables, particularly secondary and primary education levels, show that countries generally have high levels of education with high averages. The investment rate averages 23.67%, constituting a significant component of economic growth, while the population growth rate remains relatively low at an average of 0.6% (Table 2).

Table 2. Descriptive statistics of the variables (1990-2022)

Variable	N	Min	Max	Mean	Std. Dev.
GII	1254	0.01	0.82	0.18	0.12
GDP	1254	3,693.73	11,2417.88	33,053.00	20,322.96
INV	1254	11.89	54.77	23.67	4.45
POP	1254	-2.57	6.02	0.60	0.82
OPEN	1254	15.72	393.14	86.62	52.03
SEAT	1254	2.36	50.42	23.13	11.11
EDPRIM	1254	77.27	124.96	101.93	5.34
EDSEC	1254	11.51	100.00	75.36	20.51
RLFP	1254	21.56	79.77	52.07	9.28
AGDP	1163	115,893,059.48	67,637,322,892.20	12,471,426,958.85	14,270,834,921.13
FPOP	1254	48.70	54.47	50.99	1.02
FLAB	1216	0.14	2.54	0.59	0.37

Source: Authors' own calculations

The correlation analysis reveals the relationships between the variables used in the study. A strong negative correlation (-0.73) was found between GDP and the gender inequality index. This suggests that countries with lower gender inequality may experience higher economic performance. Similarly, a positive correlation (0.61) was observed between secondary education level and GDP, supporting the notion that education level has a positive impact on economic growth. There are no significant correlations between economic factors such as investment rate and trade openness, suggesting that these variables may contribute to economic growth independently. No significant correlation was found between population growth rate and other variables, indicating that the effects of population growth on economic growth may be indirect or complex. The correlation analysis for Model III emphasizes the relationships between agricultural value-added, education levels, female population, and rural female labor participation. The results indicate generally weak or moderate relationships between the variables. A weak negative correlation was observed between agricultural value-added and secondary education levels, while a weak positive correlation was found with primary education levels. This suggests that the impact of education levels on the agricultural sector may be complex. There is a weak negative correlation between the female population and agricultural value-added, whereas a weak positive correlation was observed between rural female labor participation and agricultural value-added (Table S1).

In regression analysis, it should be ensured that there is no multicollinearity between independent variables or that it is so insignificant that it can be ignored. The Variance Inflation Factor (VIF) analysis assesses the presence of multicollinearity among the independent variables in the models. VIF should be < 5 to check for multicollinearity. In this case, multicollinearity can be ignored (Tatoglu, 2020). The VIF values are generally low, with all variables having a VIF below 2, indicating no multicollinearity. For instance, the VIF value for secondary education level is 1.300, for primary education level it is 1.541, and for the rural female labor participation rate it is 1.271. These values suggest that there is no strong linear relationship between the independent variables, and the model's estimates are not suffering from multicollinearity issues. Therefore, these results can be interpreted as a positive sign regarding the reliability of the model (Table S2).

To ensure the validity of our econometric models, we first examined the stationarity of the variables in three models. Non-stationary variables can lead to spurious regression results, making it crucial to verify that the data series are stationary. We conducted panel unit root tests using the Levin-Lin-Chu and Im, Pesaran, and Shin (IPS) method, which addresses some of the limitations of other panel unit root tests by allowing for heterogeneity in the autoregressive coefficients across cross-sectional units. The results examined the stationarity of the variables at both the level and first difference forms. Overall, it was observed that most variables were stationary at the level form.

Specifically, key variables such as the gender inequality index, proportion of seats held by women, trade openness, and population became stationary after taking the first difference, according to both Levin-Lin-Chu and Im-Pesaran-Shin tests. These findings indicate that most of the variables used in the model contain a unit root but can be made stationary with appropriate transformations (Table S3).

