Export diversification and women's empowerment: Evidence from African countries

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Abstract: This paper explores the relationship between women's empowerment and export diversification in 45 African countries from 2002 to 2018. Our results indicate that women's political empowerment and gender parity in education foster diversification by enhancing the introduction of new ideas and improving their selection, while a gender wage gap in the labour market has a negative impact. Additionally, export diversification is more pronounced in North, West, and South Africa compared to Central Africa. These results imply that policies aligned with SDG 5, focusing on gender equality and women's empowerment, can potentially enhance export diversification.

Keywords: Export diversification, gender equality, women empowerment, SDG5.

1. INTRODUCTION

Recent crises like the financial crisis, economic crisis, and COVID-19 pandemic, along with commodity price volatility, highlight the importance of economic diversification for resource-rich countries to enhance resilience to external shocks. Export diversification, crucial in the early stages of development, drives sustainable growth by improving resource utilization, allocation efficiency, and productivity. It also promotes local demand for intermediates and services, facilitates technology adoption, and expands domestic market offerings (Hausmann & Hidalgo, 2011)[1]. Given this particular significance of diversification in the early stages of development, this paper examines export diversification in 45 African countries.

Numerous studies have examined the determinants of export diversification. Since the work of Cadot et al., 2011, several studies such as Agosin et al., 2012; Carrère et al., 2011; Kazandjian et al., 2019; Kilolo et al., 2023 have recognized the importance of human capital. Their focus on human capital is based on the idea that it enhances diversification by promoting the growth of skill-intensive industries, the adoption of new technologies, and facilitating technological diffusion (Bal-Gunduz et al., 2015).

Building on this literature, we introduce women's empowerment as an additional determinant of export diversification. Empowering women and reducing gender inequality are two key objectives of economic development. Sustainable Development Goal 5 (SDG 5) explicitly focuses on achieving gender equality and empowering all women and girls. These goals not only stand independently but have also been demonstrated to enhance productivity and alleviate poverty. According to (Duflo, 2012), women's empowerment occurs when women gain improved access to development constituents, particularly health, education, earning opportunities, rights, and political participation. In the political sphere, (Sundström et al., 2017) define women's political empowerment as a process of enhancing women's capacity, through increased choice, agency, and participation, in societal decision-making.

Women's empowerment influences diversification through three channels:

Labour Market Equality: Enhancing gender equality in the labour market can spur new ideas and improve labour efficiency (Cuberes & Teignier, 2016), thus boosting productivity and export diversification. Discrimination against women in labour markets and societal institutions leads to the underutilization of their skills and talents, as evidenced by the global labour force participation rate for women being significantly lower than that for men (ILO, 2018). The World Development Report (World Bank, 2012) indicates that removing barriers to women's participation could increase output per worker by 40%.

Human Capital Development via Education: Gender disparities in education hinder growth and diversification by constraining human capital (Kazandjian et al., 2019; Kilolo et al., 2023; Klasen, 2002; Klasen & Lamanna, 2009; Mitra et al., 2015). Better access to education for women can enhance the human capital pool, fostering technology adoption, innovation, economic growth, and export diversification (Duflo, 2012; Mitra et al., 2015).

The literature has demonstrated a positive correlation between the inclusion of women in the economy and economic growth, leading to diversification. However, the **effects of women's political inclusion** on diversification are less understood. This study considers women's political empowerment and their

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[1] UNCTAD (2022): Rethinking the Foundations of Export Diversification in Africa: the catalytic role of business and financial services. https://unctad.org/system/files/official-document/aldcafrica2022_en.pdf

ability to influence resource distribution and decision-making as a third channel through which women's empowerment fosters diversification.

There is a growing debate that increasing women's political participation can have a significant impact on macroeconomic performance. Women's political empowerment can be an instrument for economic development as it enhances the quality of institutions (Brollo & Troiano, 2016; Esarey & Schwindt-Bayer, 2018; Mitra et al., 2015), the effectiveness of environmental policies (Mavisakalyan & Tarverdi, 2019), and the public perception of government accountability at the local level (Deininger et al., 2011). It also promotes investment in infrastructure (Chattopadhyay & Duflo, 2004). Additionally, it fosters human capital development and economic growth (Duflo, 2012; Klasen, 2002; Knowles et al., 2002; Mitra et al., 2015). These studies focus solely on one aspect of women's political empowerment, specifically women in parliament or government.

Recently, (Kilolo et al., 2023) studied the effect of women's empowerment on export product diversification in 106 developing countries and found that women's political empowerment and gender parity in secondary school enrolment have a positive effect on export diversification. (Dahlum et al., 2022) explore the relationship between women's political empowerment and economic growth by considering three aspects: descriptive representation, protection of civil liberties, and participation in civil society. Using panel data from 182 countries over 221 years, they find that women's political empowerment, along with its components, enhances economic growth by increasing the introduction and diversity of new ideas in the economy and improving the selection of more efficient ideas. Additionally, (Awoa et al., 2022) examine the effect of natural resource abundance on women's political empowerment in 130 developing countries from 2002 to 2017, revealing a significant negative influence of total resource rent per capita on overall women's political empowerment and its subcomponents.

In this paper, we bridge this literature and address the mentioned research gap by considering how women's empowerment affects export diversification in 45 African countries from 2002 to 2017.

For this purpose, two indicators of export diversification are used: The Herfindahl index and the Theil index. These two indicators are widely used in the literature to capture export diversification (Agosin et al., 2012; Cadot et al., 2011; Kilolo et al., 2023; Osakwe & Kilolo, 2018). Regarding women's empowerment indicators, three indicators are used: (i) the women's political empowerment index (*wpei*), (ii) the gender parity index of gross secondary enrolment (*gpi_second*) and (iii) the gender wage gap (*gap wage*).

The use of these variables rests on the following hypotheses:

(H1) Women's political empowerment positively impacts export diversification by fostering the implementation of laws that promote a level playing field in the job market and reduce discriminatory barriers to accessing capital, land, and productive resources[2].

(H2) Gender parity in secondary school enrolment increases the pool of human capital, facilitating technology adoption[3] and enabling women to seize entrepreneurial opportunities.

(H3) Gender wage inequality diminishes export diversification by potentially reducing effort and productivity due to perceived unfairness[4].

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[2] See Stanistreet et al., (2007) for more details.
[3] This point has been made notably by Aghion et al., (2010).
[4] Recent trade literature, building on (Melitz, 2003) seminal work, indicates that exporters tend to be more productive than non-exporters. Consequently, gender wage inequality, by diminishing work efforts and overall productivity, can potentially diminish export diversification

The hypotheses were tested using a dataset of 45 African countries from 2002-2018. Standard panel data techniques addressed econometric issues, employing pooled OLS with Driscoll and Kraay standard errors and African regions fixed effects (Baccini & Urpelainen, 2012; Kilolo, 2018). To address the endogeneity of women's empowerment to export diversification, an IV/GMM regression with two-period lags of women's empowerment variables as internal instruments was used. For robustness, the PPML estimator (Silva & Tenreyro, 2006, 2010) was applied. The results indicate that women's political empowerment and gender parity in secondary education positively influence export diversification, while the gender wage gap negatively impacts it. Additionally, North, West, and South Africa exhibit better export diversification than Central Africa. These findings suggest that policies promoting SDG 5 (gender equality and women's empowerment) can enhance export diversification.

