Research Article

Mind The Gap: Public Education Expenditures and Gender Employment in Europe

İrem YENDİ ÇETİN[1]

[1] Assoc. Prof. Dr., Hacettepe University, iremyendi@gmail.com, ORCID: 0000-0002-3717-7462

Abstract: Reducing gender-based employment gaps is vital for sustainable development and equitable economic growth. Education policies are among the key tools for increasing women's human capital and facilitating their access to the labor market. The impact of public education expenditures on the gender gap in employment rates may vary depending on both the type of expenditure and the targeted level of education. In this context, the study analyzes the effects of public education expenditures on the gender-based employment gap in European countries using the Panel ARDL method. The study analyzes data from 30 European countries between 2014 and 2022. The findings reveal that public spending on secondary and higher education, in particular, has a significant and statistically strong effect on reducing the gender-based employment gap in the long term. In contrast, the long-term effect of education subsidies was not found to be statistically significant. The results indicate that public education policies should not only focus on the total amount of spending but also consider the quality of spending, the target audience, and the level of education. In this context, the study aims to fill the gap in the literature on the disaggregated effects of public education spending on gender equality and to provide evidence-based contributions to the design of gender-sensitive public policies.

Keywords: Gender Sensitive Employment Gap, Public Education Expenditures, Panel ARDL
Jel Codes: I28, J16, C33

Açığa Dikkat Et: Avrupa'da Kamu Eğitim Harcamaları ve Toplumsal Cinsiyete Duyarlı İstihdam

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Öz: Toplumsal cinsiyet temelli istihdam farklarının azaltılması, sürdürülebilir kalkınma ve eşitlikçi ekonomik büyüme açısından önem taşımaktadır. Eğitim politikaları ise, kadınların beşerî sermayelerini artırarak işgücü piyasasına erişimlerini kolaylaştıran temel araçlar arasında yer almaktadır. Kamu eğitim harcamalarının kadın ve erkek istihdam oranları arasındaki fark üzerindeki etkisi hem harcamanın türüne hem de hedeflenen eğitim düzeyine göre farklılık gösterebilir. Bu çerçevede, çalışmada, Avrupa ülkelerinde kamu eğitim harcamalarının toplumsal cinsiyet temelli istihdam açığı üzerindeki etkileri Panel ARDL yöntemiyle analiz edilmektedir. Çalışmada, 30 Avrupa ülkesinin 2014–2022 yılları arasındaki verileri kullanılarak analiz yapılmıştır. Elde edilen bulgular, özellikle ortaöğretim ve yükseköğretime yönelik kamu harcamalarının uzun vadede toplumsal cinsiyet temelli istihdam farkını azaltmada anlamlı ve istatistiksel olarak güçlü bir etkiye sahip olduğunu ortaya koymaktadır. Buna karşılık, eğitim sübvansiyonlarının uzun vadeli etkisi istatistiksel olarak anlamlı bulunmamıştır. Sonuçlar, kamu eğitim politikalarının yalnızca toplam harcama miktarına odaklanmakla kalmayıp, harcamanın niteliği, hedef kitlesi ve eğitim düzeyi gibi boyutlarının da dikkate alınması gerektiğine işaret etmektedir. Bu bağlamda çalışma, kamu eğitim harcamalarının toplumsal cinsiyet eşitliği üzerindeki ayrıştırılmış etkilerine ilişkin literatürdeki boşluğu doldurmayı ve cinsiyete duyarlı kamu politikalarının tasarımına yönelik kanıta dayalı katkılar sunmayı amaçlamaktadır.

Keywords: Toplumsal Cinsiyete Duyarlı İstihdam Açığı, Kamu Eğitim Harcamaları, Panel ARDL
Jel Kodları: I28, J16, C33

1. Introduction

Gender-based inequalities in employment remain one of the fundamental structural problems threatening sustainable development goals on a global scale. The differences observed between men and women in terms of labor market participation and employment rates have significant consequences not only in terms of economic efficiency but also in terms of social justice and equal opportunities. Although gender equality is a goal that encompasses both sexes, inequalities in employment often disadvantage women. Women's position in the labor market is influenced by various structural factors, such as their level of education, care responsibilities, career guidance, and sector-based segregation.

