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Comparing Global Gender Inequality Indices: What can they tell us about development?

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Abstract

Gender equality can be said to have been achieved when women and men enjoy the same rights and opportunities across all sectors of society, including economic participation and decision-making, and when the different behaviours, aspirations and needs of women and men are equally valued and favoured. A range of composite indices have been developed to try and measure this complex issue. Furthermore, the 2030 Agenda contains over 80 gender-relevant indicators including a specific goal on gender equality.

This paper presents a comparative study of three global gender inequality indices and their country rankings: The Global Gender Gap Index (GGI); the Gender Inequality Index (GII); and the Social Institutions and Gender Index (SIGI). Using a Principal Component Analysis approach, the paper compares these indices to highlight the diversity of factors or dimensions, such as, health, social conditions and education, economic and labour participation and political empowerment that impact on gender and identify the critical factors that drive gender inequality. The paper concludes with some recommendations on prioritisation of factors in the construction of future composite indices and SDG indicators.

Key Words: Principal Component Analysis, 2030 Agenda, SDGs, Gender, Inequality, Trade

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I. Gender equality and development

1. Recognition of the importance of gender equality for development has grown, so that it is now acknowledged as a key pillar in any development programme, including the Addis Ababa Action Agenda and the 2030 Agenda for Sustainable Development. As Helen Clark, former Administrator of the United Nations Development Programme (UNDP) has stated 'Any serious shift towards more sustainable societies has to include gender equality' (Clark, 2012). One simple metric of this growing recognition is the 2030 Agenda: Gender cuts across the entire Agenda for Sustainable Development. There are 53 indicators that directly refer to gender, and Goal 5 is fully dedicated to gender equality. The Millennium Development Goals, at the time, had 1 target and 3 indicators dedicated to gender equality.
2. Article 1 of the 1948 Universal Declaration of Human Rights (United Nations, 1948) states 'All human beings are born free and equal in dignity and rights'. Thus, gender equality is a basic human right. In 1979, the United Nations General Assembly adopted the Convention on the Elimination of All Forms of Discrimination against Women (United Nations, 1979). Adopting such a women-specific treaty was considered necessary because, notwithstanding the existence of general human-rights treaties, as the preamble points out, extensive discrimination against women continues to exist.
3. Gender equality is also a precondition for development and poverty reduction. Empowered women contribute to the health and productivity of families, communities and nations. In 1995, the Beijing Platform for Action noted that “insufficient attention to gender analysis has meant that women’s contributions and concerns remain too often ignored in economic structures, such as financial markets and institutions, labour markets,...” and “as a result, many policies and programmes may continue to contribute to inequalities between women and men” (para. 155). The Platform for Action called for statistics “on the full contribution of women and men to the economy, including their participation in the informal sectors” (para. 206).
4. Goal 3 of the Millennium Development Goals (MDGs)¹ had the broad aim of promoting gender equality and empowering women. The sole MDG target, 3.a was specific to education, however, aiming to eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015. Broadly speaking this was achieved, with most developing countries now enjoying gender equality in primary, secondary and tertiary level education. The MDG progress reports also note improvements in other aspects of gender equality beyond the formal target. Nevertheless, women continue to experience significant gaps in terms of poverty, labour market and wages, as well as participation in private and public decision-making (United Nations, 2015a). For example, MDG 3 target 3.a notes that globally, about three quarters of working-age men participate in the labour force, compared to half of working-age women, and women make up 41 per cent of paid workers outside of agriculture, an increase from 35 per cent in 1990, and that the average proportion of women in parliament has nearly doubled over the past 20 years.
5. In 2015, the Addis Ababa Action Agenda strengthened the focus on women’s economic empowerment by stating that “evidence shows that gender equality, women’s empowerment and women’s full and equal participation and leadership in the economy are vital to achieve sustainable development and significantly enhance economic growth and productivity” (para. 21). It also recognized “the critical role of women as producers and traders” (para. 90) and the importance of facilitating “women’s equal and active participation in domestic, regional and international trade”.

¹ <http://www.un.org/millenniumgoals/>

6. The 2030 Agenda for Sustainable Development (United Nations, 2015b) takes a broader view of gender equality than MDGs that focused on education, and it aims to end all forms of discrimination and violence against women and girls everywhere. The Sustainable Development Goals (SDGs)² also aim to eliminate harmful practices such as forced marriages and genital mutilation, and ensure universal access to sexual and reproductive health services. The new wider agenda seeks recognition of the contribution and value of unpaid and domestic work, and to ensure that women can fully participate in economic, political, social and public life at all levels, including access to economic, financial and technological resources³.

II. Defining gender equality

7. Gender refers to the roles, behaviors, activities, and attributes that a given society at a given time considers appropriate for men and women (UN Women, Gender Equality Glossary). The United Nations has set gender *equality* rather than gender *equity* as a goal. Gender equity denotes an element of interpretation of social justice, usually based on tradition, custom, religion or culture, which is most often to the detriment to women. In other words, gender equity '*is the process of being fair to women and men*' (United Nations Population Fund, 2005). Gender equality is a broader concept that includes the empowerment of women. It cannot exist without gender equity.
8. There are many definitions of gender equality. UN Women defines equality between women and men (gender equality) as: the equal rights, responsibilities and opportunities of women and men and girls and boys. Equality does not mean that women and men will become the same but that women's and men's rights, responsibilities and opportunities will not depend on whether they are born male or female. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of different groups of women and men. Gender equality is not a women's issue but should concern and fully engage men as well as women. Equality between women and men is seen both as a human rights issue and as a precondition for, and indicator of, sustainable people-centered development (UN Women, 2001). The International Labour Organization (2007) defines gender equality to mean that women and men have equal conditions for realizing their full human rights and for contributing to, and benefiting from, economic, social, cultural and political development. Gender equality is therefore the equal valuing by society of the similarities and the differences of men and women, and the roles they play. It is based on women and men being full partners in their home, their community and their society.
9. There is a dual rationale for promoting gender equality. Firstly, equality between women and men – equal rights, opportunities and responsibilities - is a matter of human rights & social justice. Secondly, greater equality between women and men is also a precondition for (and effective indicator of) sustainable and inclusive people-centered development. The perceptions, interests, needs and priorities of both women and men must be taken into consideration not only as a matter of social justice but because they are necessary to enrich development processes.

III. Gender equality indices

10. Gender equality can be said to have been achieved when women and men enjoy the same rights and opportunities across all sectors of society, including economic participation and decision-making, and when the different behaviours, aspirations and needs of women and men are equally valued and

² <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

³ <https://unstats.un.org/sdgs/metadata/>

favoured. Women and men interact in every sphere of existence – economic, social and political. Consequently, there is a variety of ways that gender equality or inequality can be measured. A range of different composite indices have been developed to try and quantify this complex issue.

