The Impact of Gender Equality on Economic Performance: A Comparative Analysis of Economies at Different Levels of Development

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Abstract

This study explores the relationship between gender equality and economic performance, focusing on how it differs based on the development of an economy. Where previous research concentrates on gender equality as a whole, this study creates indices to evaluate the impact of gender equality in different areas: health care, education, and the labour force. Both GDP and HDI are used as indicators of economic performance. Time-series econometric techniques are employed in order to carry out analysis. The findings imply that gender equality has positive implications for economic and social development, and that different areas of gender equality may change in importance depending on the level of economic development. Moreover, the results reveal that gender equality is more important for HDI and social development, compared to solely economic output.

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1. Introduction

Gender equality is a critical social, economic and human rights issue that has gained ever more attention in recent years. Research has shown that there exists a positive relationship between gender equality and economic performance. Esteve Volart (2004) even predicted that boosting the female to male ratio of total workers by just 10% would lead to an impressive 8% surge in real per capita output growth – underscoring how vital promoting gender equality can be for economies. Yet despite this growing recognition, major gender gaps continue to exist around the world, especially across developing nations, which severely restrict women's chances for education, employment and participation in decision-making processes while sabotaging their potential contributions towards an economy's development. Policymakers who seek sustainable and inclusive economic progress therefore need access to more comprehensive research on how exactly gender equality influences economic performance.

There are still gaps in the existing literature on the extent to which this positive relationship holds across different contexts. The intention of this research is to begin to fill these gaps of knowledge in order to provide a more in depth understanding of the relationship between gender equality and economic performance. It intends to do this through empirical analysis. Regression analysis is employed in order to demonstrate the impact of gender equality on economic performance.

By conducting a comparative analysis of economies at different developmental stages this research endeavours to contribute to the understanding of how gender equality influences economic performance. Currently there is limited understanding about how such differences might impact growth rates or other measures of performance. Therefore, this research provides insights that will be a valuable addition to previous research. Furthermore, another contribution of this research is the exploration of how the impact of gender equality differs for different indicators of economic performance. Where previous research focuses solely on the impact of gender equality on GDP, this research seeks to provide a more insightful analysis by investigating its impact also on HDI. This approach acknowledges the significance of gender equality beyond its economic implications and considers critical factors that reflect the overall well-being of society. As a result, this paper provides a more holistic understanding of the role of gender equality. Moreover, this paper will look at multiple dimensions of gender equality. This exploration gives a more nuanced understanding of how gender equality in different areas of society impacts economic outcomes. The development of new composite indices of gender equality are carried out in order to do so. As such, the indices are refined, using a select few variables. This differs and offers a more in-depth investigation compared to previous literature where the Gender Inequality Index (GII) has been predominantly used.

This paper finds that gender equality is more critical in improving social development than economic development. This is not to say that gender equality was not found to improve GDP, but that the impacts on HDI were much more significant. This was true for economies at all levels of development, although it was strongest for developed economies. As such, it serves

as motivation for policymakers seeking to better social development to concentrate on achieving a more gender equal society. Gender equality also was found to be important in improving GDP for large developing economies, specifically in the labour force. This information is crucial for policymakers in providing insights into specific contexts where improvements in gender equality can lead to improvements in economic performance, and therefore where policy should be concentrated.

2. Literature Review

The review that follows makes use of numerous research publications that have previously focused on the areas of interest pertinent to this paper to contextualise the research issue; the effect of gender equality on economic performance. This research paper focuses on gender equality in the labour force, education and health and how it differs for developed and the largest developing economies.

2.1 Gender Equality in the Labour Force

Recent research describes men and women as complements in production (Ostry, J. *et al.* 2018). This means that the integration of men and women in the labour force results in larger gains than if either were to have been working with the same sex only (Ostry, J. *et al.* 2018). The results presented by Ostry, J. *et al.* (2018) indicate an economic gain resulting from the inclusion of women in the workforce, which is greater than only the gain from having additional human capital. This can result from the exchange of diverse ideas, which leads to innovation and, in turn, greater productivity (Das, S. and Kotikula, A., 2019; Ostry, J. *et al.* 2018; Scarborough, W.J. 2020). This was supported by research which showed that if Morocco had increased female labour force participation (FLFP) then total factor productivity (TFP) would have also increased, bringing about an increase in GDP (Ostry, J. *et al.* 2018). Gender segregation impedes the positive impact on productivity from the inclusion of women in the labour force (Scarborough, W.J. 2020). It occurs in developing and developed economies; in the U.S., the largest contributing factor to the gender wage gap (33%) was employment segregation by occupation (Das, S. and Kotikula, A., 2019). The integration of men and women leads to innovation which Scarborough, W.J. (2020) found is particularly beneficial for finance and tech sector growth. Substantial segregation by occupation causes the economy to miss out on the economic benefits in these high-skill sectors brought about by the exchange of information between men and women (Scarborough, W.J. 2020). Also evidenced by the World Bank (2012), it was found that the presence of women on corporate boards improved the performance of firms. As a result, the participation of women in the workforce, especially in high-skill sectors, has been found to be positively correlated with growth (World Bank, 2012).