Enhancing women's participation in the workforce remains a central aim for promoting gender equality and achieving sustainable economic progress. Despite economic advancement, European countries still exhibit a substantial gender gap in employment; for instance, as of 2024, women's employment rate in the EU stood at 70.8%, trailing men's rate of 80.8% (Eurostat, 2025). Public education spending plays a critical role in shaping labor market outcomes for both men and women by enhancing human capital, improving skills, and expanding access to employment opportunities. However, in many societies, the returns on such investments are not gender neutral; structural inequalities mean that women often face greater barriers in benefiting from education driven labor market gains. Accordingly, public investment in education is recognized as a strategic policy lever that can elevate women's human capital and expand their access to employment opportunities in the long term. Evaluating the role of public education spending in this context is thus essential for crafting effective strategies to facilitate women's labor market integration.

Much of the existing research has approached the link between public education outlays and women's employment in aggregate terms, often neglecting how targeted spending at specific educational levels or subsidies may yield distinct effects (e.g Voumik et al., 2023; Bussemakers et al., 2017). Yet, the influence of such expenditures is likely to vary by educational level. For instance, tertiary education funding may enable women to gain specialized skills for high-paying careers, whereas primary education spending may elevate basic education outcomes across the broader population of women. This divergence stems from the fact that primary education serves as a foundation for general literacy and basic skill development, which while essential may not be sufficient on its own to bridge the gender employment gap. In contrast, tertiary education enhances sector-specific competencies and access to formal employment channels, often acting as a gateway to professional and higher-paying occupations that have historically excluded women.

The current study expands on these distinctions by analyzing how each level of public education expenditure affects the gender employment gap differently. Subsidies that ease educational costs may be crucial for retaining disadvantaged female students. However, the lack of disaggregated evidence on this issue points to a significant research gap. To our knowledge, no prior study has systematically examined how disaggregated categories of public education expenditures, primary, secondary, tertiary, and subsidies, shape the gender employment gap in the European context, making this analysis a novel contribution to the literature. Understanding the potential and limitations of subsidies is therefore essential for explaining why their long-term employment effects may differ from more direct educational investments.

To fill this gap we investigate the differentiated effects of public education expenditures on women's labor force participation across Europe. Utilizing a balanced panel of 30 countries, mostly EU members, from 2014 to 2022, the research categorizes public education spending into four components: primary, secondary, tertiary, and subsidies. This categorization reflects the distinct roles that different levels of education play in shaping women's labor market outcomes.

Primary education expenditures are intended to promote basic literacy, numeracy, and foundational learning, which are critical for early-stage human capital development but may not directly influence formal employment in the short term. Secondary education expenditures target the expansion of intermediate-level qualifications, offering skills and credentials that can serve as a bridge to both employment and higher education. Tertiary education expenditures aim to cultivate specialized knowledge and advanced competencies, often linked to access to high skilled, formal sector jobs, which are key to reducing gender-based occupational segregation. Education subsidies, on the other hand, are policy tools designed to lower the financial barriers to schooling particularly for disadvantaged groups and can be crucial for ensuring continuity in girls' educational trajectories. Disaggregating public education spending in this way allows for a more nuanced analysis of how each category may affect gender employment disparities through different mechanisms and time horizons. Each component's influence on gender employment disparity is analyzed independently. The methodology adopts the Panel ARDL (Autoregressive Distributed Lag) approach[1], which facilitates the estimation of both long-run equilibrium relationships and short-run fluctuations. This model enables a nuanced assessment of how education spending affects female employment over time.