This paper aligns with the economics literature on the determinants of export diversification, considering factors such as human capital, GDP per capita, institutions, trade costs, geography, location, and productivity (Agosin et al., 2012; Cadot et al., 2011; Cieślik & Parteka, 2021; Mau, 2016; Mitra et al., 2015; Parteka & Tamberi, 2013b, 2013a; Persson & Wilhelmsson, 2016; Regolo, 2013; Sheng & Yang, 2016). Unlike Kazandjian et al. (2019) and Kilolo et al. (2023), who use different datasets and broader country focuses, this study uses BACI2002 trade data at the 6-digit level of the Harmonized System classification (HS6) from CEPII[5] and concentrates solely on African countries, incorporating regional dummy variables for North, West, South, East, and Central Africa, with Central Africa as the reference category. The study employs common literature control variables, though not necessarily the same ones.

The rest of the paper is organized as follows. Section 2 describes the variables used in the analysis. Section 3 presents the empirical analysis, while Section 4 presents the results and 5 the robustness checks. Finally, Section 6 concludes.

2. Data description

This study uses 45 African countries over the period 2002 - 2018 in an unbalanced panel due to the availability of data continuously over a large set of countries. The listing of countries is presented in Table A1 in the Appendix A. There are 11 from Central Africa (CA), 8 from East Africa (EA), 6 from North Africa (NA), 5 from South Africa (SA), and finally 15 from West Africa (WA). A detailed description of all the variables and data sources is provided in Table A2, while the descriptive statistics are provided in Table A3 in the Appendix. The correlation matrix is provided in Table A4 in the Appendix.

2.1. Measures of Export Diversification

Different measures of diversification are possible and have been proposed in previous works. Among these measures we have, the number of active export lines, the Herfindahl index sometimes called the Hirschman-Herfindahl index (HHI), Theil's index, relative Theil, Gini indices, etc. We used, in this paper, Herfindahl and Theil's indices. These indices allow us to assess the degree or level of diversification of a country. The choice of these two indicators is because they are both the simplest to

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[5] CEPII stands for Centre d'Études Prospectives et d'Informations Internationales; it compiles trade data available online at http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp

calculate and the most frequently used in the literature to capture export diversification[6] (Agosin et al., 2012; Cadot et al., 2011; Carrère et al., 2011; Kilolo et al., 2023; Osakwe & Kilolo, 2018).

The Herfindahl index (HHI), which sums the squared shares of each commodity in total exports, normalized to range between 0 and 1, is given by the formula:

$$HHI_t = \frac{\sum_k \left(s_{k,t}\right)^2 - 1/n}{1 - 1/n} \tag{1}$$

where $s_{k,t} = x_{k,t} \bigg/ \sum_{k=1}^{n} x_{k,t}$ is the share of export line k (with the amount exported x_k) in total exports and n is the number of export lines (omitting country and time subscripts). This index takes values from 0 to 1, the higher representing greater concentration.

Theil's index is given by

$$T_t = \frac{1}{n} \sum_{k=1}^{n} \ln\left(\frac{x_{k,t}}{\mu}\right) \quad \text{where } \mu = \frac{1}{n} \sum_{k=1}^{n} x_{k,t} \tag{2}$$

where x_{kt} is the export of goods or products k at time t and n is the number of export lines. The Theil index varies between zero when all products are exported at the same values and ln(n) when the export consists of a single exported product; thus, like the HHI index, the higher the value, the higher export concentration and the lower the index, the more diversified the export.

Table 1 shows descriptive statistics - simple *mean* and *SD* for these indices. In general, table 1 shows that the Herfindahl and Theil indexes increase throughout the entire period. Between 2002 and 2018, the HHI and Theil indexes increased from 0.238 to 0.283 and from 5.683 to 6.683, respectively. The two indicators also show a reduction in their SD over time.

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[6] keeping in mind that these indexes apply equally well to imports. Generally, all concentration indices basically measure inequality between export shares; these shares, in turn, can be defined at any level of aggregation. Of course, the finer the disaggregation, the better the measure ((Carrère et al., 2011).

Table 1 Indicators of export diversification (concentration) and number of countries

	Countries	HHI		Theil	
		mean	*S.D.*	*mean*	*S.D.*
2002	42	0.238	0.221	5.683	1.323
2006	43	0.274	0.273	5.858	1.402
2010	43	0.23	0.216	5.721	1.330
2013	45	0.254	0.230	5.868	1.335
2016	40	0.224	0.199	5.834	1.202
2017	40	0.246	0.213	5.934	1.236
2018	40	0.283	0.236	6.125	1.293

Sources: authors' calculations using BACI2002 from COMSTRADE at the highest disaggregation level (HS6) *over the period 2002 - 2018*

Figure 1 shows in more details how export diversification has changed over the period 2002-2018. To take into account differences in country size, the aggregate indexes (HHI and Theil indexes) are obtained by weighting each country's diversification index by the ratio of its nominal GDP to total GDP. The evolution of the two indicators is similar. There is an increase in export concentration over the period (less pronounced for the Herfindahl than for the Theil index).

Figure 1: Export diversification, 2002-2018 (GDP, weighted average)
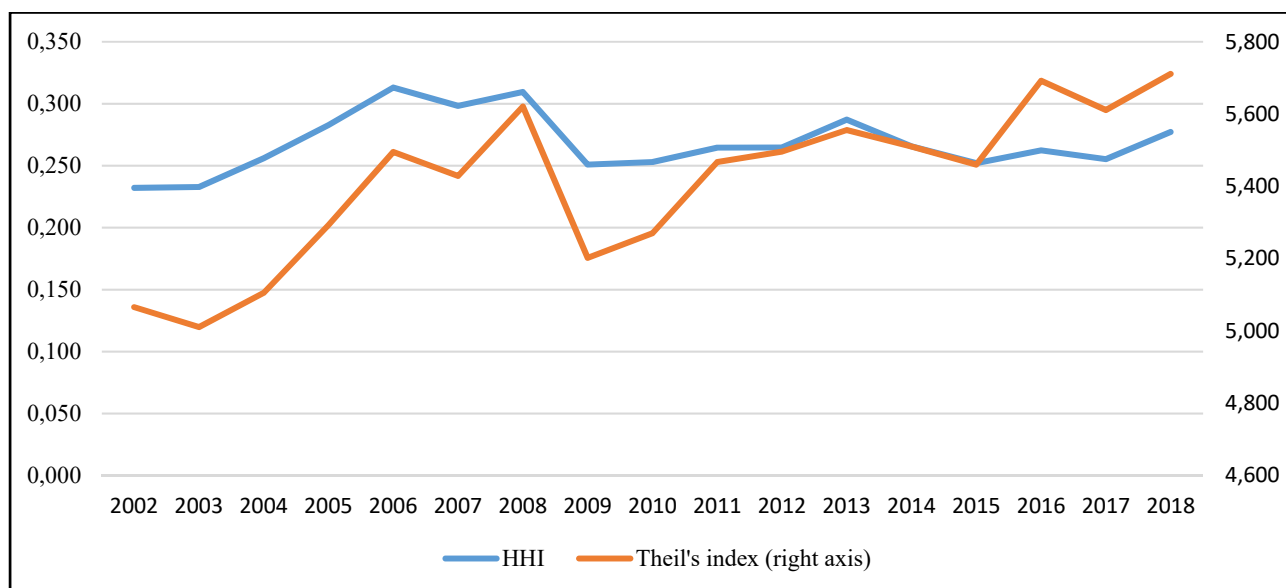
Source: *authors calculations using BACI2002 from COMSTRADE*