Working in agriculture is more prevalent among women than men (Elder, S. and Smith, A., 2010). This is especially true for developing economies where for example, in Sub-Saharan Africa, women make up a relatively large share of the labour force, with the majority working in agriculture (Baliamoune-Lutz, M. and McGillivray, M., 2007). In this sector, few skills are

needed, and wages are very low (Baliamoune-Lutz, M. and McGillivray, M., 2007). This, along with women being overrepresented in this industry, leads to low productivity (Baliamoune-Lutz, M. and McGillivray, M., 2007). The low productivity arises from the fact that land is fixed, meaning that a surplus of women in the agriculture sector leads to diminishing returns (Lewis, W.A., 1954). These surplus workers could be removed from this sector at little to no cost, representing a major misallocation of labour (Das, S. and Kotikula, A., 2019; Lewis, W.A., 1954). This is supported by evidence from India carried out by Esteve-Volart, B. (2004), where a reduction of female managers would reduce output in the non-agricultural sector, showing how labour in the agricultural sector could be reduced with no substantial effect on output. The idea that women crowd into low-productivity sectors explains why some studies have found that a larger share of women in the labour force in some developing countries harms economic growth (Baliamoune-Lutz, M. and McGillivray, M., 2007). When gender differences are removed, it has been found that women are as productive as men (World Bank, 2012). This shows that the segregation of women into low-productivity sectors can be considered the cause of the negative correlation with growth, not that women are inherently less productive (World Bank, 2012). In fact, it was found that in India, an increase in female managers would increase economic growth, therefore showing how if women had access to more highly skilled jobs such as managerial roles, then an increase in FLFP could be positively correlated with growth (Esteve-Volart, B., 2004). The segregation of women into lower-skilled occupations is much more prevalent in the largest developing economies compared to developed economies, with different social norms leading to restrictive legislation and women having less access to productive inputs (World Bank, 2012). For example, in many African countries, women are required by law to obtain permission from their husband or father to work (Breslin, J. and Kelly, S. 2010). In addition, the World Bank (2012) found that 55% of female-led households owned land across five developing regions compared to 64% of their male counterparts, reflecting how access to land is much more difficult for women in developing economies. This, in turn, reduces FLFP and the ability of women to seize economic opportunities (Das, S. and Kotikula, A., 2019; World Bank, 2012).

2.2 Gender Equality in Education

Increased gender equality in education provides beneficial economic effects through several different avenues, one of them being intergenerational effects. It has been found that women's education is positively correlated with a child's educational achievement (Hill, M.A. and O'Neill, J. 1994). This was gathered from results which showed that if a mother spent one extra year in education, her child's test scores increased by a statistically significant amount (Hill, M.A. and O'Neill, J. 1994). This serves to highlight the importance that education not only leads to more skilled human capital within the individual, however it also spills over and has beneficial effects on the human capital of their children. One explanation for this could be that more educated mothers invest more in the human capital of their children (Hill, M.A. and King, E. 1995). In addition, rising levels of women's education have reduced fertility rates (Benavot, A. 1989). This has occurred through two different routes: women have improved knowledge of the use of contraceptives, and they begin to prioritise entering the labour market rather than having children (Benavot, A. 1989; Day, C. and Dowrick, S. 2004). A reduction in fertility

rates naturally increases economic growth due to GDP being divided by a reducing population (Benavot, A. 1989). In addition, productivity increases as more women decide to prioritise and move into formal labour, which means additional people contribute to total GNP. However, there is not only an indirect effect on economic growth through fertility rates, as when they are controlled for women's education, it still has a statistically significant impact on growth (Benavot, A. 1989). This shows that women's education increases economic growth also via the direct effect of the increase in skilled human capital, which increases productivity (Day, C. and Dowrick, S. 2004).

In the largest developing economies compared to developed economies, family-mediated impacts are much more significant in increasing economic growth (Kabeer, N. and Natali, L. 2013). This is due to its prompt impact on the fertility rate and the fact that it is not dependent on market conditions (Kabeer, N. and Natali, L. 2013). The avoidance of dependence on market conditions is important because in these developing economies when women obtain secondary education, the absence of employment opportunities means they are crowded into low-return jobs despite having higher education (Das, S. and Kotikula, A., 2019; Kabeer, N. and Natali, L. 2013). Furthermore, primary education is found to have much greater effects on growth than secondary education in developing economies due to its impact on fertility (Baliamoune-Lutz, M. and McGillivray, M., 2007; Kabeer, N. and Natali, L. 2013). A study also evidenced that the positive effect on economic growth in one of the largest developing economies, Africa, is mostly explained by family-mediated impacts (Appiah, E.N. and McMahon, W.W., 2002).