The remainder of the paper is structured as follows: the second section surveys the relevant literature on public education investment and employment equality/inequality by gender. Section three outlines the dataset, model, and econometric framework. Empirical results are discussed in section four, while the final section offers conclusions and policy recommendations.

2. Literature Review

Many early studies highlighted the long-term role of public education spending in improving women's employment outcomes in Europe. Across the EU, particularly in countries like Sweden, Germany, and the Netherlands, sustained public investment in female education has been linked to a gradual rise in women's labor market participation over recent decades (Bussemakers et al., 2017; Eurostat, 2025). Between 2004 and 2014, the EU-28 female employment rate rose from 55.5% to 59.6%, although a significant gap remained compared to men (70.1% in 2014; Eurostat, 2025). These gains coincided with increased spending on post-primary education, where skill development and labor market integration policies were gender-mainstreamed. Public investments in education significantly influence women's standing in the labor market, although their effects vary by education level and context. It is widely accepted that foundational expenditures on early education are crucial for building the infrastructure necessary to promote women's workforce inclusion over time.

In contrast, in developing countries such as India and Pakistan, cultural and structural inequalities in education persist more prominently. For instance, the household prioritization of boys' education negatively affects female labor participation by limiting girls' educational opportunities (Rashmi et al., 2022; Aslam & Kingdon, 2008). These challenges are compounded by insufficient public spending on gender-equal access to schooling. Similarly, in Turkey, while more women now attain tertiary education, continuing occupational segregation and labor market rigidities hinder the transformation of educational attainment into secure and well-paid employment (Tekgüç et al., 2017).

Recent empirical findings in Europe further clarify these relationships. Spending on female education, particularly secondary school enrollment, directly promotes female labor supply. This suggests that policies focused on human capital development can

[1] The Panel Autoregressive Distributed Lag (ARDL) approach is a dynamic panel estimation method that allows for both short-run and long-run relationships between variables. It is particularly useful when the variables are integrated of order I(0) and I(1), but not I(2), and when heterogeneity across cross sectional units is present. The method supports flexible lag structures and can accommodate cointegration analysis in panels with mixed stationarity properties (Pesaran, Shin, & Smith, 1999; Blackburne & Frank, 2007).

effectively increase women's participation in the labor force (Law & Wye, 2023). These findings reinforce earlier evidence from European countries, showing that increased public investment in secondary and tertiary education contributes to narrowing gender gaps in employment by equipping women with the skills required for formal and skilled labor market integration.

Spending at the secondary education level appears to be particularly effective in enhancing women's employment opportunities. Expanding access to secondary schooling enables more women to pursue qualified jobs and mitigates gender disparities. In the European context, broad access to secondary education has historically helped more women move into skilled jobs. Nonetheless, in many developing countries, gender-biased investments favor boys, thereby impeding girls' access to quality secondary education and reinforcing inequalities (Azam & Kingdon, 2013; Singh et al., 2023). This skewed access leads to gendered occupational clustering, with women concentrated in traditional and low-income sectors (Acosta-Ballesteros et al., 2024).

Although greater spending on higher education can elevate women's employment outcomes, persisting occupational and sectoral segregation undermines its full impact. For example, even highly educated women in Turkey often occupy insecure or lower-status jobs, despite narrowing wage gaps (Tekgüç et al., 2017). This phenomenon is not exclusive to developing countries. While in many Western and Northern European countries, higher education is associated with access to better-quality employment for women thanks to stronger labor protections, parental leave policies, and anti-discrimination frameworks (Berg et al., 2021) precarious employment still exists among educated women across parts of Southern and Eastern Europe (Rubery & Tavora, 2020). Furthermore, women who hold degrees in fields outside of STEM (science, technology, engineering, mathematics) face barriers to entering high-paying occupations, perpetuating inequality (Lepinteur & Nieto, 2025). Thus, policy designs must aim to improve sectoral diversity through targeted orientation and academic guidance programs (Peter et al., 2024).