11. To provide a good general overview of the global situation, three different gender indices are presented and contrasted in this paper: (a) the Global Gender Gap Index (GGI), (b) the Gender Inequality Index (GII) and (c) the Social Institutions and Gender Index (SIGI). These indices have the widest country coverage and are constructed as composite indicators suitable for the principal component analysis. Readers will note that the choice of parameters included in each index affects not only the global index but also the outcomes at national levels. A brief summary of each of the indices is provided below:

A. Global Gender Gap Index (GGI)

12. The GGI, compiled by the World Economic Forum, was developed in 2006 to address the need for a consistent and comprehensive measure for gender equality that can track a country's progress over time. The index is based on the premise that gender inequality is the combined result of various socioeconomic, policy and cultural variables (World Economic Forum, 2018). The index quantifies the magnitude and scope of gender-based disparities across the four key areas of health, educational attainment, economic participation and political empowerment (see Appendix 1 for a more detailed description of how these elements are measured) and tracks progress over time. The GGI measures gaps rather than levels, targets outcome variables rather than input variables, and ranks countries according to gender equality rather than women's empowerment.

B. Gender Inequality Index (GII)

13. The GII, compiled by the United Nations Development Programme, was first published in 2013 and is based on the premise that all too often women and girls are discriminated against in health, education and the labour market with negative repercussions for their freedom (United Nations Development Programme, 2018). The index is a composite measure of gender-based disadvantage in three dimensions: reproductive health; female empowerment and labour market participation (see Appendix 2 for a more detailed description of how these elements are measured). The purpose of the GII is to quantify or provide a measure of the human development costs of gender equality. The higher the index value, the greater the disparities between women and men and the more losses there are to human development.

C. Social Institutions and Gender Index (SIGI)

14. The SIGI, compiled by the Organization for Economic Cooperation and Development (OECD), is a cross-country measure of discrimination against women in social institutions. The first edition of the index was published in 2009. The principle underlying the index is that gender gaps in social institutions translate into gender gaps in development outcomes (OECD, 2019), such as labour force, poverty levels, marginalization, education, vulnerability to violence and public leadership positions. The SIGI is an unweighted composite index comprised of four sub-indices (a) discriminatory family code; (b) restricted physical integrity; (c) restricted resources and assets; and (d) restricted civil liberties. Each sub-index includes several subcategories, so that the index scores countries on 14 indicators in total (See Appendix 3 for a more detailed description of how these sub-indices are compiled and measured). These dimensions examine the gaps between women and

men in terms of rights and opportunities as reflected in legislation, practices and attitudes. A SIGI value of 0 indicates complete equality, whereas a value of 1 indicates complete inequality.

D. Some other indices

15. There are also other composite indicators measuring gender equality. For instance, the World Bank carries out a study of gender equality focusing on women, business and the law across 187 economies. In 2019, they introduced a new Women, Business and the Law Index structured around eight sub-indicators that cover different stages of a woman's working life and have significance for the economic standing of women (World Bank, 2019). This study is closely related to Goal 5 of the 2030 Agenda, and its sub-indicators are highly correlated as they focus on legal aspects. Therefore, the analysis methods used in this paper cannot be applied to this indicator.
16. The Women's Economic Opportunity Index (WEOI), was compiled by the Economist Intelligence Unit (EIU) looking beyond gender disparities to the underlying factors affecting women's access to economic opportunity in the formal economy (Economist Intelligence Unit, 2012). The index was first published in 2010 by EIU in cooperation with the World Bank. The index looked at: labour policy and practice; access to finance; education and training; women's legal & social status; and the general business environment, but it has not been updated since 2012.

IV. Gender equality by region

17. Despite being based on somewhat different approaches to gender inequality, using different methodologies and being comprised of quite different sub-indices, a comparison of the available gender composite indices at regional level reveals similar results (see Table 1). The table compares the gender equality ranking of regions according to four gender indices: SIGI, GII, GGI and the World Bank's Women, Business and the Law Index.
18. In order to make such a comparison, the regions had to be standardised across the indices, as the indices do not use the same nomenclature or definitions. The four indices rank OECD and Europe & Central Asia as the regions with the lowest gender inequality. East Asia and the Pacific, and Latin America and the Caribbean share the second and third places, depending on the index. Three of the four indices (SIGI, GII and WB index) rank Latin America & the Caribbean at the third position. It should be noted that the GII has quite a low representation of Latin America and the Caribbean. Women in sub-Saharan Africa and the Middle East and North Africa are generally judged to experience the most gender inequality.

Table 1. Comparison of rankings provided by Gender Equality Indices by region
(latest year available)

Region	SIGI 2018	GII 2017	GGI 2018	WB index 2018
OECD	1	1	1	1
Europe and Central Asia	2	2	2	2
Latin America and the Caribbean	3	4	3	3
East Asia and the Pacific	4	3	4	4
Sub-Saharan Africa	5	7	5	5
South Asia	6	5	6	6
Middle East and North Africa	7	6	7	7

Source: Authors' calculations on data from the World Economic Forum (WEF), OECD, UNDP and the World Bank⁴

19. Across the indices, there is a very high consistency at a global level. If gender equality is distilled into top half and bottom half regional performers, we see all indices place Europe & Central Asia, Latin America & the Caribbean and East Asia & Pacific in the top half (i.e. higher gender equality). Equally Sub-Saharan Africa, Middle East & North Africa and South Asia are all ranked in the bottom half by all indices.
20. There is, however, much more variation in the scores of the different indicators for a country. This should not be surprising as it would be extremely difficult for an individual country to score consistently well or poorly across the wide variety of sub-indicators employed by the various indices. Nevertheless, although individual rankings may differ, some countries appear in the top 10 rankings of several of the indices. For example (see Table 2), Switzerland is ranked first by the SIGI, GII and GGI, but does not appear among the six⁵ countries who reached the score 100. This means that Switzerland (WB index 82.5) does not yet give women and men equal legal rights that are in the focus of the WB index (World Bank, 2019). By contrast, Belgium, one of the countries who reached score 100 for the WB index, was ranked fifth by the GII and SIGI and twenty-eight by the GGI.
21. Denmark, for instance, is ranked first by the WB index, second by GII and SIGI and twelfth by GGI. Several countries (Denmark, Finland, Germany, Iceland, Slovenia and Switzerland) all appear in the top 10 of at least two of the four indices.

⁴ World Bank's Women, Business and the Law 2018 report

⁵ The six countries who reached the score 100 are Belgium, Denmark, France, Latvia, Luxembourg and Sweden

Table 2. Comparison of country rankings according to Gender Equality Indices

Lowest gender inequality				
Rank	SIGI	GII	GGI	WB index
1	Switzerland	Switzerland	Norway	Belgium
2	Denmark	Sweden	Sweden	Finland
3	Sweden	Belgium	Finland	Australia
4	France	Slovenia	Nicaragua	Peru
5	Belgium	Finland	Rwanda	Italy

Highest gender inequality				
Rank	SIGI	GII	GGI	WB index
1	Yemen	Yemen	Yemen	Jordan
2	Pakistan	Chad	Pakistan	Iraq
3	Iran	Mali	Iraq	Pakistan
4	Jordan	Cote Ivoire	Chad	Bangladesh
5	Lebanon	Liberia	Congo	Nepal

Note: The ranking refers to the countries available in the dataset used for the purpose of this study. Several countries can have the same ranking for the WB index.

22. A similar pattern is also evident at the other end of the scale. Here also a surprisingly high degree of consistency is present. Yemen is ranked as having the highest gender inequality by three indices (SIGI, GII and GGI). Pakistan also appears in three indices towards the bottom ranking, ranked as having the second highest inequality by the GGI and SIGI and third lowest by the WB index. Chad, Jordan and Iraq also appear in two of the four indices among countries having some of the worst gender equality situations.
23. The indices, thus, reflect diverse realities of gender inequality at country level that largely overlap but do not exactly match. They indeed rely on different methodologies, weightings and most notably, input variables, accounting for disparities across the respective country rankings.