2.3 Gender Equality in Health

As a result of declining fertility rates due to increasing knowledge and use of contraceptives, pregnancies become more carefully planned and lead to healthier children (Bailey, M.J. 2006). In addition, contraceptives allow women to choose to have children later in life, which in turn increases FLFP and hours worked due to them having more time to work instead of taking care of children (Bailey, M.J. 2006). Another way in which improvements in healthcare for women can lead to increased FLFP is through interventions which make pregnancy and delivery safer, consequently reducing the maternal mortality rate (Onarheim, K.H., Iversen, J.H. and Bloom, D.E. 2016). For example, in the U.S., a reduced maternal mortality rate led to an increase in FLFP among women between the ages of 23-33 of 52% (Albanesi, S. and Olivetti, C. 2009). This allows for improvements in economic growth as an increase in FLFP increases productivity.

In developing regions such as SSA, there is a much higher risk of women dying in pregnancy or childbirth due to preventable causes than in developed regions (World Bank, 2007). The relative comparison is 1 in 22 compared to 1 in 7300 (World bank, 2007). This saddening statistic is both a personal and economic tragedy; a woman's personal and economic contributions to society are ceased (Hage, G., 2009). Furthermore, infant mortality in developing regions is also higher, leading to adverse effects on economic productivity as women take more time out of work due to increased pregnancies (Hage, G., 2009). In large developing economies such as India, improvements in healthcare for women have been seen to directly increase productivity in the labour force (Gopaldas, T. and Gujral, S. 2003). At first,

it was found that female farmers were 20-30% less productive than male farmers (World Bank, 2012). Lozano, R. *et al.* (2012) suggested the cause may be poor women's health. Furthermore, the study in India found that after multi-micronutrient supplements were given to female tea pickers, their productivity increased significantly (Gopaldas, T. and Gujral, S. 2003). This evidences a positive correlation between women's healthcare and labour productivity. In fact, data supports that where women have better healthcare, economic growth is higher (Hage, G. 2009).

3. Sample

The sample used in this study draws countries from different levels of development to investigate the interaction between economic performance and gender in economies with differing economic structures and gender relations. The sample consists of developed, largest developing, and least developed economies. Table 1 in the appendix provides a precise list of the countries used in the sample.

The developed economies used in this study are a selection of OECD countries. Typically high-income countries, they are considered to have achieved significant economic and social development and pertain a high HDI.

The large developing economies investigated are a selection of countries often referred to as BRICS (Brazil, Russia, India, China, and South Africa) and MINT (Mexico, Indonesia, Nigeria, and Turkey). Jim O'Neill identified these countries as having high potential for future growth and investment in a research paper on the "Next Eleven" (N-11) economies (Martin, 2012). The basis of this were criteria such as macroeconomic stability, political maturity, openness of trade and investment policies, and the quality of education.

The least developed economies (LDCs) used have been selected United Nations' list of LDCs, which is reviewed every three years by the Committee for Development Policy (CDP) (UN list of least developed countries, 2023). Their classification is based on three criteria: income, the Human Assets Index (HAI), and the Economic and Environmental Vulnerability Index (EVI) (UN list of least developed countries, 2023). Characterized by low levels of economic development, these economies typically pertain high poverty rates, and limited access to basic services such as education and healthcare.

4. Data

A plethora of data was utilized to investigate the relationship between gender equality and economic performance. Specifically, three key areas of gender equality were focused on: the labour force, education, and health. Accordingly, data on labour force participation rates, educational attainment, and health indicators such as life expectancy and infant mortality rates were employed in analysis. In order to ascertain the level of economic performance of each country, data on GDP and HDI growth was also utilized.

To gather the data needed for the study, a variety of databases were used, including World Bank, United Nations Development Programme and Global Health Data Exchange. These databases provided access to a wide range of indicators related to gender equality and economic growth.

To construct each index, several variables were used. Table 2 in the appendix provides a precise list of the variables used in each index. These variables were carefully selected based on their relevance to the specific area of gender equality being measured.

However, objective data constraints were encountered for some countries, particularly those of lesser development, due to data unavailability. Consequently, it was necessary to rely on a subset of data to which access was available. This presents a challenge to the robustness of the results, as they may not reflect a complete understanding of the relationship between gender equality and economic growth in these countries.

Comparable labour force participation and employment data were not available for most developing countries. This limited the ability to analyse the impact of gender equality in the labour force on economic growth in these countries.