Figure 2 illustrates the evolution of export concentration/diversification across differences regions of Africa, employing GDP-weighted means. The indicators reveal that Central Africa (CA) and West Africa (WA) have a higher level of export concentration compared to other regions. The South Africa region

has a lower level of export concentration, especially when measured by the Herfindahl index, which remains relatively stable over the period.

Figure 2: Export diversification by regions, 2002-2018 (GDP, weighted average)
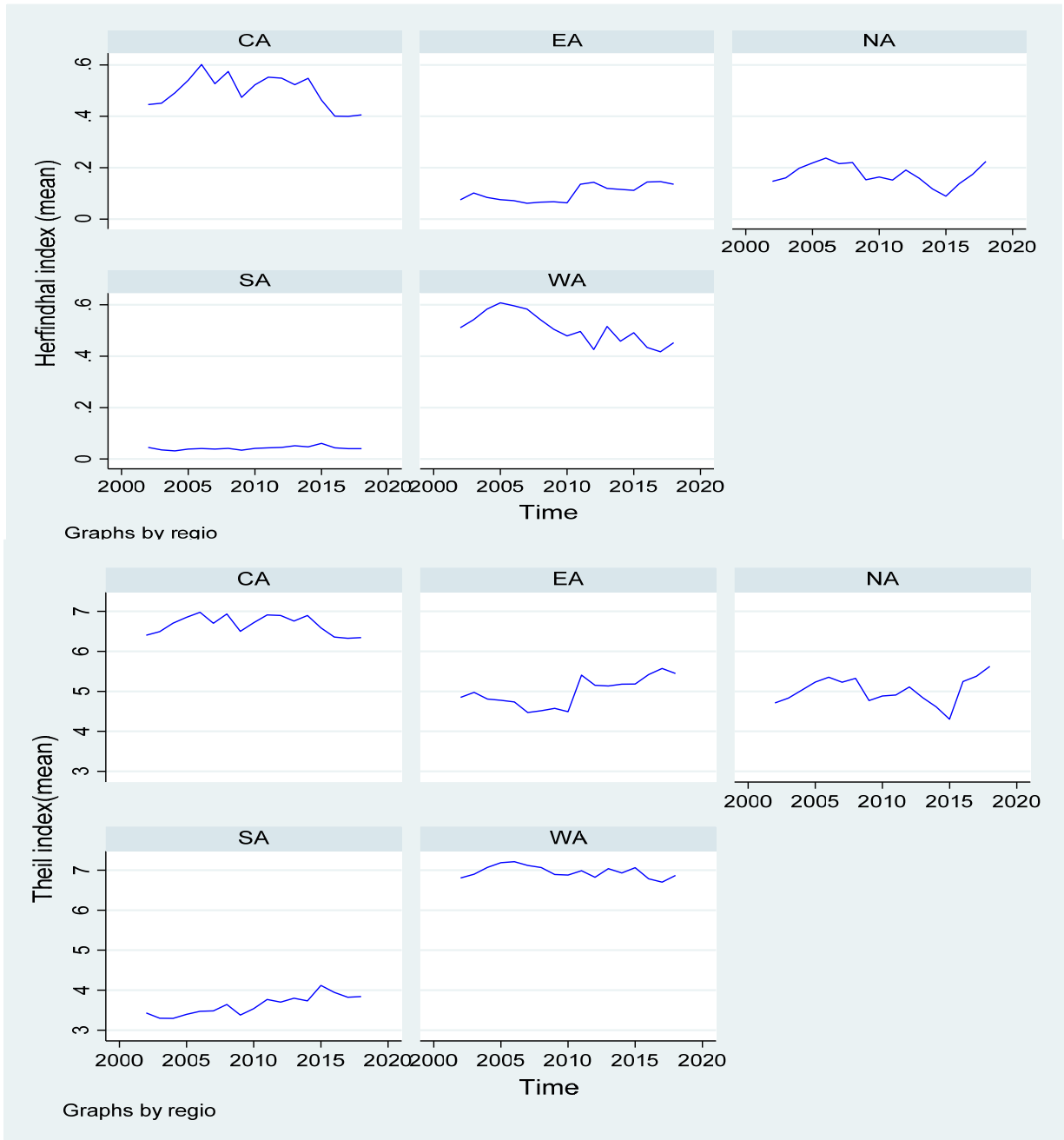
Note: CA= Central Africa, EA= East Africa, NA= North Africa, SA= South Africa, SSA=Sub-Saharan Africa, WA=West Africa

2.2. Measure of women's empowerment

The study uses the gender wage gap in the labour market, as outlined by the ILO, as the first indicator to assess women's empowerment. Wage and salaried workers (employees) are individuals employed in

positions characterized as paid employment jobs, where the employees hold explicit (written or oral) or implicit employment contracts entitling them to a basic remuneration not directly linked to the revenue of the unit they work for[7]. The gender wage gap is the difference in wages between male and female wage and salaried workers. The data are sourced from the WDI database.

Globally, women earn significantly less than men on average. In our sample, the proportion of wage and salaried workers in total employment varies greatly across regions, ranging from approximately 19 % in West Africa to nearly 58 % in North Africa. Gender wage gaps can be considerable within the category of wage and salaried workers. On average, women earn 89.5% of what men earn, indicating a gender wage gap of 10.5% (refer to Table 2). For example, Table 3 illustrates that positive average gender wage gaps are observed in all African regions among wage and salaried workers. The gender wage gap is notably larger in Central Africa compared to other regions.

Table 2: Gender wage gap by region (population-weighted average)

Regions	Wage and salaried workers (weighted average)		
	Men	**women**	**Gap**
Central Africa	0.356	0.184	0.173
East Africa	0.191	0.117	0.074
North Africa	0.607	0.555	0.051
South Africa	0.551	0.468	0.082
West Africa	0.205	0.107	0.097
Total	**0.335**	**0.2299**	**0.105**

Source: Based on World Development indicators database

The Women's Political Empowerment Index (WPEI) is the second indicator used to assess women's empowerment. The data for WPEI are sourced from the Varieties of Democracy (V-Dem) project's database version 11 (Coppedge et al., 2021). WPEI is calculated as the simple unweighted average of three sub-indices: Women's Civil Liberties Index (WCLI), Women's Civil Society Participation Index (WCSPI), and Women's Political Participation Index (WPPI). WCLI measures women's autonomy in making important decisions in their daily lives, such as freedom of movement, freedom from forced labour, property rights, and access to justice (Sundström et al., 2017). WCSPI evaluates women's freedom to participate in public discourse, including freedom of discussion, involvement in civil society organizations (CSOs), and representation in journalistic roles. Finally, WPPI assesses women's participation in political decision-making by averaging two indicators: the representation of women in the legislature and the distribution of political power by gender[8].