The panel cointegration analysis, examining both common AR coefficients (within-dimension) and individual AR coefficients (between-dimensions), did not identify a cointegration relationship. The p-values for the panel v, rho, PP, and ADF statistics range from 0.72 to 1.00, indicating that the results of all tests are statistically insignificant. This suggests that there is no long-run equilibrium relationship between the analyzed variables (Table S4). Therefore, the independent variables in the model are not expected to move together and follow a common trend in the long run. Due to the absence of a long-run relationship in the panel cointegration analysis, Two-Step Difference and System GMM analyses were conducted to investigate the short-run dynamics. In the first model examining the effects of gender inequality on economic growth, GDP was used as the dependent variable, and the independent variables included the gender inequality index, investment rate, and population growth rate. Two-Step Difference GMM analysis results revealed that the previous period's GDP has a strong and positive effect on the current period's GDP (coefficient: 0.950, $p < 0.001$). This finding suggests that a country's past economic performance significantly shapes its future growth dynamics. A negative relationship was found between the gender inequality index and economic growth. The coefficient of the GII was found to be -0.027. This means that if the GII decreases by one unit (i.e., with increased gender equality), economic growth will increase by 0.027 units. This shows that economic growth slows down in countries with high gender inequality. Therefore, promoting gender equality is critical for sustainable economic growth. The coefficient of the investment rate was found to be 0.005, indicating that a one-unit increase in the investment rate will increase economic growth by 0.005 units. Investments are one of the fundamental elements supporting economic development. The coefficient of the population growth rate is -0.023. This shows that a one-unit increase in the population growth rate will reduce economic growth by 0.023 units (Table 3). A high population growth rate may constrain economic growth by exerting pressure on available resources.

The Two-Step System GMM analysis for Model I yielded findings consistent with the Difference GMM results. The gender inequality index continues to have a negative and significant effect on this model (coefficient: -0.020, $p < 0.05$). The investment rate also maintains its positive and significant impact on economic growth in the System GMM analysis (coefficient: 0.005, $p < 0.001$). However, the population growth rate does not show a significant effect on this model (coefficient: -0.0006, $p > 0.10$) (Table 3). These results once again emphasize the importance of gender equality and investment on economic growth but also suggest that the effects of population growth may vary depending on the model specification. These findings suggest that gender equality is a crucial factor in economic development, and increasing investments can support growth. It is also understood that population growth, if not controlled, can put pressure on economic growth. Therefore, policies promoting gender equality and investment-friendly strategies are essential for sustainable economic growth.

In both models, the Arellano-Bond tests indicate the presence of first-order autocorrelation but no second-order autocorrelation in the model. The Hansen test confirms the validity of the instruments, and there is no over-identification problem.

Model II provides a more comprehensive analysis compared to Model I, examining the impact of variables representing the fundamental dimensions of gender inequality on economic growth. This model incorporates variables such as trade openness, the proportion of women in parliament, primary education level, secondary education level, and female labor participation rate. According to the Two-Step Difference GMM analysis, the positive effect of the previous period's GDP on the current period is confirmed once again (coefficient: 0.684, $p < 0.001$). The coefficient of trade openness is found to be 0.001, indicating that a one-unit increase in trade openness will increase economic growth by 0.001 units. This finding suggests that global trade can enhance the economic performance of countries. Increasing trade openness can support economic growth by strengthening countries' integration into global markets. Secondary education level has a positive and significant effect on economic growth (coefficient: 0.004, $p < 0.001$) (Table 3). This means that a one-unit increase in the secondary education level will increase economic growth by 0.004 units. Education, particularly at the secondary level, stands out as a crucial factor for economic growth. However, primary education level, the proportion of women in parliament, and female labor participation rate did not show a significant effect in this model. This suggests that the effects of education and gender equality policies may be more pronounced at higher education levels and in different social contexts.

Table 3. The effects of gender inequality on economic growth (GMM analysis: DGMM and SGMM models)

Variables	Model I		Model II		Model III	
	DGMM	SGMM	DGMM	SGMM	DGMM	SGMM
L.GDP	0.950*** (0.017)	0.984*** (0.005)	0.684*** (0.001)	0.881*** (0.058)		
GII	-0.027*** (0.008)	-0.020*** (0.009)				
INV	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.003*** (0.001)		
POP	-0.023*** (0.004)	-0.0006 (0.004)				
OPEN			0.001*** (0.000)	0.0003** (0.000)		
EDPRIM			0.0007 (0.000)	0.007* (0.004)		
EDSEC			0.004*** (0.000)	0.001 (0.000)		
SEATS			0.0003 (0.000)	0.002* (0.001)		
RLFP			0.0006 (0.001)	0.0005 (0.001)		
L.AGDP					0.410*** (0.132)	0.988*** (0.006)
EDPRIM					-0.004** (0.001)	0.0005 (0.000)
EDSEC					0.007*** (0.001)	-0.0001 (0.000)
FPOP					0.008 (0.041)	0.004** (0.002)
FLAB					0.042 (0.085)	-0.003 (0.012)
2.DEVELOP			-0.182 (0.034)	0.182 (0.114)		
2.REGION						0.025* (0.012)
3.REGION						-0.008 (0.017)
Wald test	6660.77	6.64e+06	797.13	1.22e+06	16.91	6.38e+06
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1178	1216	1178	1216	1087	1125
No of id	38	38	38	38	38	38
AR(1)	-4.46	-4.61	-3.85	-4.17	-2.80	-3.81
	(0.000)	(0.000)	(0.000)	(0.000)	0.005	(0.000)
AR(2)	-1.48	-1.23	-0.72	-1.22	-0.34	0.01
	(0.139)	(0.218)	(0.471)	(0.224)	(0.737)	(0.989)
Sargan test	548.11	144.81	476.68	80.81	76.52	65.05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen test (overid)	37.32	27.38	37.46	25.15	34.66	35.80
	(0.168)	(0.007)	(0.164)	(0.014)	(0.255)	(0.215)
Hansen test excluding group	36.94	27.37	36.65	25.15	31.27	35.69
	(0.096)	(0.004)	(0.035)	(0.009)	(0.218)	(0.183)
Hansen test difference	0.38	0.01	0.81	0.00	3.39	0.11
	(0.945)	(0.936)	(0.997)	(0.989)	(0.495)	(0.741)