V. Principal components of gender equality indices

24. The Principal Component Analysis (PCA) is an ordination-based statistic data exploration tool that converts potentially correlated variables (with some shared attribute, such as points in space or time) into a set of uncorrelated variables that capture the variability in the underlying data.
25. This paper presents a PCA of all variables used as sub-indices in three gender indices: GGI, GII and SIGI. The WB index was excluded, because the characteristics of its sub-indices are not suitable for this type of analysis. The PCA allows for a more synthetic overview of inequalities captured by the indices. The analysis not only identifies correlations between the different sets of input variables but also highlights similarities across countries in terms of their strengths or weaknesses in gender inequality. PCA is a mathematical procedure (a dimension-reduction tool) that can be used to reduce a large set of correlated variables to a small set of uncorrelated variables that contain most of the information of the sub-indicators – the principal components. The three gender equality indices combine 15 sub-indices used as their inputs. Table 3 provides a description of all variables and sources. The gender equality indices initially covered 194 countries (observations). However, as

only 114 countries have data for all 15 sub-indices, the PCA was conducted only for these 114 countries. It should be noted that this sample nevertheless represents 87 per cent of the world's population.

Table 3. Summary of gender inequality indices used in the analysis

Variable name	Year	Data Source
Restricted access to productive and financial sources	2018	OECD
Adolescent birth rate	2017	UNDP
Economic participation & opportunity	2017	WEF
Educational attainment	2017	WEF
Female with at least secondary education	2017	UNDP
Restricted physical integrity	2018	OECD
Health and survival	2017	WEF
Labor force participation, male	2017	UNDP
Discrimination in family	2018	OECD
Maternal mortality ratio	2017	UNDP
Political empowerment	2017	WEF
Restricted civil liberties	2018	OECD
Labor force participation rate, female	2017	UNDP
Male with at least secondary education	2017	UNDP
Share of seats in parliament, female	2018	OECD

Note: Maternal mortality ratio data for Bolivia, Bosnia and Herzegovina, Côte D'Ivoire, Czech Republic, Iran, Kyrgyzstan, Liberia, Moldova, Philippines, Russia, Slovakia and Tanzania, refers to year 2014, Restricted physical integrity data for Algeria, Botswana, China and Mauritius refers to year 2014.

26. We identify four principal components of gender equality by using the PCA. Together, these four principal components explain 75 per cent of the total variance of the 15 indices that comprise the GGI, GII and SIGI gender equality indices.
27. Table 4 presents the four components and the contribution that each of the 15 indices makes to explaining the variance in the observed variables. For example, the first component, education & social conditions accounts for 37 per cent of total variance. The second component accounts for 16 per cent of the remaining variance. The third and fourth components explain more than 20 per cent of the rest of the variance⁶.

⁶ It should be noted that each additional component has two important characteristics. First, it accounts for a maximal amount of variance in the data set that was not accounted for by the previous component and second, it is uncorrelated with all other components.

Table 4. Retained principal components (eigenvectors)

Factor loadings	Education & Social condition (PC1)	Economic & labour participation (PC2)	Political empowerment (PC3)	Health (PC4)	Other
Female with at least secondary education	-0.408	-	-	-	-
Adolescent birth rate	0.376	-	-	-	-
Educational attainment	-0.307	-	-	-	-
Maternal mortality ratio	0.358	-	-	-	-
Male with at least secondary education	-0.409	-	-	-	-
Labour force participation rate, female	-	0.614	-	-	-
Economic participation & opportunity	-	0.565	-	-	-
Discrimination in family	-	-0.424	-	-	-
Share of seats in parliament, female	-	-	0.643	-	-
Political empowerment	-	-	0.633	-	-
Restricted civil liberties	-	-	-0.309	-	-
Health and survival	-	-	-	0.914	-
Restricted access to productive and financial services	-	-	-	-	0.431
Restricted physical integrity	-	-	-	-	0.328
Labour force participation, male	-	-	-	-	-
Proportion in total variance	0.371	0.159	0.144	0.076	0.250

Note: The numbers (or factor loadings) with the same sign contribute within the given component in the same direction, while those with opposite sign contribute to the given component but in an opposed direction. Literally, the correlation between components 1, 2, 3 and 4 would be zero.

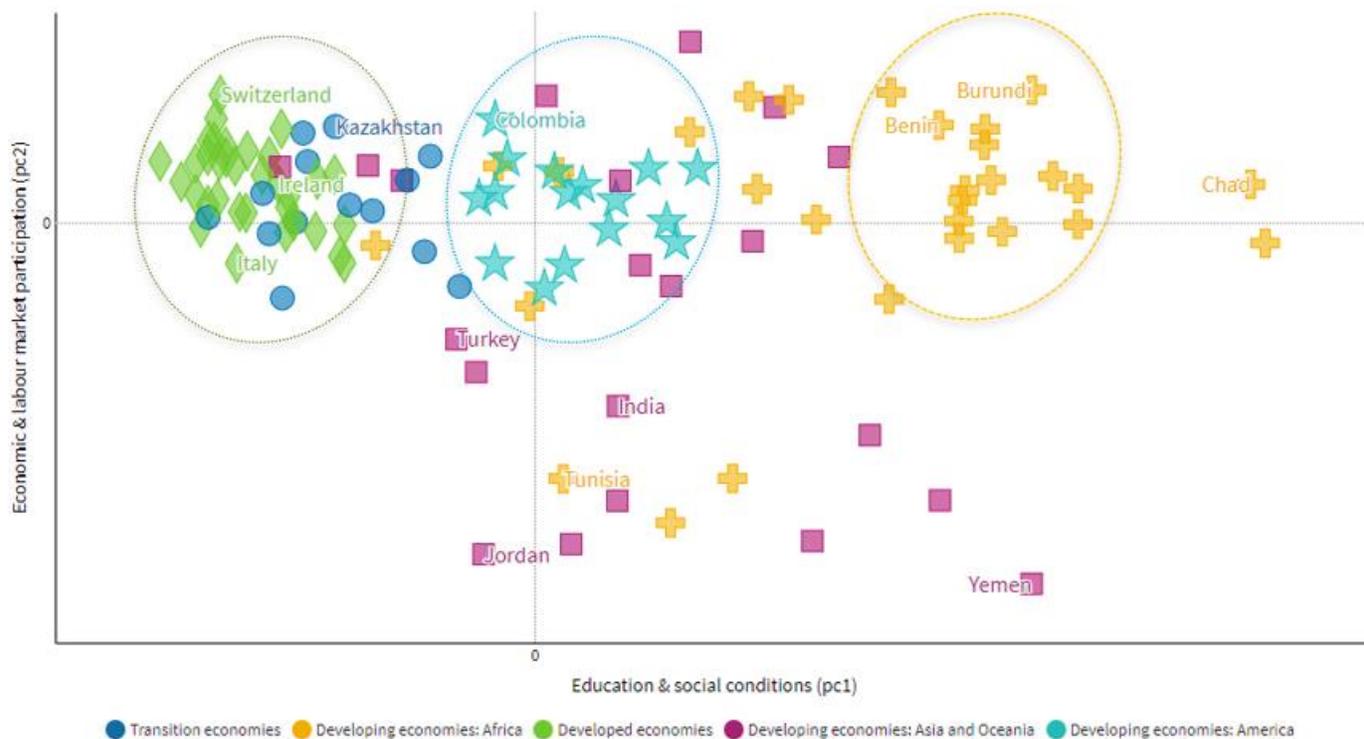
28. We call the first principal component (PC1), “education & women’s social conditions”⁷ where education is an important factor, both for male and female. Reproductive health also has a strong effect on the component. It should be noted that higher education levels of women and men seem to be linked to lower maternal mortality and adolescence at birth.
29. The second component (PC2) “women’s economic and labour market participation” is driven mainly by female participation in the labour market & economic participation (measured by salaries, participation and leadership) and discrimination within the family (child marriage, household responsibilities). The latter, discrimination in the household (loading is in the opposite direction), can influence women’s possibilities to participate in the economy.
30. The third component focuses on “women’s political participation” and is measured by female share of seats in parliament, political empowerment (both with positive loadings) and restricted civil liberties (with negative loading). The last component is heavily defined by health.
31. In Figure 1, gender equality in education & social conditions is represented by the x-axis and gender equality in economic and labour market participation by the y-axis. The closer a country is to the top left corner, the better it performs with regard to the two first components of gender equality. Figure 1 illustrates a clear distinction between developed and developing countries in gender equality in education & social conditions. Countries can be categorized into three broad groups with regard to gender equality in education & social conditions:

⁷ Education and reproductive health are of crucial importance to gender equality. Investment in these areas will be important to ensuring female empowerment and gender equality, especially in developing countries (<https://www.un.org/youthenvoy/2016/03/education-reproductive-health-girls-key-sustainable-development/>).

- The group of countries near the top left is mainly comprised of developed countries that rank highest in gender equality in education & social conditions. Transition countries are very close on the left, except for Azerbaijan, Macedonia and Tajikistan.
- The group of countries in the middle are comprised of mostly developing countries of America that achieve a relatively good score in gender equality in education & social conditions. Some developing economies of Asia and Oceania, like Indonesia and Vietnam, belong to this group, which is nevertheless, the most heterogeneous group.
- The group of countries on the right is mainly comprised of sub-Saharan African countries that face more challenges in providing gender equality in education & social conditions.

32. There is less dispersion between country groups in gender equality in economic and labour market participation. Developed countries are ranked between Switzerland (strong participation) and Italy (low participation). Belarus, Benin, Colombia and Ghana, for instance, have a relatively similar score with New Zealand and Sweden⁸. However, we observe in general, a greater dispersion between developing economies. **For country-specific results, please see the online graphs through links provided under each figure.**

Figure 1. Education & social conditions vs. economic and labour participation



Source: UNCTAD calculations based on data from OECD, WEF and UNDP.

Online graph: <https://public.flourish.studio/visualisation/277456/>

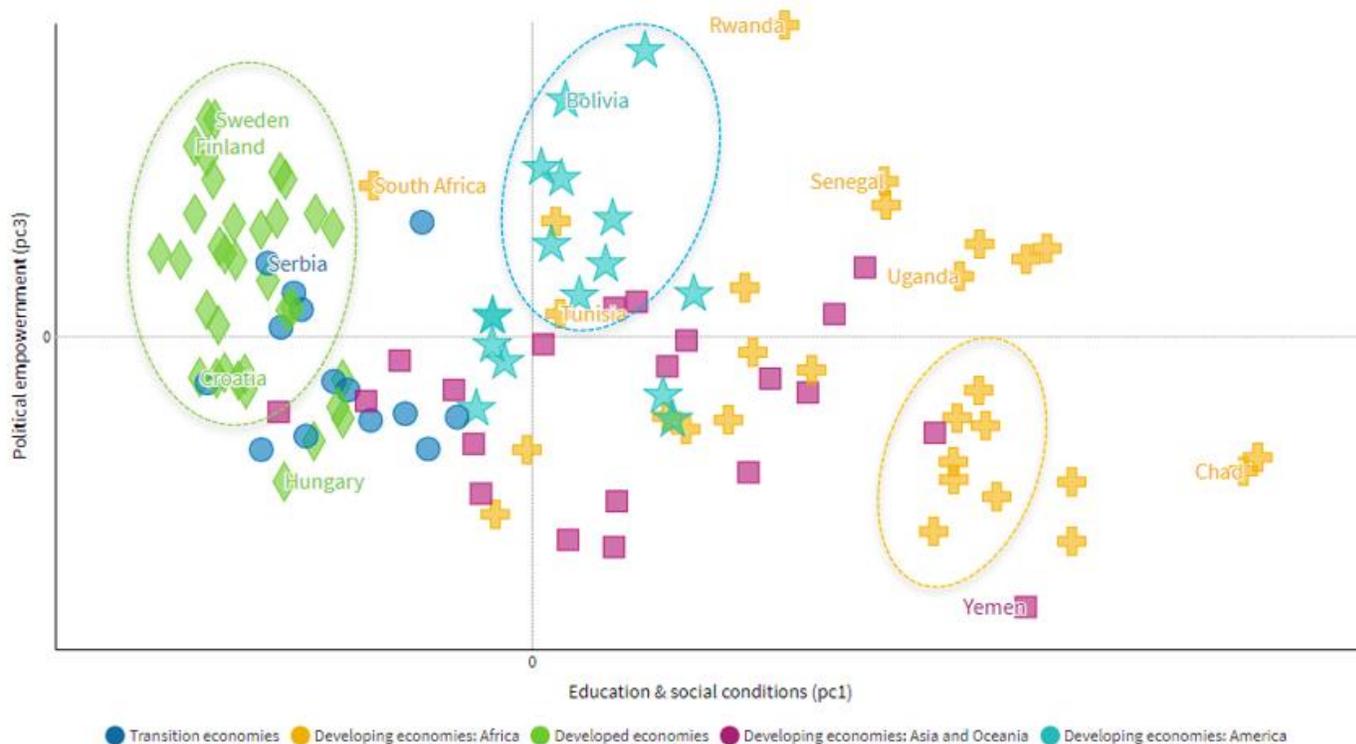
Note: Each country has its x-axis and y-axis coefficient, called scores. Principal component scores are synthetic variable values associated to each sub-indices (row) and each factor (column). To compute the score for a given country for a given factor,

⁸ Regarding to the economic and labour market participation component.

one takes the sub-indices' standardized score on each country, multiplies by the corresponding factor loading (pc1 and pc2) of the variable for the given factor, and sums these products.

33. Developed countries rank comparatively well not only in the education & social conditions, but also for economic and labour participation as well as for health (Figures 1 and 3). It is interesting to note that in sub-Saharan African countries, gender equality in economic and labour participation is relatively high, even though the overall scores in the gender indices show that these economies are among the least gender equal countries. South Africa, on the other hand, is very close to the developed countries' group.
34. There is considerable discrimination linked to gender in some areas, like political empowerment depending on country (Figure 2). For example, while Yemen, Burundi and Tanzania have similar scores for education & social conditions, women in Yemen appear to be much more disadvantaged compared with men in political empowerment than women in Burundi or Tanzania (Figures 1 and 2).