Table 3 presents the Women's Political Empowerment Index (WPEI) across regions, including both weighted and unweighted means. Across the 45 African countries, the weighted average WPEI is 0.685. Countries with notably low WPEI values are predominantly from the North Africa region, with an

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[7] See https://ilostat.ilo.org/resources/concepts-and-definitions/description-employment-by-status/ accessed on 29/03/2023

[8] We opted for WPEI instead of other indexes of women's political empowerment due to its broader coverage both geographically and temporally (Sundström et al., 2017). The V-Dem WPEI is more extensive in its spatial and temporal scope. The aggregated WPEI and its three sub-indices range from 0 to 1, with higher values indicating greater empowerment.

average WPEI of 0.560. South African countries exhibit an average WPEI of 0.809, while West African countries have an average WPEI of 0.720.

Table 3: Women's political empowerment index (*wpei*) across regions, 2002 - 2018 (Population-weighted average)

Regions	Average (weighted) *wpei*	Average (unweighted) *wpei*
Central Africa	0.659	0.643
East Africa	0.667	0.6808
North Africa	0.560	0.5828
South Africa	0.809	0.771
West Africa	0.720	0.734
Total	**0.685**	**0.686**

Source: Calculation based on V-Dem project (2021). *Note:* based on World Bank's regional classification. Regional means are based on weighted population means.

The Women's Political Empowerment Index (WPEI) shows significant cross-country variation, with the lowest scores recorded in Libya (0.302), Congo (0.33), Egypt (0.38), Sudan (0.46), and Equatorial Guinea (0.475). In contrast, Senegal (0.825), Sao Tome and Principe (0.826), Ghana (0.83), Benin (0.86), and South Africa (0.88) achieved the highest scores between 2002 and 2018 in our sample.

Finally, women's empowerment is further assessed through the gender parity index of gross secondary enrolment (gpis), calculated as the ratio of girls to boys enrolled in secondary education across public and private schools (WDI, 2022). A gpis below 1 indicates a disadvantage for girls in educational access compared to boys, while a gpis greater than 1 indicates the opposite. The data are taken from the WDI database.

Table 4: Gender parity index of gross secondary enrolment (*gpis*) by regions (population-weighted average)

Regions	Women	Men	*GPIS*
Central Africa	0.19	0.2317	0.476
East Africa	0.167	0.198	0.456
North Africa	0.427	0.4362	0.575
South Africa	0.505	0.494	0.72
West Africa	0.273	0.327	0.633
Total	**0.283**	**0.317**	**0.569**

Source: calculations based on World Development Indicators database

In African countries, the average Gender Parity Index (GPI) stands at 0.569, indicating a disadvantage for girls compared to boys in terms of learning opportunities (Table 4). The average GPI remains below 1 across all regions. Notably, only Central Africa and East Africa perform below this average.

2.3. Additional (control) variables

The following control variables were used in the regression analyses:

- **GDP per capita and GDP per capita square**: These measure a country's income level and economic development, revealing a threshold effect in the diversification process (Imbs & Wacziarg, 2003). Data are from the World Development Indicators (WDI) database.
- **Human capital**: Measured by average years of schooling for adults, this variable positively impacts export diversification by enhancing productivity and economic efficiency. Data are from the WDI.
- **Quality of institutions**: Captured by a composite index from six governance indicators (e.g., government effectiveness, control of corruption) via Principal Component Analysis (PCA), reflecting institutions' positive influence on diversification. Data are from the WDI.
- **Size of the economy**: Proxied by population size, larger countries tend to have more diversification due to larger internal markets and product differentiation (Carrère et al., 2011; Mau, 2016; Osakwe & Kilolo, 2018). Data are from the WDI.

Before presenting our findings, we conducted correlation analyses between variables related to women's empowerment and export diversification (refer to Figures 3 and 4). In the top-left of Figure 3, a positive association is observed between the gender wage gap and export concentration. It is important to note that an increase in export concentration corresponds to a decrease in export diversification, and vice versa. This implies that economies with a high gender wage gap have a lower level of diversification. Additionally, in the top-right and the bottom of Figure 3, there is a negative correlation between women's empowerment (*gpis* and *wpei*) and the export concentration.

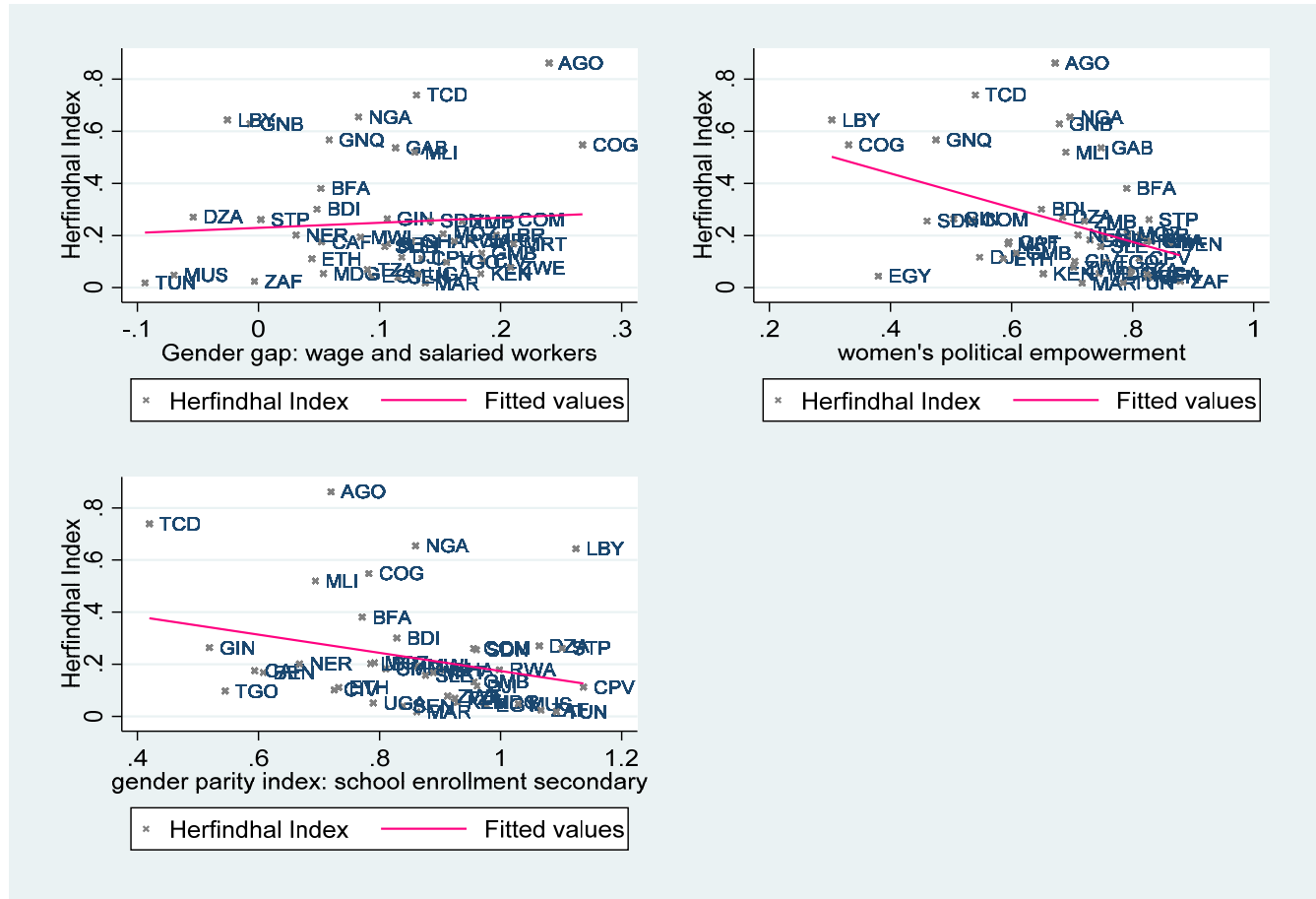**Figure 3: correlation between Herfindahl index and women's empowerment**