Source: Authors' own calculations

The Two-Step System GMM analysis results for Model II are largely consistent with the Difference GMM results. However, the effects of trade openness and secondary education level remain statistically significant only at the borderline in the System GMM analysis. Trade openness still shows a positive and significant effect on economic growth in this model (coefficient: 0.0003, $p < 0.10$). Nevertheless, the investment rate continues to have a positive and significant effect on economic growth in this model as well (coefficient: 0.003, $p < 0.01$) (Table 3). These findings emphasize the importance of education and trade policies that support economic growth. However, it is understood that the impact of education is more pronounced at the secondary education level, and investments made at this level can contribute more to economic growth. Therefore, education policies should specifically target the secondary education level. The Arellano-Bond tests for the validity of the model confirm that there are no autocorrelation problems, and the Hansen test confirms the validity of the instruments and no over-identification problem (Table 3).

Model III investigates how gender inequality impacts the value added of the agricultural sector in OECD countries, using agricultural value added as the dependent variable. Independent variables include female population, primary and secondary education levels, and the rural female labor participation rate. The Two-Step Difference GMM analysis reveals several key findings. First, past agricultural value added significantly predicts current agricultural value added (coefficient: 0.410, $p < 0.01$), indicating that performance in this sector relies heavily on historical trends. Interestingly, primary education level negatively affects agricultural value added (coefficient: -0.004, $p < 0.05$), suggesting that low education levels can hinder productivity. Conversely, secondary education level demonstrates a positive and significant effect (coefficient: 0.007, $p < 0.001$), emphasizing the importance of higher education for this sector. However, neither female population nor rural female labor participation rate shows a significant impact on agricultural value added ($p > 0.10$) (Table 3).

The Two-Step System GMM analysis largely supports these findings. The previous period's agricultural value added remains a strong predictor of the current period's value (coefficient: 0.988, $p < 0.001$). The negative effects of primary education and the positive effect of secondary education persist. Again, neither female population nor rural female labor participation rate demonstrates a significant impact on agricultural value added. The coefficient for the Europe regional variable is 0.025, and this effect is statistically significant ($p < 0.05$). This indicates that compared to Asia, the European region has a positive effect on increasing agricultural value added. The coefficient for America is -0.008, and this effect is not statistically significant ($p > 0.10$), meaning that America does not appear to have a significant impact on agricultural value added. Importantly, the Hansen test confirms the validity of the instruments used and no over-identification problem, and the Arellano-Bond tests indicate no autocorrelation problems, strengthening the reliability of these findings (Table 3). The analysis specifically highlights the significant and positive relationships found between rural women's secondary education enrollment and agricultural value-added, emphasizing the critical role of gender equality in the agricultural sector.

DISCUSSION

This study establishes that gender inequality directly impacts economic growth in OECD countries. Women's parliamentary representation and secondary education enrollment rates drive economic growth. In rural regions, secondary education enrollment and female agricultural employment show the strongest ties to growth. These results confirm that gender inequality hampers economic progress and that its effects differ across development contexts.

The findings align with existing literature. Karoui and Feki (2018) find a negative relationship between the Gender Inequality Index (GII) and GDP, consistent with patterns observed here. Seguino and Were (2014) propose public investment as a tool to mitigate gender disparities, a strategy applicable to the education and employment gaps identified in this analysis. Altuzarra et al. (2021) reinforces the role of educational equity in national development, particularly secondary schooling. The long-term growth constraints linked to gender gaps in education, as shown by Klasen (2000) and Yu et al. (2015) further validate these conclusions.