Despite these data constraints, a substantial amount of data was gathered covering the period from 2000 to 2017. This enabled a comprehensive analysis to be conducted of the relationship between gender equality and economic growth across a wide range of countries.

5. Methodology

5.1 PCA Analysis

To ensure a comprehensive analysis of gender equality in education, health, and the labour market, utilizing a wide range of data that reflects various aspects of gender equality was necessary. However, large data sets can be challenging to manage and analyse simultaneously. On account of this, issues such as multicollinearity can arise when carrying out regression analysis. This is where the independent variables in the regression are highly correlated. In consequence, it becomes difficult to discern their individual effects on the dependent variable (Montgomery, D. C. et al. 2012). Multicollinearity can lead to unstable and unreliable coefficient estimates, which can decrease the predictive power of the regression model.

PCA is a statistical method that can help address these issues. It does this by reducing the complexity of large datasets by identifying underlying patterns and correlations among variables (Jolliffe, I. T. 2002). It achieves this by transforming the original variables into a smaller set of principal components, which explain the majority of the variance in the data and are uncorrelated with one another (Jolliffe, I. T. 2002). They are ordered by the amount of variance they explain. These principal components can then be used to identify the most critical factors influencing gender equality. Therefore, by applying PCA analysis, the most relevant variables that drive variation in the data can be identified. This approach simplifies interpretation by visualizing data in a lower dimensional space all while minimizing redundancy and collinearity among variables.

In some cases, missing data can interfere with PCA because it may not be possible to compute the principal components if there are missing values (Josse, J. and Husson, F. 2016). This is a problem because it means excluding variables which have only one missing value. One approach to dealing with missing data in PCA is to impute the missing values before computing the principal components. Imputation is a process of filling in missing data with plausible values (Van Buuren, S. 2018). Missing data can arise for many reasons, such as incomplete surveys or measurement errors, and imputation is often used to minimize bias and increase the power of statistical analyses.

5.2 Imputation

Iterative PCA imputation is a data imputation method that is used to fill in missing values in a dataset by using the principal components obtained from the complete cases. This method is particularly useful when dealing with large datasets that have missing values, as it can help to preserve the overall structure of the data. The imputation will be used to construct a synthetic index. A synthetic index will be created for data on gender equality in education, health care and the labour market. This can then be used within regression analysis in order to discern the impact of each index of gender equality on economic performance.

The type of imputation used in this paper is a regularised iterative PCA algorithm suggested by Josse et al (2009). This method is regularized to help with overfitting issues caused by the data having several missing values (Josse, J. and Husson, F. 2016). Overfitting can occur when the imputation algorithm fits too closely to the observed data, leading to poor performance when the model is applied to new data. Regularization helps to prevent this by constraining the model complexity and reducing the risk of overfitting. The imputation is estimated in R using the package "**MissMDA**" (Josse, J. and Husson, F. 2016). Specifically, the function used is "**imputePCA**".

In order to avoid highly biased estimates, imputation will be employed sparingly – solely in cases where one variable has limited missing data while others are complete. In view of this, imputed values should not result as overly biased due to the absence of important variables. Possible bias through imputation should be offset by the presence of the rest of the variables entering the index (typically four to five). This means that the impact of the imputation on the overall synthetic index will be relatively small, and any potential bias will be mitigated by the consideration of multiple variables. In practice this means that even if the imputation were to be incorrect (a rare occurrence), the naive expectation of the bias in the index would be around 20%. However, in practice, the bias would be much less than this due to the inclusion of other variables and the use of the regularized iterative PCA algorithm.

Below is a step-by-step explanation of how the iterative PCA imputation works in the **imputePCA** function (Josse, J. and Husson, F. 2016):

1. The incomplete data set is first transformed using PCA to obtain the principal components and scores from the complete cases (i.e., the cases with no missing values).

2. The principal components and scores are then used to impute the missing values in the incomplete data set.

3. The imputed data set is then transformed using PCA to obtain new principal components and scores.

4. Steps 2 and 3 are repeated until convergence is reached, i.e., until the imputed values stop changing. At this point, the algorithm has estimated the principal components and scores of the partially observed data and has imputed the missing values.

5. The imputed data set is returned as the output of the **imputePCA** function, and the completed data set is stored in the **completeObs** object.

The number of dimensions (i.e., the number of principal components to use in the imputation process) is specified by the **ncp** argument. This parameter controls the balance between the amount of information retained from the original data set and the level of noise in the imputed data (Josse, J. and Husson, F. 2016). An **ncp** value of 2 has been used for the imputation in this paper. This is appropriate because the first two principal components explain a large portion of the variation in the data.

5.3 Interpreting PCA Results

When interpreting PCA analysis results, there are several key components to consider, however for this paper the focus is on eigenvalues. Eigenvalues represent the amount of variance explained by each PC. The larger the eigenvalue, the more important that PC is in explaining the variability in the data. PC1 is the principal component that explains the most variability in the data, followed by PC2 and so on.