Figure 4 shows a similar pattern. As both measures convey the same qualitative information, further analysis is unnecessary. These relations suggest that women's political empowerment and the gender parity index of gross secondary enrolment (gender wage gap) have a positive (negative) effect on export diversification.

Figure 4: correlation between Theil index and women's empowerment
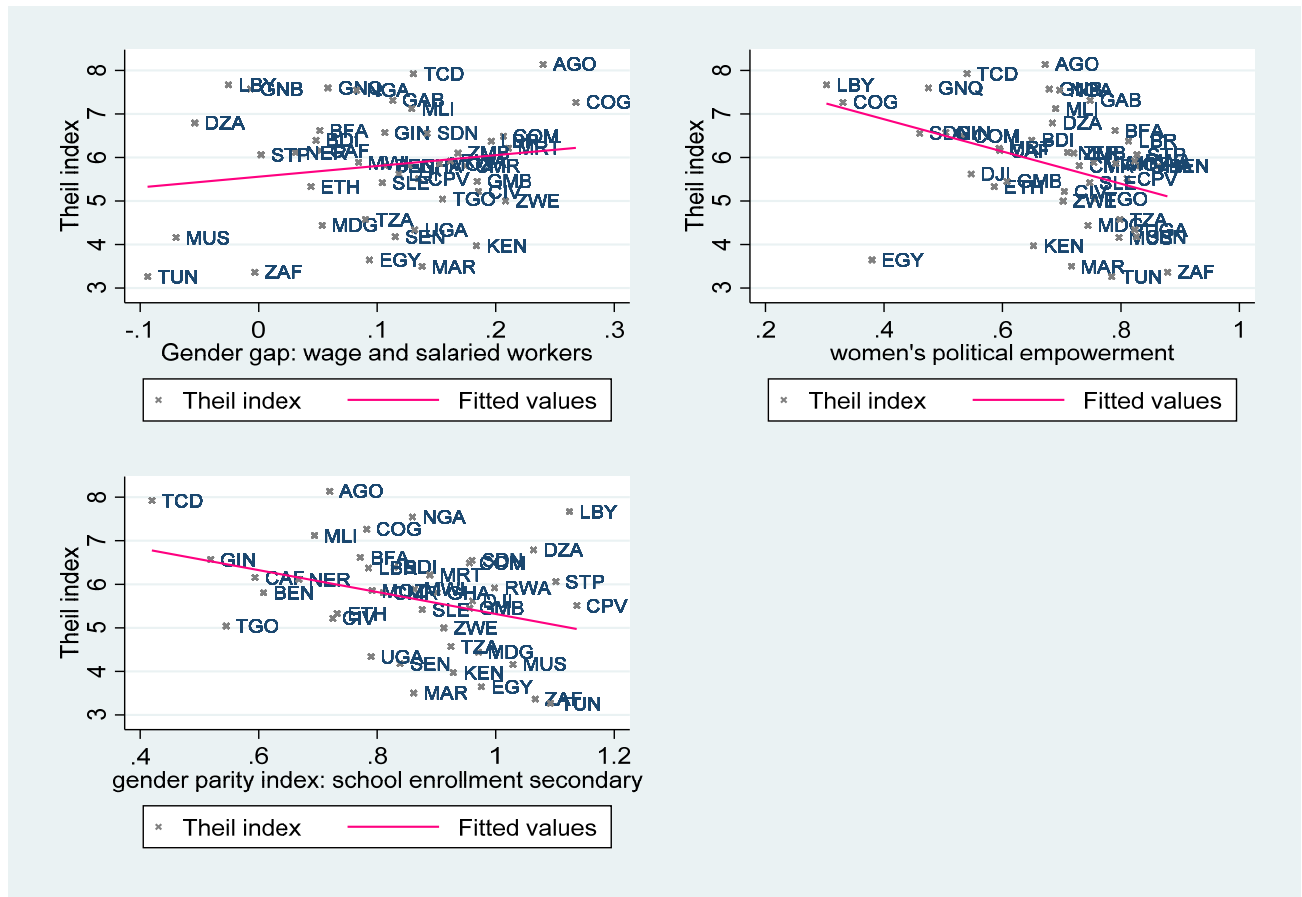
3. Empirical methodology

3.1. Econometric specification

To analyse the relationship between women's empowerment and diversification, our basic econometric specification takes the following form:

$$D_{it} = \gamma_0 + \beta_i empower_{it} + \gamma_1 \log(gdppc)_{it} + \gamma_2 \log(gdppc)_{it}^2 + \gamma_3 inst_{it} + \gamma_4 HC_{it} + \gamma_5 \log(popu)_{it} + \lambda_t + \mu_i + \vartheta_{it}, \quad i = 1, \dots, N_t; \ t = 1, \dots, T \tag{4}$$

where D_{it} denotes the index of trade concentration (Herfindahl and Theil index) for country i at time t expressed in logarithms. $empower_{it}$ denotes the women's empowerment variables (gender vulnerable gap, gender wage gap, women's political empowerment, gender parity index of gross secondary enrolment) for country i at time t. $\log(gdppc)_{it}$ and $\log(gdppc)_{it}^2$ represent the GDP per capita and its square[9] both in log. $inst_{it}$ denotes the corruption and HC_{it} the human capital (the year of schooling), $\log(popu)_{it}$ is the population in log. μ_i denotes the unobservable individual-specific effect, λ_t is the

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[9] This term captures the curvature of GDP per capita. This variable captures the threshold effect.

unobservable time effect and ϑ_{it} represents the remainder disturbance. $\beta_{i(i=1,2,3)}$ and $\gamma_{i(i=0,1,2,3,4,5)}$ are the coefficient to be estimated.