Figure 2. Education & social conditions VS political empowerment



Source: UNCTAD calculations based on data from OECD, WEF and UNDP.

Online graph: <https://public.flourish.studio/visualisation/288478/>

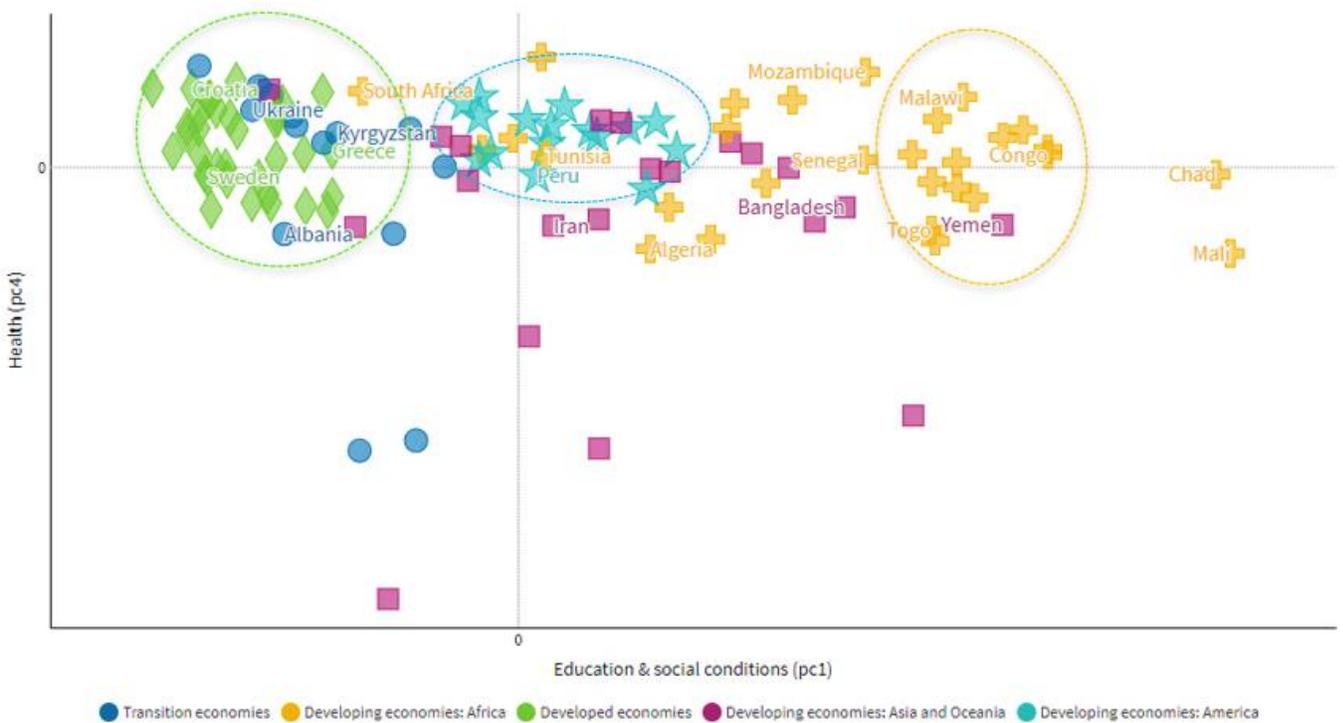
Note: Each country has its x-axis and y-axis coefficient, called scores. Principal component scores are synthetic variable values associated to each sub-indices (row) and each factor (column). To compute the score for a given country for a given factor, one takes the sub-indices' standardized score on each country, multiplies by the corresponding factor loading (pc1 and pc3) of the variable for the given factor, and sums these products.

35. This heterogeneity helps to explain why country rankings can change when different types of gender equality indices, applying different sub-indices or weights, are considered. For example, women in Rwanda appear to be clearly disadvantaged in education & social conditions compared with developed countries, yet Rwanda has the highest score for women's political empowerment (Figure 2). Likewise, there is significant variation in political empowerment even within the group of

developed countries. Gender equality in education & social conditions are equally high in Croatia and Sweden, but for economic & labour participation, and political empowerment, gender equality is much higher in Sweden than in Croatia (Figures 1 and 2). In contrast, Sweden ranks below Croatia for gender equality in health, but with small differences (Figure 3).

36. There is clear separation between developing America and developed countries regarding the education & social conditions component, but there are less discrepancies within developing America than within developed countries.
37. It should also be noted that, except for political empowerment, transition countries are clustered together with developed countries, which means that transition countries have relatively similar gender equality scores with developed countries. However, developing economies of Asia and Oceania cannot be easily clustered, in fact, there are large disparities between them in all areas covered in this study.

Figure 3. Education & social conditions VS health



Source: UNCTAD calculations based on data from OECD, WEF and UNDP.

Online graph: <https://public.flourish.studio/visualisation/288599/>

Note: Each country has its x-axis and y-axis coefficient, called scores. Principal component scores are synthetic variable values associated to each sub-indices (row) and each factor (column). To compute the score for a given country for a given factor, one takes the sub-indices' standardized score on each country, multiplies by the corresponding factor loading (pc1 and pc4) of the variable for the given factor, and sums these products.

VI. Discussion

38. There are likely to be multiple types of gender inequality occurring simultaneously within a country. Due to this complexity, policy makers may have difficulties designing effective policy measures and could argue that gender inequality should be quantified in relation to all its multiple, almost infinite manifestations. However, sometimes the opposite may be true, and it may be necessary to distill all of the information to enable a 'focused' policy response. The analysis presented in this

paper synthesises the multiple factors reflected in the gender equality indices to identify the key components of gender equality - the factors that affect gender equality most.

39. The analyses presented above suggest a number of issues. Firstly, it is clear that gender equality is a complex issue comprised of many moving parts. Consequently, there is probably no one set of policy prescriptions for countries to follow. Different countries will need to target or prioritise elements of health, or economic participation and so forth, depending on the local circumstances. But what to prioritise or target? One of the challenges or drawbacks with composite indices is the difficulty in interpreting them – they are ideal for providing country rankings but less good at informing policy direction. The analyses above distill the issues highlighted by several composite indices, providing countries with a set of metrics that will allow them to prioritise their actions. For example, as Rwanda enjoys strong female political empowerment and economic participation, it could perhaps focus its efforts on improving education and women’s social conditions.
40. The results of our analysis suggest that inequality measured by the analysed indicators can be reduced to four main clusters that are of central importance to achieving gender equality, namely: education & social conditions; economic and labour market participation; political empowerment and health. Looking at this from a development perspective, it suggests that with regard to acknowledging and addressing gender inequality, the 2030 Agenda and the SDGs have made important strides in the right direction vis-à-vis the MDGs.
41. The MDGs had 21 targets, of which 13 could be considered gender related⁹. Mapping these targets to the four clusters identified above, we see they largely align with health & social conditions & education. Only indicators 1A, 1B and 1C, which deal with improving income distributions, providing decent work and reducing hunger might be considered relevant to economic & labour market participation. The MDGs did not address political empowerment at all.
42. In contrast, of the 169 SDG targets and 232 SDG indicators, UN Women have identified 38 targets and 53 indicators as being gender related (UN Women, 2017). Mapping these targets to the same four clusters, the greater recognition of economic & labour market participation (14 targets and 17 indicators)¹⁰ and political empowerment (3 targets and 4 indicators)¹¹ is evident. Health (6 targets and 8 indicators)¹² & social conditions & education (18 targets and 24 indicators)¹³ of course, remain important¹⁴.
43. For political empowerment, the indicators represent the ambition of their corresponding targets reasonably well. That said, other choices, such as, the ratio of women to men in ministerial-level positions or the ratio of women to men in terms of years in executive office could also have been considered. Across all three indices, the economic & labour market participation cluster does appear to have an important element missing: trade.