Public education subsidies can also influence gender-based labor disparities. When implemented as gender-neutral tools in patriarchal settings, they may unintentionally benefit boys more than girls. This unintended outcome is not solely the result of patriarchy but also stems from the absence of gender-responsive budgeting practices. In most countries, public budgets are formulated without a gender lens, making them inherently gender-neutral. As a result, subsidies tend to favor already privileged groups often men unless explicitly designed to promote gender equity. Furthermore, male-dominated policymaking processes and institutional structures reinforce these outcomes. Hence, the effects of education subsidies are shaped by both structural gender biases and the lack of systemic mechanisms to address them.

By contrast, subsidy schemes tailored specifically for girls have shown greater success in narrowing employment gaps over time by fostering equitable access to education (Mukhopadhyay, 2022, 2024). In addition to supporting girls' participation in STEM, targeted financial support in fields such as law, education, health care, and entrepreneurship can also improve women's labor market outcomes. Rather than prematurely concluding that education subsidies are ineffective, this study proceeds to empirically analyze how the gender sensitivity of educational spending across all schooling levels shapes employment outcomes for women and men in European countries. The goal is to evaluate not only the overall volume but also the structure and targeting of education-related expenditures.

Overall, greater public education spending tends to promote gender equity across all schooling levels by opening employment avenues for women and decreasing labor market disparities (Mbodji, 2023). However, such investments do not solely contribute to macroeconomic development; they also play a vital role in advancing social equity, human capital formation, and long-term institutional resilience (Klasen & Lamanna, 2009).

Public education expenditures, when strategically allocated, constitute vital investments in human capital and social equity. Rather than treating education spending and investment as entirely separate concepts, this study defines public education spending as fiscally budgeted allocations aimed at generating long-term socio-economic benefits.[2]If such spending contributes positively to labor market participation particularly among women it can enhance economic productivity and, as a result, support overall economic growth. In less-developed contexts, infrastructure development and time-saving policies help reduce barriers to women's workforce engagement (Cubas, 2016). In advanced economies, however, the benefits of growth are often channeled through improved educational access and skill levels (Afonso & Blanco-Arana, 2025). Nevertheless, widespread informal or precarious employment among women may blunt these effects (Gharehgozli & Atal, 2021). Persistent wage discrimination, as noted by Cavalcanti & Tavares (2016), further hampers gender-equal growth, highlighting the need for proactive equality strategies such as wage transparency laws, gender quotas in leadership, and subsidized childcare services that can address structural labor market barriers.

3. Data, Model and Methodology

This study draws on panel data from 30 European countries[3]; including EU member states and a few others; for the 2014–2022 period, with all indicators sourced from European Statistical Office (EurostatT). The gender employment gap (GAP), defined as the male-female employment rate difference, serves as the dependent variable. Four key types of education expenditures are assessed: subsidies (SUB), primary education (PRIM), secondary education (SECON), and higher education (TER), all measured as percentages of Gross Domestic Product (GDP). Real per capita GDP (LNGDP) is included as a control variable in all model specifications. Descriptive statistics for all variables are presented in Table 1. The gender employment gap (GAP), measured as the difference between male and female employment rates, has a mean value of 9.54 percentage points, indicating that, on average, women's employment rates are nearly 10 points lower than those of men across the sample countries. The gap ranges from a minimum of 0.8 to a maximum of 26.8, reflecting significant variation in gender employment inequality across European countries.

The variable LNGDP, representing the natural logarithm of real GDP per capita, has a mean of 10.29, with values ranging from 8.83 to 11.61, indicating cross-country income differences in the panel.

Regarding public education expenditures (as a percentage of GDP), the average spending on education subsidies (SUB) is 0.21%, with some countries reporting no expenditure at all (min=0). Primary education (PRI) has a mean value of 1.75%, showing relatively high public investment at the foundational level, with some countries allocating up to 5% of GDP. Expenditures on secondary education (SECON) average 1.70%, ranging between 0.7% and 2.8%, while tertiary education (TER) spending is the lowest among categories, with a mean of 0.94%, indicating relatively limited allocation to higher education.