3.2. Estimation strategy

Before choosing the estimation strategy, we first run a Hausman test, which indicated the need to use fixed effects rather than random effects to deal with the heterogeneity across countries in the panel data. Consequently, our primary statistical model incorporates fixed effects for each country. Secondly, we use pooled ordinary least squares with Driscoll and Kraay standard errors, incorporating fixed effects for African regions, as suggested by (Baccini & Urpelainen, 2012; Kilolo, 2018). To address the potential endogeneity of women's empowerment to export diversification, we used instrumental variable generalized method of moments (IV/GMM) regression and instrumented for women's empowerment. To ensure the validity of our internal instrument, we employed the two-period lag of women's empowerment variables (gap_wage, wpei, and gpi_second). To ensure robustness, we use the pseudo-Poisson maximum likelihood (PPML) estimation technique proposed by (Silva & Tenreyro, 2010) and compute robust standard errors for all estimations. Additionally, we address regional disparities by including dummy variables for North Africa, West Africa, South Africa, East Africa, and Central Africa. Central Africa is used as the reference category for the estimates.

3.3. Hypotheses

Based on the economic literature and graphical analysis, we propose the following hypotheses:

H1: Women's Political Empowerment Index (WPEI) and the Gender Parity Index of Gross Secondary Enrolment (GPIS) have a positive influence on export diversification.

H2: The gender wage gap (Gap Wage) harms diversification.

To validate these hypotheses, we examine the coefficients signs across the econometric estimation results presented below. To confirm H1, the coefficient estimates of WPEI and GPIS must be positive, while to confirm H2, the coefficient estimates of Gap Wage must be negative. It is important to note that a decrease in concentration corresponds to an increase in export diversification, and vice versa.

4. Results

This section presents the results of the analysis on the effect of women's empowerment on diversification. Tables 5 and 6 show the results of the pooled ordinary least squares with Driscoll and Kraay standard errors.

Table 5 presents the results for the HHI export concentration index. The gender wage gap is strongly and positively associated with export concentration in Africa (column 1). As demonstrated in column 2, women's political empowerment (WPEI) has a significant and negative impact on export concentration. This finding supports the notion that WPEI enhances economic growth by stimulating the process of economic diversification, which increases the number and variability of new ideas introduced into the economy and improves the selection of more effective ideas ((Dahlum et al., 2022). While in column 3, the gender parity index in secondary school (GPIs) has the expected sign, it is not significant in relation to export diversification. These results suggest that gender inequality in African countries does not favour export diversification. These findings are consistent with previous studies (Kazandjian et al., 2019; Kilolo et al., 2023).

Additionally, the impact of women's empowerment persists when controlling for other variables associated with export diversification. In this study, we demonstrate that per capita income (lngdppca_wdi), human capital (average year of schooling), governance, and the size of the economy (lnpopulation) are significantly and positively correlated with higher levels of diversification. Based on the explanatory variables, North, West, and South Africa exhibit better export diversification than Central Africa, which is the omitted reference category.

Table 5: Pooled ordinary least squares with Driscoll and Kraay standard errors: Export diversification and its Determinants logarithm of HHI Index

	(1)	(2)	(3)
gap_wage	**0.355***		
	(0.040)		
lngdppca_wdi	-0.680***	-0.159**	-0.471**
	(0.087)	(0.069)	(0.182)
ln2gdppca_wdi	0.058***	0.020***	0.045***
	(0.006)	(0.005)	(0.013)
lnpopu_wdi	0.020***	0.007	0.005
	(0.003)	(0.006)	(0.004)
hc_pwt	-0.233***	-0.041***	-0.049***
	(0.030)	(0.004)	(0.007)
av_yearschooling	-0.039***	-0.047***	-0.065***
	(0.003)	(0.005)	(0.009)
East Africa	-0.177***	-0.179***	-0.206***
	(0.010)	(0.005)	(0.024)
North Africa	-0.226***	-0.231***	-0.257***
	(0.011)	(0.017)	(0.021)
South Africa	-0.076***	-0.066***	-0.073*
	(0.012)	(0.012)	(0.038)
West Africa	-0.037**	-0.065***	-0.052*
	(0.016)	(0.017)	(0.028)
wpei		**-0.158****	
		(0.072)	
gpi_second			**-0.088**
			(0.073)
Constant	2.191***	0.548**	1.547**
	(0.286)	(0.223)	(0.619)
Observations	588	680	399
R-squared	0.499	0.459	0.500
Number of groups	36	45	41
Time fixed effects	yes	yes	yes

Note: Pooled OLS estimation with Driscoll–Kraay standard errors (AR 1) including region FE. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. *Women's empowerment variable: Gapwage (gender wage gap), wpei (women's political empowerment index) and gpi_second (gender parity index of gross secondary enrolment).* Central Africa is the reference category omitted from the estimates

Table 6 presents Theil's export concentration estimates, which are quantitatively similar to those in Table 5. However, the secondary school gender parity index (GPI) in column 3 has the expected sign but is not statistically significant at conventional levels.

Table 6: Pooled ordinary least squares with Driscoll and Kraay standard errors: Export diversification and its Determinants of Theil Index

Explanatory Variables	(1)	(2)	(3)
gap_wage	**0.992****		
	(0.385)		
lngdppca_wdi	-2.409***	-1.134*	-2.380*
	(0.487)	(0.606)	(1.156)
ln2gdppca_wdi	0.206***	0.112**	0.203**
	(0.031)	(0.042)	(0.083)
lnpopu_wdi	-0.119***	-0.133***	-0.143***
	(0.025)	(0.019)	(0.021)
av_yearschooling	-1.321***	-0.221***	-0.266***
	(0.167)	(0.022)	(0.024)
gouvernance	-0.325***	-0.337***	-0.447***
	(0.018)	(0.030)	(0.046)
East Africa	-0.874***	-0.801***	-0.804***
	(0.040)	(0.028)	(0.092)
North Africa	-1.102***	-1.041***	-1.023***
	(0.069)	(0.032)	(0.146)
South Africa	-0.179*	-0.116	-0.137
	(0.093)	(0.087)	(0.186)
West Africa	-0.068	-0.088	0.203
	(0.107)	(0.106)	(0.123)
wpei		**-0.803*****	
		(0.239)	
gpi_second			**0.187**
			(0.241)
Constant	16.235***	11.623***	15.378***
	(1.380)	(2.124)	(4.143)
Observations	588	680	399
R-squared	0.466	0.492	0.525
Number of groups	36	45	41
Time fixed effects	yes	yes	yes

Note: Pooled OLS estimation with Driscoll–Kraay standard errors (AR 1) including region FE. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. *Women's empowerment variable: Gapwage (gender wage gap), wpei (women's political empowerment index) and gpi_second (gender parity index of gross secondary enrolment).* Central Africa is the reference category omitted from the estimates.