⁹ Authors assessment: 1A, 1B, 1C, 2A, 3A, 4A, 5A, 5B, 6A, 6B, 6C, 7C and 7D

¹⁰ 1.1, 1.2, 1.4, 2.3, 5.4, 5.5, 5.A, 8.3, 8.5, 8.7, 8.8, 8.9, 10.2 and 13.B

¹¹ 5.5, 5.C and 16.7

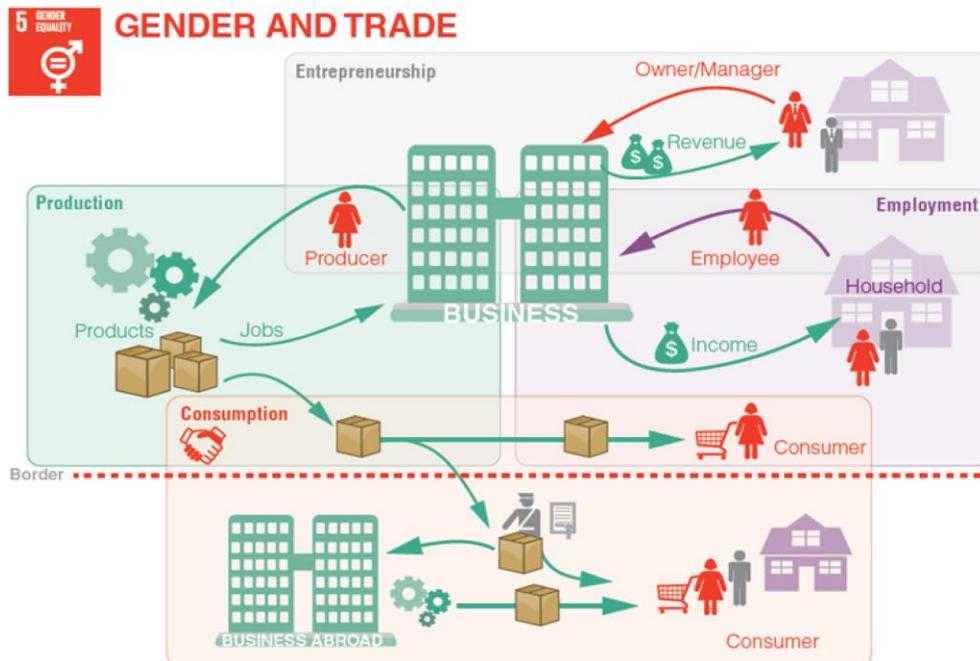
¹² 3.1, 3.3, 3.7, 3.8, 4.2 and 8.8

¹³ 1.3, 1.B, 4.1, 4.2, 4.3, 4.5, 4.6, 4.7, 4.A, 5.1, 5.2, 5.3, 5.6, 5.B, 11.2, 11.7, 16.1 and 16.2

¹⁴ Astute readers will notice that the sum of targets by cluster (41) does not sum to 38. This is because 3 targets cannot to classified to a single cluster alone: 4.2 relates to both health & social conditions & education; 5.5 relates to both political empowerment and economic & labour market participation; and 8.8 relates to both health and economic & labour market participation.

44. It has long been argued by many development economists that international trade is an engine for development. The role of trade in the development process is widely accepted today - see Monterrey Consensus (United Nations, 2002). In fact, reviewing the progress made by development economics, the eminent economist Sir Arthur Lewis (quoted in Yergin and Stanislaw, 1998) identified the underestimation of the power of international trade to propel growth as a fundamental and costly error.
45. Changes in trade impact the sectoral composition of the economy affecting job opportunities and the welfare of women and men. Trade and trade policies, therefore, can have important redistributive effects within an economy, which can magnify or reduce existing disparities, including gender inequality. The issue is that trade statistics cannot just be disaggregated by gender, since they do not collect information by sex. Such data needs to be linked across statistical domains or collected directly through additional surveys or survey modules. The analyses of women and men as traders could look at their roles in trade, including:
- Employment role – as employees of businesses engaged in international trade as exporters or importers;
 - Entrepreneurship – as owners or managers of businesses engaged in international trade;
 - Production – as producers of goods and services traded internationally, using imported inputs or sold in markets that compete with imported products; and
 - Consumption – as consumers of traded goods and services.

Figure 4. The roles of women and men in trade



Source: UNCTAD (2018)

46. The measurement of gender-in-trade would go a long way with the collection of data on the gender of entrepreneurs, self-employed and employees. That could enable the linking of data for indicators on women's and men's employment and wages in exporting firms, female and male entrepreneurs' trade participation, the profitability of their firms and the kinds of products they produce etc.

VII. Conclusion

47. New gender equality indicators continue to emerge at international, regional and national levels. Regional gender equality indices are tailored to address the local context and challenges. For instance, the European Gender Equality Index, developed by the European Institute for Gender Equality, assesses gender equality across EU member states¹⁵, and the African Gender Equality Index, developed by the African Development Bank, combines gender-differentiated outcomes and data on social institutions that influence the gender gap¹⁶.
48. Recently, governments, like Germany and the United Kingdom, have started to introduce gender pay gap reporting requirements for businesses. In the United Kingdom, the Equality Act (in force since 6 April 2017) made it compulsory for public bodies and private companies with more than 250 employees to report their gender pay gap figures annually. Significant pay gaps disclosed since then have provoked much public reaction and action by company CEOs. Some other countries are also looking to follow this approach.
49. The French Gender Equality Index for Companies with over 1000 employees¹⁷ also foresees penalties for companies with low scores and no progress. Starting from September 2019, the reporting requirement will apply to all French companies with over 250 employees. In addition, Bloomberg introduced a voluntary Gender Equality Index now covering 230 companies from ten sectors headquartered in 36 countries¹⁸ to reinforce corporate social responsibility. The new regional and corporate gender equality indices would merit a dedicated analysis in the future.
50. New global gender-related indices are also being developed. At the Women Deliver Conference in June 2019, Equal Measures 2030 (EM2030) will release a new global gender index for 129 countries that is aligned to the SDGs. The Index provides the “big picture” on the state of gender equality as well as goal-specific measures of progress towards gender equality for 14 of the 17 SDGs. The index identifies critical policy issues for girls and women across the SDGs, including those which are currently gender-blind (e.g. climate change, public finance and tax policy). The Index relies on SDG indicators and complementary data that capture existing legal and policy frameworks, perceptions of women, etc. The Index and underlying indicators as well as country and thematic policy deep-dives are housed on the EM2030 Gender Advocate Data Hub¹⁹.
51. In the recent years, researchers and gender equality advocates have started to pay increasing attention to economic empowerment, and this is reflected in the latest gender equality indices and the SDG indicator framework. However, the current data limitations have focused the assessment of economic empowerment on the labour markets and political participation.
52. Next year will mark the 25th anniversary of the Beijing Declaration and a 5-year milestone in implementing the 2030 Agenda. The Buenos Aires Declaration on Trade and Women’s Economic Empowerment, signed in December 2017, has launched a series of talks about the role of trade in gender equality and the urgent need for better data. The trade and gender links are not considered by current gender equality indices, while participation in the economy, and thus in trade, is a key factor of gender equality. Trade policy makers have turned to statisticians asking for better data. We need to deliver – also on issues that cut across the statistical system like gender and trade.