These descriptive statistics reveal heterogeneity in both gender employment gaps and education spending patterns across European countries, justifying the need for a disaggregated and level-specific econometric analysis in the subsequent sections of the study.

[2] In this study, "public education spending" is conceptually aligned with "investment" as it refers to deliberate and strategic fiscal allocations intended to yield long-term economic and social returns, especially in the context of human capital development and gender equality.

[3] These countries are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and Switzerland.

Table 1. Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Min	Max
GAP	270	9.538148	5.226995	0.8	26.8
LNGDP	270	10.28642	0.6638834	8.825076	11.6121
SUB	270	0.2148148	0.1540137	0	0.7
PRI	270	1.746296	0.8013727	0.6	5
SECON	270	1.699259	0.4294886	0.7	2.8
TER	270	0.9403704	0.344203	0.4	2

Source: Author's calculations based on Eurostat data.

In panel data analysis, it is essential to test for cross-sectional dependence prior to unit root testing to ensure the reliability of the results. First-generation panel unit root tests such as Levin, Lin & Chu and Maddala & Wu rely on the assumption that cross-sectional units are independent. However, due to economic, social, or structural interlinkages among countries, the presence of cross-sectional dependence is highly probable in macro-level data. Therefore, the CD test developed by Pesaran (2004) was conducted as a preliminary diagnostic. The test results indicate that the null hypothesis of no cross-sectional dependence cannot be rejected, suggesting that first-generation unit root tests are appropriate for the dataset. The results of this test are presented in Table 2.

Table 2. Cross Sectional Dependence Test

Variable	CD Test Statistics	p value
GAP	-1.129	0.637
LNGDP	0.758	0.448
SUB	-0.472	0.637
PRI	0.381	0.703
SECON	0.532	0.595
TER	0.194	0.846

Source: Author's calculations based on Eurostat data

To estimate both short-run and long-run relationships between education spending and the gender employment gap, the study employs the Panel ARDL approach. This technique is well-suited for panel datasets featuring variables integrated at different orders, specifically I(0) and I(1), and supports robust inference even when cointegration exists among the variables.

The Panel ARDL approach is methodologically flexible, as it permits variables to be stationary at different integration levels, such as I(0) or I(1)[4] (Pesaran, Shin, & Smith, 1999; Blackburne & Frank, 2007). However, none of the variables should be integrated of order two (I(2)). Given the integration levels of the variables, panel unit root tests were conducted prior to estimation. Table 3 displays the results of panel unit root tests for all variables in their first-differenced forms. The Levin, Lin & Chu and Maddala & Wu tests consistently reject the null hypothesis of non-stationarity at the 1% and 5% significance

[4] In this context, the notation I(0), I(1), and I(2) refers to the order of integration of a time series variable. A variable is said to be I(0) if it is stationary in levels, meaning its statistical properties such as mean and variance remain constant over time. A variable is I(1) if it becomes stationary after taking the first difference, which means it shows trends over time but these trends can be removed by differencing once. Similarly, a variable is I(2) if it becomes stationary only after differencing twice. The Panel ARDL model requires that the variables be either I(0) or I(1), but not I(2), to ensure valid estimation and inference.

levels for all variables. This indicates that the gender employment gap (GAP), real GDP per capita (LNGDP), and all categories of public education expenditures, subsidies (SUBSIDATY), primary (PRIM), secondary (SECON), and tertiary (TER), are integrated of order one, i.e., I(1). These findings validate the use of the Panel ARDL method, which requires that the variables be either I(0) or I(1), but not I(2). The confirmation of I(1) behavior across all variables also justifies proceeding with panel cointegration tests to explore long-run relationships among them.