For subsequent regression analysis, PC1 will be used as the synthetic index for gender equality in education, health and the labour market. PC1 consists of the highest eigenvalues, which represent the largest amount of variance in the data. This means the most important information from the data can be retained while discarding the least informative variables.

From the newly constructed indices, observations about each type of economy can be discerned. Overall, the PC1 results suggest that there are significant differences in gender equality across different types of economies. Developed economies have, in general, achieved high levels of gender equality and show a steady increase over time. Large developing economies have made significant progress in improving gender equality, also showing steady increases over time. On the other hand, least developed economies still have a long way to go, with gender equality being low. They experience a clear trend of stagnation or even regression over time, which suggests that they continue to face significant challenges in improving gender equality. Overall, the rate of improvement varies between countries, with some countries showing more significant progress than others. These trends align with expectations, thereby enhancing confidence in the accuracy of each index.

5.4 Empirical Model

The methodology used in this investigation is a linear fixed effects regression model on a panel data set of countries which pertain diverse levels of economic development. This model will estimate the impact of gender equality on different indicators of economic performance while controlling for unobserved country-specific factors. The dependent variable therefore is the indicator for economic performance. The indicators used will be GDP growth and HDI growth. The independent variables will consist of the three indices of gender equality, along with the ratio of investment to GDP and the ratio of government consumption to GDP according to Barro's growth regression equation (Barro, R. J., 1997). Economists such as Barro, R. J. (1997) include a variable for human capital. The reason for why it has been decided to not include this as a separate explanatory variable in the regression is because of the indices included in the model. Education and health care are significant determinants of human capital; therefore, the indices representing gender equality in these areas should successfully capture the effect of human capital on economic performance. Including human capital separately could lead to multicollinearity, meaning that the independent variables are highly correlated with each other. This problem leads to difficulty in determining the impact of each variable on the dependent variable in the regression model. Furthermore, each country's fixed effects are represented by dummy variables in the linear fixed effects model. To control for time-specific effects, 17 time dummy variables will be used. These dummy variables represent each year from 2001 to 2017, with the reference year being 2000. The model captures the year-specific variation in economic performance that is common to all countries by including these dummy variables, while allowing the effect of gender equality to vary across countries. The following model illustrates the framework used in the regression analysis for GDP growth:

$$GDP_{growth_{it}} = \beta_0 + \beta_1 GEe_{index_{it}} + \beta_2 GEl_{index_{it}} + \beta_3 GEh_{index_{it}} + \beta_4 Investment_{it} + \beta_5 Government_{it} + \sum \gamma t D_t + \alpha_i + \varepsilon_{it}$$

Where $GEe_{index_{it}}$ denotes the index for gender equality in education, $GEl_{index_{it}}$ the index for gender equality in the labour force, $GEh_{index_{it}}$ the index for gender equality in health care, $Investment_{it}$ the ratio of investment to GDP and $Government_{it}$ the ratio of government consumption to GDP. The coefficient β_0 represents the intercept of the regression, which captures the value of GDP growth when all independent variables are equal to zero. The coefficients $\beta 1, \beta 2, \beta 3, \beta 4,$ and $\beta 5$ capture the effect of each independent variable on GDP growth, holding all other variables constant. The sum of all time dummy variables $\sum \gamma t D_t$ represents the common time-specific effects on GDP growth across all countries. α_i is the fixed effect for country i, representing the country-specific differences in GDP growth that are not explained by the independent variables or time dummy variables. ε_{it} is the error term.

Separate regression will be carried out for HDI growth, using the same independent variables. The model will be estimated separately for the developed economies, large developing economies, and least developed economies to examine how the effect of gender equality on economic growth varies across different groups of countries with varying levels of economic development.

6. GDP and HDI

To gain a comprehensive understanding regarding how gender equality impacts economic performance, this study utilized two different regressions. One looking specifically at GDP growth rates, calculated by summing the value of all goods & services produced in a country, while another took into account human development index (HDI) figures; this being a wider reaching measurement encompassing social factors such as life expectancy, years of schooling and GNI per capita (Callen, 2019; United Nations Development Programme, 2023). For this purpose, HDI can be used as a more comprehensive measure of development, capturing not only economic development, but also social development and well-being. As a result, the analysis should provide a more nuanced understanding of the impact of gender equality on different dimensions of development. Moreover, previous research lacks investigation on the impacts on HDI growth as GDP growth is the most predominantly used indicator, so incorporating it in the analysis can provide a novel perspective and fill gaps in the literature.