¹⁵ <https://eige.europa.eu/gender-equality-index/2015>

¹⁶ www.afdb.org/en/topics-and-sectors/topics/quality-assurance-results/gender-equality-index/

¹⁷ www.thalesgroup.com/en/group/responsibility/news/gender-equality-index-1-march-2019

¹⁸ <https://www.bloomberg.com/gei>

¹⁹ <https://data.em2030.org/>

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IX. Appendix - Description of the World Economic Forum Global Gender Gap Index

1. The Gender Gap Index (GGI) was developed in 2006 by World Economic Forum to address the need for a consistent and comprehensive measure for gender equality that can track a country's progress over time. The index quantifies the magnitude and scope of gender-based disparities across the four key areas of health, educational attainment, economic participation and political empowerment.
2. These four key areas are measured as follows:
 - Gender inequality in health and survival is measured by using two indicators: (a) sex ratio at birth, which aims specifically to capture the phenomenon of missing women prevalent in many countries with a strong preference for sons; (b) the gap between women's and men's healthy life expectancy. This measure provides an estimate of the number of years that women and men can expect to live in good health by taking into account the years lost to violence, disease, malnutrition or other relevant factors.
 - Gender inequality in economic participation and opportunity is measured using three concepts: (a) the participation gap – the difference between women and men in labour force participation rates; (b) the remuneration gap – measured using a combination of two indicators – ratio of estimated female-to-male earned income and wage equality for similar work; (c) the advancement gap – measured using a combination of two indicators – the ratio of women to men among legislators, senior officials and managers, and the ratio of women to men among technical and professional workers.
 - Gender inequality in educational attainment is measured by the gap between women's and men's access to education; that is, the ratios of women to men in primary, secondary and tertiary education. A longer-term view of the country's ability to educate women and men in equal numbers is captured by the ratio of male and female literacy rates.
 - Gender inequality in political empowerment is measured using the ratio of women to men in minister-level positions and the ratio of women to men in parliamentary positions. In addition, the ratio of women to men in terms of years in executive office (prime minister or president) for the last 50 years is also incorporated. Unfortunately, there are insufficient data to measure male and female participation in local government.

X. Appendix - Description of the UNDP Gender Inequality Index

3. The GII is a composite measure of gender-based disadvantage in three dimensions: reproductive health; empowerment; and labour market (Measured by female and male labour force participation rates) (see Appendix 2). The purpose of the GII is to quantify or provide a measure of the human development costs of gender inequality. Thus the higher the GII value the greater the disparities between females and males and the more loss to human development.
 - Health is measured by two indicators (1) maternal mortality ratio and (2) adolescent birth rates.
 - Empowerment is measured two indicators by (1) the proportion of parliamentary seats occupied by females and (2) the proportion of adult females and males aged 25 years and older with at least some secondary education.
 - Labour market is measured by comparing female and male labour force participation rates.
4. For more information, see the technical notes in UNDP (2015).

XI. Appendix - Description of the OECD Social Institutions and Gender Index

5. The SIGI is a cross-country measure of discrimination against women in social institutions. It is an unweighted composite index comprised of four sub-indices (a) discriminatory family code; (b) restricted physical integrity; (c) restricted resources and assets; and (d) restricted civil liberties. Each sub-index includes several subcategories, so that the index scores countries on 14 indicators in total:
6. Discrimination institutionalized in family code is measured using four indicators: (1) legal age of marriage i.e. Whether women and men have the same legal minimum age of marriage (data source: SIGI country profiles); (2) early marriage i.e. Percentage of women married between 15-19 years of age (data source: UN World Marriage Data - Demographic Health Survey); (3) parental authority in marriage and divorce (data source: SIGI country profiles); (4) inheritance rights of widows and daughters (data source: SIGI country profiles).
7. Discrimination institutionalized in restricted physical integrity is measured using three indicators: (1) violence against women i.e. Laws on domestic violence, laws on rape, laws on sexual harassment, Attitudes toward violence and Prevalence of violence in the lifetime; (data source: SIGI country profiles and WHO Demographic Health Surveys); (2) female genital mutilation (data source: WHO Demographic Health Surveys) ; (3) reproductive autonomy i.e. Percentage of married women aged 15-49 with an unmet need for family planning (data source: WHO Demographic Health Surveys).
8. Discrimination institutionalized as restricted resources and assets is measured using three indicators: (1) secure access to land i.e. Whether women and men have equal and secure access to land use, control and ownership (data source: SIGI country profiles); (2) secure access to non-land assets i.e. Whether women and men have equal and secure access to non-land assets use, control and ownership (data source: SIGI country profiles); (3) access to financial services i.e. Whether women and men have equal access to financial services (data source: not specified).
9. Discrimination institutionalized as restricted civil liberties is measured using two indicators: (1) access to public space i.e. Whether women face restrictions on their freedom of movement and access to public space, such as restricted ability to choose their places of residence, visit their

families and friends or to apply for a passport (data source: SIGI country profiles); (2) political voice i.e. Quotas (whether there are legal quotas to promote women's political participation at national and sub-national levels) and Political representation (the share of women in national parliaments) (data sources: SIGI country profiles and World Development Indicators)

10. For more information see Annex of OECD (2019) or background paper 'What is SIGI?' which can be found at: <http://www.genderindex.org/data#discriminatory-family-code>

XII. Appendix - Principal Component Analysis

11. Principal component analysis is probably the oldest and best known of the techniques of multivariate analysis. It was first introduced by Pearson (1901) and developed independently by Hotelling (1933). PCA is an ordination-based statistic data exploration tool that converts a variety of potentially correlated variables (with some shared attribute, like points in space or time) into a set of uncorrelated variables that capture the variability within the underlying information. As such, PCA can be used to emphasise patterns among multivariable data. PCA uses orthogonal linear transformation to identify a vector in N-dimensional space. This first principal component (pc1) accounts for the maximum amount of the total variability in a set of N variables, where the total variability within the data is the sum of the variances of the observed variables, when each variable has been standardized (to have a mean of 0 and a standard deviation of 1). A second vector (pc2), orthogonal to the first, which accounts for the maximum of the remaining variability in the original variables. Each succeeding pc is linearly uncorrelated to the others and accounts for the maximum of the remaining variability (Jolliffe, 2002).
12. PCA can, therefore, be used as descriptive, statistical approach to data transformation as a method of overcoming variable incommensurability. The ranking of the principal components in order of their significance (based on what proportion of the variability within the information they capture) is denoted by the eigenvalues related to the vector for each pc. In the case of a spatially explicit analysis each data point for each variable is related to a specific point in space and the principal components derived from the PCA can be assigned as scores (synthetic variable values) for each of these points in space.
13. In this study, PCA analysis was undertaken using the Stata software. We conceptualise the PC scores associated with the multiple variables of inequality. As none of the fifteenth inequality sub-indices were highly correlated, all fifteenth inequality indices were retained in the PCA analysis. By retaining only those PCs that account for a substantial proportion of the variability in the original data a smaller number of independent indices of gender inequality can be generated.
14. The results presented here correspond to PCA with orthogonal rotation. We proceed to orthogonal rotation to maximize the variance of coefficients. We increase the explained variance of the sample by the components and we reduce the unexplained variance.
15. In addition, the rotation increases the specificity of each component which allows a more precise component analysis. The higher dispersion of countries in the PCA before rotation could, therefore, be explained by the expression of origin variables, the weighting of which is modified after rotation.