Table 3. Panel Unit Root Tests

Variable	Levin, Lin & Chu t*	PP - Fisher Chi-square
D(LNGDP)	-5.20395***	229.869***
D(TER)	-12.8207***	118.788***
D(SUBSIDATY)	-2.72111***	50.0290***
D(SECON)	-9.34317***	219.964***
D(PRIM)	-1.65619**	143.977***
D(GAP)	-9.66164***	152.508***

Source: Author's calculations based on Eurostat data
Note: *** and ** denote statistical significance at the 1% and 5% level, respectively.

After conducting unit root tests, the existence of a long-run cointegration relationship among the non-stationary variables is examined using the Pedroni (2004) [5] panel cointegration test, which is applied to four separate models, each incorporating a different education expenditure variable. The test includes both within-dimension statistics, based on the joint autoregressive coefficient assumption, and between-dimension statistics, based on the individual autoregressive coefficient assumption.

Table 4. Panel Cointegration Tests

Model	Panel PP-Stat (within)	Panel ADF-Stat (within)	Group PP-Stat (between)	Group ADF-Stat (between)
Model 1: SUB	-3.853***	-0.891	-7.129***	-4.301***
Model 2: PRI	-6.361***	-2.092**	-5.940***	-1.214
Model3: SECON	-1.876**	-2.032**	-3.433***	-1.705**
Model 4: TER	-2.540**	-1.842**	-4.790***	-1.185

Source: Author's calculations based on Eurostat data
Note: *** and ** denote statistical significance at the 1% and 5% level, respectively.

Table 4 summarizes the results of Pedroni panel cointegration tests applied separately to four models. Each model includes the gender employment gap (GAP) and real per capita GDP (LNGDP) alongside one category of education expenditure:

Model 1: Education subsidies (SUB)
Model 2: Primary education expenditures (PRI)
Model 3: Secondary education expenditures (SECON)
Model 4: Tertiary education expenditures (TER)

[5] The Pedroni (2004) panel cointegration test is designed to assess the existence of a long-run equilibrium relationship among non-stationary panel variables. It accounts for heterogeneity across cross-sections and provides two sets of statistics: within-dimension (panel) statistics that assume a common autoregressive process, and between-dimension (group) statistics that allow for individual autoregressive processes for each cross-sectional unit.

Each model tests whether these sets of variables share a long-run cointegration relationship, implying that they move together over time despite being non-stationary individually. The results in Table 4 provide strong evidence of long-run relationships between gender employment disparities and various types of education expenditures. Model 1 shows robust cointegration between GAP, LNGDP, and education subsidies, with all test statistics (panel and group) being statistically significant at the 1% level. Model 2 indicates that GAP, LNGDP, and primary education spending also share a long-run relationship; however, the Group ADF statistics are not significant, suggesting slightly weaker evidence compared to Model 1. Model 3, which includes secondary education spending, yields consistently significant results across all test statistics, strongly supporting the presence of cointegration. Model 4 (with tertiary education spending) shows partial, but meaningful cointegration three out of four statistics are significant, with within-dimension results being particularly strong. These findings suggest that public spending on education, particularly at the secondary and higher levels, tends to co-move with the gender employment gap and economic development, forming a stable long-run equilibrium. The statistical significance of both Panel PP-Stat and Group PP-Stat reinforces the reliability of proceeding with Panel ARDL estimation for long-term impact analysis.

Equation 1 presents the structure of the panel ARDL(p,q) model:

$$\Delta GAP_{it} = \phi_i\left(GAP_{i,t-1} - \theta_1 LNGDP_{i,t-1} - \theta_2 EDU_{i,t-1}\right) + \sum_{p=1}^{P} \lambda_{ip}\Delta GAP_{i,t-p} + \sum_{q=0}^{Q} \gamma_{iq}\Delta LNDP_{i,t-q} + \sum_{r=0}^{R} \delta_{ir}\Delta EDU_{i,t-r} + \ \mu_i + \varepsilon_{it} \quad (1)$$