7. Findings

Table 3

	GDP			
	Full Dataset	**Developed**	**Large Developing Economies**	**Least Developed Economies**
IndexE	0.295921	0.462173	0.869218	0.869218
IndexH	0.009962*	0.209674	0.602107	0.602107*
IndexL	0.001915*	0.969575	0.003303*	0.003303
Government	0.00132*	4.02E-10*	0.049538*	0.049538
Investment	1.52E-08*	0.637042	0.425371	0.425371**
R^2	0.34588	0.59749	0.55775	0.41943

** indicates significance at the 5% level.*
IndexE, IndexH and IndexL refer to the index for gender equality in education, health care and the labour market, respectively.

Table 4

	HDI			
	Full Dataset	**Developed**	**Large Developing Economies**	**Least Developed Economies**
IndexE	7.82E-0*	3.69E-06*	0.000722*	1.19E-06*
IndexH	2.5E-14*	0.012227*	0.707165	0.470126
IndexL	0.066413	0.000208*	3.42E-07*	0.850979
Government	0.000263*	0.000146*	0.931897	0.037386*
Investment	0.033294*	0.824496	0.522431	0.906827
$\mathbf{R^2}$	0.87545	0.90835	0.94475	0.97516

** indicates significance at the 5% level.*
IndexE, IndexH and IndexL refer to the index for gender equality in education, health care and the labour market, respectively.

Table 3 summarises the regression results obtained. Firstly, the regression on GDP using the full dataset is discussed. The results indicate that gender equality has a significant but varying impact on GDP growth. The coefficients for IndexH and IndexL are both positive and statistically significant at the 5% level. This indicates that increasing gender equality in health care and the labour force is associated with higher GDP growth. To gain further insight into the results, the dataset is split into subsections. For developed economies, none of the indices for gender equality have statistical significance. This indicates that gender equality does not have a significant impact on GDP growth in developed economies. Large developing economies however display positive statistical significance for IndexL at the 5% level. This reveals that an increase in gender equality in the labour force is associated with an increase in GDP growth. On the other hand, gender equality in health care appears to be most important for least developed economies, with IndexH pertaining positive statistical significance.

The results for the regression on HDI reveal different insights. When regressed using the full dataset of countries, gender equality in education and healthcare result as positively statistically significant at the 5% level. As a result of this, it can interpreted that gender equality in these two areas is positively associated with HDI growth. When looking at the statistics for individual subsets, it can gathered that for developed economies all indices for gender equality are of importance. The coefficients for IndexE, IndexH and IndexL are positively statistically significant at the 5% level, representing that they are of equal importance for HDI growth in developed economies. For large developing economies, the coefficients for IndexE and IndexL are positively statistically significant at the 5% level. This implies that gender equality in education and the labour force are correlated with HDI growth in large developing economies. On the other hand, for least developed economies, the only index of statistical significance is IndexE, at the 5% level.

Overall, the regression results suggest that gender equality has important implications for economic and social development, and that different aspects of gender equality may be more

or less important depending on the level of economic development. The most important insight drawn from these results is that gender equality is more significant for HDI growth than GDP growth. Important differences can be unpacked; it is of particular note that gender equality in education does not result as statistically significant for GDP at any level of economic development, yet it is statistically significant for HDI growth at all levels. Additionally, the impact of gender equality in health care also differs completely based on the indicator used for economic performance in the regression. Gender equality in the labour force appears to be more correlated, resulting as statistically significant for large developing economies across both indicators of economic performance. Moreover, positive statistical significance of gender equality on HDI growth is more apparent in economies of higher development, which contrasts the results for GDP growth where statistical significance is more prevalent where economic development is lesser. From this it can be gathered that gender equality is important for economies pertaining higher levels of development in improving HDI, meanwhile for economies of lesser development it is important in improving GDP.

7.1 Consistency with Previous Studies

It is important to compare these findings with those from previous studies. This study found that gender equality in education was not significant for the GDP regression. For the most part this aligns with the conclusions drawn by Dollar and Gatti (1999) where they found that, over the time period 1975-1990, in less developed economies, female education did not have a significant impact on per capita income. They suggest the reason for this is that in less developed economies where many women work in agriculture, the positive return to female education is low (Dollar and Gatti, 1999). This could be because even if women attain higher education, they are likely to still be crowded into the agricultural sector. Contrastingly, they did find in developed economies that female education was positive and highly significant (Dollar and Gatti, 1999). A reason for this could be due to the difference in time period analysed; during the time period analysed in this study, high-income countries may have already made significant progress towards gender equality in education and therefore the benefits of further progress may be smaller. It could also be that the impact of gender equality in education impacts GDP more indirectly, for example through healthcare in the form of reduced fertility rates. Klasen (1999) evidenced this in his investigation when he found that by including fertility and child mortality in his growth regression, the impact of female education on economic growth was reduced but not eliminated, showing that the impact was partially due to reduced fertility and improved health. This would also explain why for least developed economies, no significance was found for gender equality in education but positive statistical significance for gender equality in healthcare. Therefore, it could be gathered that gender equality in education is important for least developed economies, however it indirectly has a positive impact on economic growth through better health. This corroborates with the conclusions drawn by Appiah and McMahon (2002) who underline the importance of considering indirect impacts, demonstrating that when just direct impacts on market outcomes are examined, as measured by standard growth equations, actual returns to education are underestimated. Moreover, when regressed on HDI, gender equality in education is positively statistically significant for economies of all development types. This corroborates the