Rural economies present unique patterns. Women's agricultural employment and primary education correlate with productivity gains, reflecting similar findings in the work of Osabohien et al. (2021), in African settings. However, Matthew et al. (2022) warn that agricultural employment without institutional support risks weakening human capital, a caveat supported by OECD data. Rural growth strategies must therefore combine employment opportunities with training and resource access, as Yu and Osabohien (2023) propose.

Improved agricultural productivity raises rural household incomes, stimulating local economies through farm investments and increased demand for goods and services (Panda, 2015). This creates a multiplier effect, reducing poverty and enabling women to allocate resources to family education and healthcare, which strengthens human capital. Educated women further diversify rural economies by engaging in agro-processing, small-scale manufacturing, and services, reducing reliance on volatile agricultural markets (Asantewa, 2024). Such diversification enhances economic resilience, improves household bargaining power, and sustains long-term development.

Cross-country analyses reveal consistent economic returns from female education. Regression models controlling investment, trade, and institutions link gender-equal education to higher GDP per capita growth. The stronger effect in recent decades aligns with the growing role of knowledge-based sectors, where educated workforces spur innovation. Longitudinal studies confirm that investments in female education produce lasting growth benefits through accumulated human capital.

Political representation disparities amplify economic inefficiencies. Low female legislative participation correlates with policies neglecting gender-specific barriers, such as unequal pay and inadequate childcare. Altuzarra et al. (2021) and Sumithira (2024) demonstrate that greater female representation fosters policies prioritizing education, healthcare, and workplace equity, factors tied to productivity. Political reforms, such as gender quotas or campaign finance adjustments, could address systemic biases limiting growth.

Policy implications are twofold. First, educational interventions should target rural primary schooling and urban secondary enrollment to address regional disparities. Second, agricultural employment initiatives require vocational training and resource allocation to avoid the pitfalls Matthew et al. (2022) identify. Legislative measures to increase female political participation, including quotas and anti-discrimination laws, could align policy priorities with economic needs.

This study's limitations include its reliance on macro-level data, which may mask subnational variations. Future research could use microeconomic datasets to explore intra-country disparities. Extending this framework to developing economies would clarify how development stages shape the gender-growth relationship.

The evidence confirms that gender inequality functions as a structural economic barrier. Addressing it demands integrated strategies connecting education, labor markets, and political systems. Such measures would enhance equity while unlocking productivity gains in underutilized rural and female labor pools.

CONCLUSION

This study analyzes the impact of gender inequality on economic growth across 38 OECD countries from 1990 to 2021 using dynamic panel models. Results demonstrate that disparities in education and political representation constrain economic performance. Countries neglecting investments in women's education exhibit slower growth, with developing countries showing stronger effects. Women's parliamentary representation correlates positively with growth, reflecting the economic value of inclusive governance. The findings particularly emphasize the importance of reducing gender gaps in secondary education and enhancing employment opportunities for rural women. Our analysis clearly indicates that improvements in rural women's education significantly boost agricultural productivity, thereby contributing directly to rural economic growth.

Persistent gender gaps in labor markets, education, and leadership remain prevalent across OECD countries. Systemic barriers, including unpaid care burdens, occupational segregation, and wage discrimination, reduce women's lifetime earnings and limit economic contributions. Underrepresentation in politics risks perpetuating policies that overlook gender-specific challenges, such as childcare access and pay equity.

Recent policy advancements, such as paternity leave reforms and gender budgeting, signal progress. However, crises like the COVID-19 pandemic threaten to reverse gains. Women's overrepresentation in pandemic-affected sectors and disproportionate care responsibilities emphasize vulnerabilities requiring targeted interventions.

Given these results, targeted rural policies such as expanding secondary educational infrastructure, vocational training tailored to agricultural contexts, and enhancing women's land rights are crucial. Such targeted interventions can unlock substantial productivity gains in rural economies. Further studies should investigate the effectiveness of specific policy interventions in rural and agricultural contexts to address gender inequality. Utilizing micro-level data could offer deeper insights into subnational variations, particularly in rural areas where gender gaps in education and employment are most pronounced.

In Turkey, gender inequality remains pronounced. Educational reforms increased enrollment, but men disproportionately benefit. Women's per capita income lags at less than half of men's, reflecting low labor force participation and occupational segregation. Rural women face additional barriers, including limited land access and quality education. The pandemic increased unpaid labor burdens and reduced employment rates, particularly in critical sectors like healthcare and education.

Effective policies must address structural inequities. For rural areas, improving educational quality, securing land rights, and enhancing occupational safety are critical. Expanding access to financial resources and decision-making power can empower women economically. Nationally, integrating gender considerations into policymaking through gender-disaggregated data collection and equitable representation can align economic strategies with equality goals.