An alternative estimation technique (IV/GMM) is used to address the issue of reverse causality between export diversification and women's empowerment. This technique allowed for the introduction of a two-period lag of the women's empowerment variables (gap_wage, wpei and gpi_second) as an instrument. The results are presented in Table 7 for the HHI index and Table 8 for the Theil index. The Cragg-Donald/Kleibergen-Paap Wald statistic indicates that there is no weak identification problem, while the Hansen J-test statistic's p-value supports the validity of the instruments. The gender parity index of gross

secondary enrolment (gpi_second) now has a clear negative impact on export concentration, while the women's political empowerment index (wpei) still favours diversification. Regarding the control variables, the results are quantitatively similar to those presented in the previous tables. Export diversification is more successful in North, West, and South Africa than in Central Africa.

Table 7: IV/GMM estimation: Export diversification and its Determinants of HHI Index

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
gap_wage	**0.195***	**0.112**				
	(0.114)	**(0.114)**				
lngdppca_wdi	-0.499***	-0.268**	-0.257**	-0.109	0.507***	-0.057
	(0.132)	(0.134)	(0.108)	(0.126)	(0.162)	(0.185)
ln2gdppca_wdi	0.037***	0.027***	0.020***	0.017**	-0.031***	0.015
	(0.009)	(0.009)	(0.007)	(0.008)	(0.011)	(0.013)
East Africa	-0.259***		-0.241***	-0.169***	-0.193***	-0.210***
	(0.023)		(0.020)	(0.021)	(0.026)	(0.032)
North Africa	-0.197***		-0.254***	-0.229***	-0.197***	-0.253***
	(0.031)		(0.027)	(0.026)	(0.037)	(0.034)
South Africa	-0.227***		-0.146***	-0.058**	-0.134***	-0.038
	(0.025)		(0.023)	(0.026)	(0.027)	(0.032)
West Africa	-0.088***		-0.039	-0.051**	-0.095***	-0.035
	(0.025)		(0.024)	(0.024)	(0.029)	(0.033)
lnpopu_wdi		-0.006		0.007		-0.005
		(0.006)		(0.006)		(0.008)
av_yearschooling		-0.044***		-0.041***		-0.034***
		(0.006)		(0.007)		(0.010)
gouvernance		-0.061***		-0.047***		-0.058***
		(0.005)		(0.007)		(0.010)
wpei			**-0.652***	**-0.175**		
			(0.052)	**(0.074)**		
gpi_second					**-0.704***	**-0.344***
					(0.068)	**(0.087)**
Constant	2.013***	0.993**	1.576***	0.396	-1.118*	0.449
	(0.467)	(0.481)	(0.394)	(0.491)	(0.587)	(0.677)
Observations	636	595	636	595	275	261
R-squared	0.228	0.362	0.348	0.451	0.448	0.562
Time fixed effects	yes	yes	yes	yes	yes	yes
Cragg-Donald or Kleibergen-Paap	12787	10061	3947	2648	2617	1718
Hansen J (p-value)	0.827	0.714	0.360	0.424	0.943	0.586

*Note: robust standard errors in parentheses. Significant at: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Women's empowerment variable: Gapwage (gender wage gap), wpei (women's political empowerment index) and gpi_second (gender parity index of gross secondary enrolment). The weak identification test is based on the Kleibergen-Park Wald F statist*

Table 8: IV/GMM estimation: Export diversification and its Determinants of Theil Index

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
gap_wage	**2.307***	**1.172***				
	(0.677)	**(0.625)**				
lngdppca_wdi	-4.285***	-1.884***	-2.028***	-0.921	3.375***	-0.466
	(0.779)	(0.716)	(0.592)	(0.625)	(0.988)	(1.163)
ln2gdppca_wdi	0.293***	0.159***	0.138***	0.098**	-0.245***	0.060
	(0.053)	(0.048)	(0.040)	(0.042)	(0.068)	(0.081)
East Africa	-1.397***		-1.344***	-0.790***	-0.741***	-0.756***
	(0.139)		(0.109)	(0.102)	(0.175)	(0.150)
North Africa	-1.009***		-1.473***	-1.047***	-0.687**	-0.857***
	(0.212)		(0.195)	(0.176)	(0.298)	(0.259)
South Africa	-1.274***		-0.778***	-0.058	-0.852***	0.012
	(0.149)		(0.142)	(0.159)	(0.164)	(0.189)
West Africa	-0.291**		-0.027	-0.004	-0.160	0.365*
	(0.121)		(0.118)	(0.111)	(0.144)	(0.200)
lnpopu_wdi		-0.186***		-0.134***		-0.172***
		(0.029)		(0.028)		(0.051)
av_yearschooling		-0.244***		-0.220***		-0.187***
		(0.031)		(0.038)		(0.069)
gouvernance		-0.384***		-0.342***		-0.422***
		(0.026)		(0.037)		(0.064)
wpei			**-4.121***	**-0.863***		
			(0.322)	**(0.431)**		
gpi_second					**-2.449***	**-0.400**
					(0.360)	**(0.505)**
Constant	21.558***	14.579***	16.332***	10.966***	-3.455	9.797**
	(2.762)	(2.733)	(2.110)	(2.416)	(3.554)	(4.314)
Observations	636	595	636	595	275	261
R-squared	0.231	0.425	0.363	0.496	0.413	0.549
Time fixed effects	yes	yes	yes	yes	yes	yes
Cragg-Donald or Kleibergen-Paap	12787	10061	3947	2648	2617	1718
Hansen J (p-value)	0.902	0.966	0.198	0.302	0.936	0.786

Note: robust standard errors in parentheses. Significant at: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Women's empowerment variable: Gapwage (gender wage gap), wpei (women's political empowerment index) and gpi_second (gender parity index of gross secondary enrolment). The weak identification test is based on the Kleibergen-Park Wald F statistics

5. Robustness check

As an additional check for robustness, we also performed regressions of equation (4) using a counting estimation method, namely pseudo poison maximum likelihood (PPML). The results for the HHI index are presented in Table 9 and for the Theil index in Table 10. All specifications include time-fixed effects and region-fixed effects. The variables related to women's empowerment are significant and have the expected signs.

The results suggest that the gender wage gap may indeed be a cause of low economic diversification, while WPEI (Women's Political Empowerment Index) and GPI_second (Gender Parity Index of Gross Secondary Enrolment) have an impact on diversification. It is worth noting that there is a correlation between GDP per capita (and its square) and export diversification. African countries tend to diversify their export products as their income increases, but they reach a certain threshold where they start to specialise. These findings are consistent with previous studies (Cadot et al., 2011; Carrère et al., 2011; Imbs & Wacziarg, 2003; Kazandjian et al., 2019; Mau, 2016). In most of our specifications, population size is associated with greater export diversification, which may be due to a larger talent pool.