conclusions previously drawn, as HDI also captures the social aspects important to economic growth. Therefore, although gender equality in education may not directly improve GDP through the labour market due to the lack of employment opportunities, it does directly improve HDI. This could be because it improves family mediated impacts which are less contingent on market conditions, such as women's voice within the family, the benefits of which are captured by HDI (Kabeer, N. and Natali, L., 2013). It can be discerned therefore that gender equality in education is more closely correlated with overall human development and well-being than solely economic output. Some research (Baliamoune-Lutz and McGillivray, 2007; Caselli et al., 1996; Forbes, 2000) contradicts these findings. These papers find a direct significant positive impact of female education on GDP. A reason for which this study presents different findings could be due to the time period investigated; while this study begins to investigate within the 21st century, the time period investigated by previous academic papers is within the 20th century. The findings considering the 20th century appear robust, however research utilizing more recent data lacks thorough investigation. Hence, further research is required to validate the findings presented here for more current data in order to confirm their reliability.

It was found that gender equality in health care was positively significant for GDP in least developed economies. This could be due to the direct impacts it has on the labour market; a healthier population leads to increased productivity. An example through which this occurs is through reduced fertility rates (a variable specifically included in the index), which allows women to spend more time in work. This aligns with the demographic dividend theory proposed by Bloom et al (2002). They explain how when a country experiences a decline in fertility rates and a subsequent increase in the working-age population relative to the dependent population, economic growth arises (Bloom et al, 2002). This is due to there being fewer dependents to support, and moreover due to lower healthcare and education costs as there are fewer children and more resources available per capita (Bloom et al, 2002). This is specifically relevant to least developed economies, where typically fertility rates and gender health disparities are very high and therefore a reduction in which would have more prominent impact than, a developed economy which has already advanced levels of health care, per say. This could explain why gender equality in health did not result as significant for GDP for economies of higher development. This highlights that it is most critical for GDP growth in countries of lesser development. These findings are in line with previous research. For example, Ashraf et al (2011) estimated the impact of a reduction of fertility in Nigeria, a least developed economy, concluding that per capita income would increase by 5.6% over 20 years. In addition, the more recent study of Bloom et al (2014) investigated the outcome when a third of the unmet need for family planning was met in a selection of least developed economies and concluded once again that per capita income could increase. These therefore imply that improved female health can lead to economic growth. However, it is important to note that this research differs from these predictions, given that the focus is on determining the significance of impacts that have already occurred. Despite this, the research aligns with the notions they have presented. This study revealed that gender equality in healthcare has a positive and significant impact on HDI growth in developed economies, but not in economies at other levels of development. However, there is a lack of high-quality studies examining the relationship between gender equality and HDI, as most research has concentrated on GDP. Therefore, the investigation is crucial in

shedding light on this important topic. These findings may be explained by the fact economies pertaining high levels of economic development can more easily facilitate the impact of gender equality in health on HDI growth. Large developing or least developed economies, on the other hand, may encounter additional structural constraints and challenges, limiting the influence of gender equality in health on overall growth. It could also be possible that the impacts of healthcare may take longer to materialise in developing economies because of a variety of issues such as a lack of resources, political instability, and cultural obstacles. As a result, the beneficial impact of gender equality on HDI may take longer to emerge in these economies, which is not captured over the time frame.