This equation represents the Panel ARDL model in its error correction form, which allows the simultaneous estimation of short-run dynamics and long-run equilibrium relationships between the gender employment gap (GAP_{it}), real GDP per capita ($LNGDP_{i,t}$), and various components of public education expenditures ($EDU_{i,t}$). Here, Δ denotes first differences, capturing short-term effects, while the term in parentheses captures long-run relationships, where $\phi_i$is the error correction coefficient indicating the speed of adjustment back to equilibrium. The model includes country-specific intercepts μ_i and idiosyncratic errors ε_{it}. Parameters λ_{ip}, γ_{iq}, δ_{ir} represent short-run coefficients, and $\theta_1$and θ_2 are long-run coefficients. The inclusion of the error correction term ensures that deviations from long-run equilibrium are corrected over time, validating the use of the ARDL framework under mixed order integration.

To ensure robustness, both the Pooled Mean Group (PMG) and Mean Group (MG) estimators are applied. PMG assumes that long-run coefficients are consistent across countries, while MG allows for complete heterogeneity. The Hausman test is used to determine which estimator is preferable for each model. While slope homogeneity is often examined using the Pesaran & Yamagata (2008) delta test, this study relies on the Hausman test, which indirectly controls homogeneity by comparing the PMG and MG estimators. The joint use of PMG, MG, and the Hausman test enhances robustness by addressing potential heterogeneity across countries and ensures that long-run effects are not biased by incorrect parameter assumptions. In this way, the Hausman test provides an empirical basis for model selection and reinforces the credibility of the long-run inferences.

4. Empirical Findings

Table 5 displays the estimation outcomes derived using the Panel ARDL method under both PMG and MG specifications. It also includes the p-values from the Hausman tests, guiding the choice of the most appropriate estimator.

Table 5. Panel ARDL and Hausman Test Results

Model	PMG Long-Run LNGDP	PMG Long-Run Education	PMG SR LNGDP	PMG SR Education	PMG Short-Run ECT	MG Long-Run LNGDP	MG Long-Run Education	MG Short-Run ECT	Hausman Test p-value
Model 1: SUB	-2.824***	1.479	3.567**	1.638	-0.503***	-14.592	1.875	-0.766***	0.8919
Model 2: PRI	-2.061***	1.543***	2.973	-0.631	-0.531***	7.497	-9.824	-0.688***	0.8981
Model 3: SECON	-3.235***	-2.184***	3.689	0.777	-0.487***	139.156	55.378	-0.612***	0.7837
Model 4: TER	-3.764***	-3.295***	2.364	1.606*	-0.441***	8.858	11.966	-0.892***	0.6934

Source: Author's calculations based on Eurostat data

Note: *** and * denote statistical significance at the 1% and 10% level, respectively.

According to Table 5, Model 1 indicates that long-run results indicate that increases in real GDP per capita are significantly associated with a narrowing gender employment gap (β=-2.824, $p<0.01$). However, the long-term effect of education subsidies is not statistically significant. Short-run findings reveal a temporary increase in the gap due to GDP growth possibly due to initial employment expansion in male-dominated sectors while the effect of subsidies remains insignificant. The Hausman test supports the PMG estimator (p=0.8919). This finding not only justifies the choice of PMG but also implies that the assumption of slope homogeneity across countries is empirically supported, since the test fails to reject the null that the PMG estimator is consistent.

In Model 2, long-run GDP growth again shows a negative and significant effect on the gender gap (β=-2.061), whereas primary education expenditures display a significant positive relationship (β=1.543), suggesting that such investments may not be sufficiently targeted toward women's employment needs. Short-run effects are not statistically significant. The PMG estimator is retained (p=0.8981).

Model 3 results demonstrate that both GDP and secondary education spending significantly reduce the gender employment gap over the long term (β=-3.235 and -2.184, respectively). Short-term coefficients are insignificant. Hausman test results again justify the use of the PMG approach (p=0.7837).