Table 9: PPML: Export diversification and its Determinants of HHI Index

	(1)	(2)	(3)
gap_wage	**0.300**		
	(0.408)		
lngdppca_wdi	-1.310***	-0.627*	-0.243
	(0.388)	(0.324)	(1.084)
ln2gdppca_wdi	0.100***	0.0525**	0.0311
	(0.0258)	(0.0214)	(0.0767)
lnpopu_wdi	0.0334	0.0348	0.0661**
	(0.0246)	(0.0249)	(0.0310)
East Africa	-1.189***	-1.110***	-0.985***
	(0.110)	(0.0868)	(0.164)
North Africa	-0.773***	-0.992***	-0.833***
	(0.135)	(0.110)	(0.166)
South Africa	-0.958***	-0.630***	-0.899***
	(0.111)	(0.108)	(0.169)
West Africa	-0.296***	-0.108	-0.358***
	(0.0748)	(0.0769)	(0.0829)
wpei		**-2.169*****	
		(0.158)	
gpi_second			**-1.533*****
			(0.188)
Constant	2.607*	1.501	-0.737
	(1.499)	(1.305)	(3.832)
Observations	726	726	419
R-squared	0.264	0.335	0.361

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: PPML: Export diversification and its Determinants logarithm of Theil Index

	(1)	(2)	(3)
gap_wage	**0.422*****		
	(0.109)		
lngdppca_wdi	-0.679***	-0.285***	0.248
	(0.113)	(0.0846)	(0.230)
ln2gdppca_wdi	0.0460***	0.0190***	-0.0189
	(0.00751)	(0.00565)	(0.0162)
lnpopu_wdi	-0.0196***	-0.0181***	-0.0136*
	(0.00611)	(0.00561)	(0.00755)
East Africa	-0.222***	-0.223***	-0.154***
	(0.0231)	(0.0184)	(0.0317)
North Africa	-0.147***	-0.239***	-0.132***
	(0.0371)	(0.0344)	(0.0473)
South Africa	-0.200***	-0.120***	-0.172***
	(0.0253)	(0.0249)	(0.0341)
West Africa	-0.0476***	-0.00925	-0.0498**
	(0.0184)	(0.0181)	(0.0216)
wpei		-0.661***	
		(0.0487)	
gpi_second			-0.363***
			(0.0548)
Constant	4.561***	3.581***	1.523*
	(0.445)	(0.342)	(0.834)
Observations	726	726	419
R-squared	0.240	0.359	0.297

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

This study provides insights into economic diversification and its determinants. A methodological framework based on two diversification measurement indicators, namely HHI and Theil, was employed. A fixed effects model with GMM estimation was used to examine the impact of women's empowerment on export diversification. The findings support the idea that women's political empowerment and gender parity in education can enhance the introduction and selection of innovative ideas, which is consistent with Dahlum's (2022) research. On the other hand, the gender wage gap hinders diversification.

These findings highlight the potential of policies that promote SDG 5 - gender equality and women's empowerment - to improve export diversification. Policies should aim to achieve equal employment conditions regardless of gender, as wage inequality can reduce labour incentives and productivity, which are crucial factors for export capacity according to international trade literature. Furthermore, the integration of women into political processes could be pivotal in the diversification journey, potentially convincing hesitant social groups and decision-makers to support women's inclusion in politics. Furthermore, African nations should strengthen their human capital by improving the education of women and enhancing institutional quality.

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8. Appendix

Table A 1: List of countries in different samples

Country	Code	Region	Country	Code	Region
1. Algeria	DZA	NA	2. Angola	AGO	CA
3. Benin	BEN	WA	4. Burkina Faso	BFA	WA
5. Burundi	BDI	CA	6. Cabo Verde	CPV	WA
7. Cameroon	CMR	CA	8. Central African Republic	CAF	CA
9. Chad	TCD	CA	10. Comoros	COM	EA
11. Congo	COG	CA	12. Cote d'Ivoire	CIV	WA
13. Djibouti	DJI	EA	14. Egypt	EGY	NA
15. Equatorial Guinea	GNQ	CA	16. Ethiopia	ETH	EA
17. Gabon	GAB	CA	18. Gambia, The	GMB	WA
19. Ghana	GHA	WA	20. Guinea	GIN	WA
21. Guinea-Bissau	GNB	WA	22. Kenya	KEN	EA
23. Liberia	LBR	WA	24. Libya	LBY	NA
25. Madagascar	MDG	EA	26. Malawi	MWI	SA
27. Mali	MLI	WA	28. Mauritania	MRT	NA
29. Mauritius	MUS	EA	30. Morocco	MAR	NA
31. Mozambique	MOZ	SA	32. Niger	NER	WA
33. Rwanda	RWA	CA	34. Sao Tome et Principe	STP	CA
35. Senegal	SEN	WA	36. Sierra Leone	SLE	WA
37. South Africa	ZAF	SA	38. Sudan	SDN	EA
39. Tanzania	TZA	EA	40. Togo	TGO	WA
41. Tunisia	TUN	NA	42. Uganda	UGA	EA
43. Zambia	ZMB	SA	44. Zimbabwe	ZWE	SA
45. Nigeria	NGA	WA			

Note: *CA= Central Africa, EA= East Africa, NA= North Africa, SA= South Africa, SSA=Sub-Saharan Africa, WA=West Africa*

Table A 2 Data sources

Symbols	Description	Sourceᵃ		
HHI	Herfindahl index (Export diversification index)	Authors	based	on
Theil	Theil index (Exort diversification index)	Authors	based	on
Gap wage	Gender gap in wage employment	WDI		
GPI second	Gender parity index in gross in gross secondary	WDI		
WPEI	Women's political empowerment index	V-Dem		
gdppca	GDP per capita (constant 2015 US$)	WDI		
Governance	Composite index through a PCAᵇ	WDI		
Av_yearschooling	Average year schooling	WDI		
population	Population, total	WDI		

ᵃ WDI: World Development Indicators database provided by World Bank (2022), V-Dem: Varieties of Democracy project's database version 11 (Coppedge et al., 2021). BACI2002 disaggregated trade data provided by CEPII.ᵇ Governance is a composite index constructed through a Principal Component Analysis (PCA) based the six governance indicators provided by the World Bank, namely: government effectiveness, control of corruption, political stability and absence of violence, quality of the regulation, the rule of law, and voice and accountability.

Table A 3: Descriptive statistics

	N	Mean	SD	Min	Max
HHI	726	.25	0.23	.01	.96
Theil	726	5.82	1.32	3.06	8.41
wpei	726	.69	0.14	.19	.9
gap wage	726	.1	0.09	-.14	.29
gpi second	419	.86	0.19	.32	1.21
lnpopu wdi	726	16.05	1.45	11.9	19.09
governance	726	-.84	1.67	-4.74	4.04
av yearschooling	680	4.59	1.99	1.2	10.1

Table A4: correlation matrix (45 African countries during the 2002-2018 period)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) HHI	1.00							
(2) Theil	0.88*	1.00						
(3) wpei	-0.38*	-0.36*	1.00					
(4) gap_wage	0.07	0.15*	-0.13*	1.00				
(5) gpi_second	-0.39*	-0.40*	0.25*	-0.22*	1.00			
(6) lnpopu_wdi	-0.11*	-0.23*	0.05	0.02	-0.25*	1.00		
(7) gouvernance	-0.45*	-0.52*	0.57*	-0.24*	0.49*	-0.09*	1.00	
(8) av_yearschooling	-0.12*	-0.27*	0.08*	-0.17*	0.65*	0.05	0.26*	1.00

*** $p<0.01$, ** $p<0.05$, * $p<0.1$