A. Appropriateness of using PCA

16. The table below shows the correlation matrix of the variables. The correlation between variables is high. Which confirm that the PCA analysis is appropriate to this database.

Table 5. Correlation matrix

r_mortm	physint	f_status	accessfi	lab_poli	r_adobir	f_parliam	f_second	m_second	f_labpart	m_labpart	ecopart	edu_att	health	empower	
r_mortma	1														
physinteg	0.6115	1													
f_status	0.3412	0.3872	1												
accessfi	0.4959	0.5595	0.4556	1											
lab_policy	0.4035	0.5519	0.6662	0.5818	1										
r_adobirtl	0.7067	0.5878	0.2515	0.5366	0.3531	1									
f_parliam	-0.1347	-0.3401	-0.5122	-0.3524	-0.278	-0.1354	1								
f_second	-0.696	-0.5924	-0.3775	-0.5295	-0.5248	-0.7141	0.057	1							
m_second	-0.6707	-0.5889	-0.3519	-0.5079	-0.495	-0.7179	0.0325	0.9759	1						
f_labpart	0.3041	-0.0542	-0.2398	-0.0935	-0.3923	0.2979	0.3098	-0.1417	-0.1644	1					
m_labpart	0.2664	0.3336	0.2106	0.2675	0.2335	0.4238	0.0294	-0.4856	-0.5163	0.3915	1				
ecopart	-0.0543	-0.3339	-0.3959	-0.3228	-0.6451	-0.0962	0.277	0.2898	0.2331	0.7057	-0.1127	1			
edu_att	-0.7169	-0.5603	-0.4058	-0.5364	-0.4455	-0.6529	0.2729	0.6491	0.587	-0.0858	-0.1966	0.2682	1		
health	-0.0691	-0.2863	-0.1352	-0.1671	-0.142	0.0902	0.16	0.0608	-0.0143	0.1055	-0.0774	0.2611	0.1731	1	
empower	-0.1553	-0.3038	-0.4727	-0.2973	-0.2571	-0.172	0.7486	0.1652	0.1454	0.124	-0.1071	0.2225	0.2793	0.1142	1

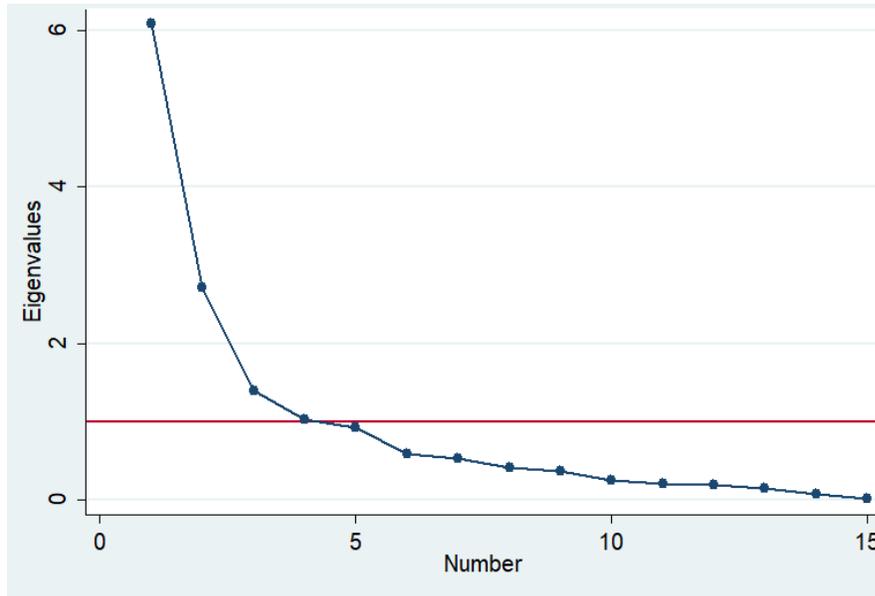
17. The Kaisere_Mayere-Olkin (KMO) sampling adequacy test values were >0.5 (Health and Female Labour participation $>.4$), and the overall value was close to 1, suggesting that the variables were suitable for PCA analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). Also, the inter-variable correlation (correlation matrix) contains several small-moderated sized correlations ($>.3$).

Table 6. Kaiser-Meyer-Oklin test

Variable name	kmo
Restricted access to productive and financial sources	0.8583
Adolescent birth rate	0.8874
Economic participation & opportunity	0.5974
Educational attainment	0.8992
Female with at least secondary education	0.7643
Restricted physical integrity	0.8583
Health and survival	0.4000
Labor force participation, male	0.5724
Discrimination in family	0.8415
Maternal mortality ratio	0.8793
Political empowerment	0.7058
Restricted civil liberties	0.8273
Labor force participation rate, female	0.4674
Male with at least secondary education	0.7451
Share of seats in parliament, female	0.6709
Overall	0.7668

18. For the present study, we use a graphical method, known as the Catell’s (1966) scree test (Figure 5). These are plots of each of the eigenvalues of the factors. One can inspect the plot to find the place where the smooth decrease of eigenvalues appears to level off. To the right of this point, only ‘factorial scree’ is found. After examining the scree plot, four factors were extracted for analysis.

Figure 5. Scree plot of eigenvalues of factors after PCA



19. We retain only components for which the (proper values) is greater than 1 (Kaiser rule). In fact, we want to retain the component which have the minimum power to explain the variance more than an original variable. Here we notice 2 breaks.

Table 7. Coefficients of the four principal components

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	6.09223	3.37432	0.4061	0.4061
Comp2	2.71792	1.31268	0.1812	0.5873
Comp3	1.40524	.372699	0.0937	0.6810
Comp4	1.03254	.0983754	0.0688	0.7499
Comp5	.934165	.346705	0.0623	0.8121
Comp6	.58746	.0586445	0.0392	0.8513
Comp7	.528815	.114946	0.0353	0.8866
Comp8	.41387	.0396858	0.0276	0.9141
Comp9	.374184	.122278	0.0249	0.9391
Comp10	.251905	.0468904	0.0168	0.9559
Comp11	.205015	.00243616	0.0137	0.9696
Comp12	.202579	.0489379	0.0135	0.9831
Comp13	.153641	.0692265	0.0102	0.9933
Comp14	.0844145	.0683961	0.0056	0.9989
Comp15	.0160184	.	0.0011	1.0000