Three priorities emerge from the analysis. First, education systems must focus on reducing regional disparities in access and quality, particularly in rural Turkey, while correcting subject-choice imbalances that limit opportunities for girls in OECD countries. Second, labor market reforms require reducing occupational segregation through policies that promote flexible work arrangements, expand childcare support, and enforce anti-discrimination laws to ensure equitable hiring and promotion practices. Third, advancing political representation centers on adopting quota systems and campaign financing reforms to strengthen women's influence in legislative and executive decision-making processes, ensuring policies reflect gender-specific needs.

Economic growth alone cannot eliminate gender inequality. Proactive measures, such as gender responsive budgeting and crisis resilience frameworks, are essential to convert parity into sustained economic gains. Future research should explore subnational disparities and policy efficacy in developing economies.

For Turkey and OECD members, advancing gender equality remains a strategic imperative. Closing gaps in education, employment, and leadership will unlock productivity, foster innovation, and build resilience against future shocks.

Supplementary Materials

Table S1. Correlation Matrix

	Model I and II								
	GDP	GII	EDSEC	EDPRIM	SEATS	LFPR	INV	OPEN	POP
GDP	1								
GII	-0.73	1							
EDSEC	0.60	-0.59	1						
EDPRIM	-0.21	0.11	-0.36	1					
SEATS	0.49	-0.70	0.38	0.05	1				
RLFP	0.49	-0.50	0.59	-0.09	0.51	1			
INV	-0.04	0.05	0.05	-0.06	-0.22	-0.04	1		
OPEN	0.33	-0.28	0.31	-0.21	0.13	0.04	0.02	1	
POP	0.04	0.09	-0.19	0.15	0.05	-0.00	0.03	-0.07	1
	Model III								
	AGDP	EDSEC	EDPRIM	FPOP	FLAB				
AGDP	1								
EDSEC	-0.29	1							
EDPRIM	0.23	-0.42	1						
FPOP	-0.23	0.13	-0.10	1					
FLAB	0.30	-0.39	-0.06	-0.02	1				

Source: Authors' own calculations

Table S2. Multicollinearity Analysis of the variables

Variable	Collinearity Statistics		
	Model I Tolerance VIF	Model II Tolerance VIF	Model III Tolerance VIF
GII	0.9911.010		
EDSEC	0.9971.003	0.4942.025	
EDPRIM	0.9921.008	0.8151.227	
SEATS		0.6531.532	
RLFP		0.5281.894	
INV		0.9281.078	
OPEN		0.8571.167	
POP			
EDPRIM			0.7691.541
EDSEC			0.6491.300
FPOP			0.9811.019
FLAB			0.7871.271

a. Dependent Variable: lgdp, lagdp
Source: Authors' own calculations

Table S3. Panel Unit Root Test Results

Variable	Levin Lin Chu		In Pesaran Shin	
	I(0)	I(1)	I(0)	I(1)
GDP	-5.215***	-14.367***	1.692	-16.685***
GII	6.181	-9.721***	11.830	-11.814***
EDSEC	-8.658***	-2.612**	-2.091**	-6.387***
EDPRIM	-3.655***	-13.416***	-4.828***	-17.728***
SEATS	5.639	-13.119***	9.748	-16.674***
RLFP	-4.268***	-13.547***	1.839**	-18.150***
INV	-4.467***	-16.576***	-6.227***	-20.258***
OPEN	0.221	-16.196***	0.3.455	-20.398***
POP	-2.358*	-7.642***	-4.718***	-17.268***
AGDP	-2.482***	-16.531***	-0.849	-21.336***
FPOP	-9.272***	-7.165***	-2.171**	-7.088***
FLAB	-3.864***	-15.158***	-1.396*	-20.965***

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$ Source: Authors' own calculations

Table S4. Panel cointegration test results

			Weighted	
	Statistic	Prob.	Statistic	Prob.

Alternative hypothesis: common AR coefs. (within-dimension)				
Panel v-statistics	-0.587	0.7216	-1.581	0.9432
Panel rho-statistics	2.652	0.9960	2.836	0.9977
Panel PP-statistics	1.375	0.9155	1.493	0.9323
Panel ADF-statistics	2.443	0.9927	2.793	0.9974
Alternative hypothesis: individual AR coefs. (between-dimensions)				
Group rho-statistics	4.433	1.000		
Group PP-statistics	1.688	0.9543		
Group ADF-statistics	2.587	0.9952		

Source: Authors' own calculations

Informed Consent Statement

Not applicable

Conflicts of Interest

The authors declare no conflicts of interest.

Additional Information

This study is based on the first author's MSc thesis.

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