In the final model, both GDP and tertiary education spending have a strong, negative, and statistically significant impact on the gender gap (β=-3.764 and -3.295, respectively). Short-run estimates indicate a mild positive effect of higher education expenditure, suggesting a lag in women's transition to high-quality employment. PMG remains the preferred estimator (p=0.6934).

Collectively, the empirical evidence underscores that economic growth consistently supports women's employment in the long run. The effectiveness of education spending, however, depends greatly on its composition: secondary and higher education investments reduce gender disparities, while primary-level spending may have unintended consequences. Education subsidies, lacking targeted design, fail to produce significant effects. Thus, policy design should emphasize both the strategic allocation and gender-sensitive targeting of education budgets. From a country-level perspective, these findings suggest that European countries with larger investments in secondary and tertiary education are more likely to experience long-term improvements in gender equality within the labor market. In contrast, countries that allocate a disproportionate share of education budgets to primary education or poorly targeted subsidies may fail to address the structural barriers women face in accessing quality employment. The fact that the long-run effects of GDP are consistently negative across all models indicates that macroeconomic growth tends to narrow the gender employment gap, but only when combined with effective education policy design. Thus, policy implications may vary across countries depending on their current spending priorities, demographic needs, and labor market structures.

5. Conclusion

This study sets out to explore how different types of public education expenditures influence gender-based employment disparities in Europe, with a particular focus on understanding both the level-specific and temporal dynamics of such investments. The empirical approach combined a rich panel dataset of 30 European countries over the 2014–2022 period with a Panel ARDL framework capable of distinguishing between short-run fluctuations and long-run equilibria. By disaggregating education expenditures into four distinct categories, primary, secondary, tertiary, and subsidies, the study offers a comprehensive evaluation of how the composition of public education budgets can shape labor market outcomes along gender lines.

The analysis focuses on the effects of public education expenditures at different levels, primary education, secondary education, higher education, and education subsidies, on the gender gap in employment across European countries. Using a panel data set covering 30 European countries over the period 2014–2022, the Panel ARDL method was employed to distinguish between short-and long-term dynamics. This approach enabled the evaluation of both the temporal and categorical effects of education, spending on gender-based employment disparities within a holistic framework.

Empirical findings reveal that the impact of public education expenditure varies significantly by expenditure type. Specifically, public spending on secondary and higher education has a significant long-term effect in reducing the gender employment gap. In contrast, while primary education spending shows a positive long-run effect, it appears to enhance general educational attainment rather than directly advancing female employment. Additionally, education subsidies were not found to have any statistically significant long-term impact. In the short run, economic growth may disproportionately benefit male employment, temporarily widening the gender gap; however, this effect tends to stabilize over time.

These results underscore the importance of restructuring public education expenditures not only with respect to their magnitude but also in terms of their quality, target population, and level of education. Investments in secondary and higher education are particularly valuable in promoting gender equality by facilitating women's integration into the skilled workforce. Conversely, the absence of gender-sensitive design in education subsidies may limit their effectiveness in addressing gender-based employment disparities.

Moreover, the findings reveal that long-term economic growth can contribute to narrowing the gender employment gap, but only when combined with well-designed education policies. In this regard, countries with disproportionate emphasis on primary education or poorly targeted subsidy schemes may not achieve the intended equity outcomes. This points to the necessity of aligning education spending with gender-sensitive planning and labor market realities.

The findings further highlight the need for a gender-conscious framework in the design of public education budgets. It is crucial to increase public investments; especially at the secondary and higher education levels; and to design these investments in a way that actively encourages women to pursue careers in high-income, high-demand sectors such as STEM. Moreover, reconfiguring existing education subsidies to include targeted gender-equality mechanisms could help eliminate structural barriers that hinder women's access to education. Finally, education policies should aim for long-term social transformation, not just short-term labor market adjustments. Achieving this requires comprehensive and structural policy strategies focused on breaking persistent gender inequalities along the education-employment continuum.

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