Regarding previous research on gender equality in the labour force and its impact on GDP, the findings are inconsistent and often contradictory. Disparities in results have been attributed to a shortage of global data regarding pertinent indicators of gender inequality, as well as endogeneity and unobserved heterogeneity issues (Kabeer, N. and Natali, L., 2013). While some studies suggest that increasing female employment can lead to economic growth (Klasen, 1999; Klasen and Lamanna, 2009; Tzannatos, 1999), others present results that contradict this conclusion (Baliamoune-Lutz and McGillivray, 2007; Esteve-Volart15, 2004). The results from this investigation are congruent with the former, indicating a positive and significant relationship between gender equality in the labour force and GDP growth in large developing economies. This is consistent with the findings of Tzannatos (1999), who employed simulation techniques to examine a group of 11 countries, encompassing both least developed and large developing economies. Tzannatos discovered that eradicating gender segregation in the labour force could potentially boost national output by 3-9%. The significance of gender equality in the labour force for large developing economies could be attributed to their stage of development. Large developing economies are in a stage of development, where employment opportunities are increasing as a result of a shift from predominantly agricultural sectors to increasing industrial and service sectors (Rostow, W. W., 1959). Therefore, job creation arises which is especially important for women and can lead to a significant impact on GDP growth. Alternatively, for developed economies, which have likely made considerable progress in achieving gender equality in the labour force, further advancements may not lead to significant outcomes. Contrastingly, for least developed economies, opportunities in the labour force which lead to GDP growth are not prevalent and therefore gender equality in this area would have little impact, as seen in these results. The observations for the impact of gender equality in the labour force on HDI however are even more significant, underlying a positive impact on developed and large developing economies. This is likely because these economies offer more opportunities for women to participate in the labour force and translate their skills into productive work. As a result, not only productivity and GDP are improved, but also social factors such as education, health, and living standards. By enabling women to contribute fully to the labour force, these economies can unlock a significant source of untapped potential, which in turn contributes to overall economic and social development.

8. Elementary Robustness Analysis

Table 5

	GDP			
	Full Dataset	**Developed**	**Large Developing Economies**	**Least Developed Economies**
IndexE	0.6927	0.1769	0.9858	0.4133
IndexH	0.8179	0.7915	0.8502	0.4496
IndexL	0.0957	0.5875	0.0244*	0.0494*
Government	0.1511	1.919E-08*	0.1517	5.283E-05*
Investment	3.786E-06*	0.6789	0.3964	0.1081
Human Capital	0.2527	0.4601	0.9641	0.1306
Population Growth	0.4686	0.8154	0.9131	0.6301
Macroeconomic Stability	0.0084*	0.0017*	0.1263	0.3175
Natural Resources	0.2263	0.0009*	0.5293	0.2843
Technological Change	0.0199*	0.9032	0.2786	0.4133
R^2	0.3723	0.6440	0.5911	0.5803

** indicates significance at the 5% level.*
IndexE, IndexH and IndexL refer to the index for gender equality in education, health care and the labour market, respectively.

Table 6

	HDI			
	Full Dataset	**Developed**	**Large Developing Economies**	**Least Developed Economies**
IndexE	4.679E-05*	3.366E-07*	0.0011*	0.0008*
IndexH	2.162E-10*	0.0059*	0.7131	0.2803
IndexL	0.0661	0.0001*	7.084E-05*	0.0233*
Government	0.0058*	3.9837E-06*	0.5080	0.5054
Investment	0.0373*	0.7553	0.2454	0.5395
Human Capital	0.6154	0.2297	0.0022*	0.9691
Population Growth	0.0011*	0.0887	0.3198	0.3685
Macroeconomic Stability	0.0056*	0.1176	0.4971	0.7893
Natural Resources	0.1548	0.9168	0.0111*	0.5457
Technological Change	0.8485	0.0004*	0.0072*	0.0008
R^2	0.87833	0.91887	0.96313	0.98213

** indicates significance at the 5% level.*
IndexE, IndexH and IndexL refer to the index for gender equality in education, health care and the labour market, respectively.

Robustness analysis has been carried out in order to ensure that the results found in this paper are reliable. It involves testing the stability of the findings by including a more comprehensive range of independent variables. To achieve this, the new regression model incorporates human capital, population growth and macroeconomic stability as included in the Barro's growth regression model (Barro, R. J., 1997). Furthermore, the contribution of natural resources to GDP and a variable representing technological change were also included, as these factors are known to impact economic growth. In the new regression, Sudan which pertained to the least developed economies subset has been excluded as a result of data constraints.

The inclusion of these additional variables in the regression analysis helps to provide a more robust assessment of the determinants of GDP. The higher R-squared values obtained in the regression analysis with the expanded set of independent variables indicate that the model now explains a larger portion of the variation in GDP, strengthening the reliability of the results.

Interestingly, some previously significant variables have become insignificant after the robustness analysis, while new variables have emerged as significant determinants of GDP. For large developing economies, gender equality in the labour force remains consistently significant. As a result, it can be gathered that this result is reliable to a greater extent and therefore indicates its importance in driving economic growth in these countries. However, for least developed economies, gender equality in health care is no longer significant, and instead, gender equality in the labour force has emerged as a significant factor. Moreover, where previously across the whole dataset several of the gender equality indices resulted significant, in the new regression they do not. As a result of this inconsistency, this subsection of the results is reliable to a lesser extent. The loss of significance could be attributed to the inclusion of additional variables which changed the relative importance of the original variables.

As for HDI, the results remained consistent after the robustness analysis. The sole disparity observed is that gender equality in the labour force now appears as a significant factor for least developed economies, whereas it was not significant previously. This change could potentially be attributed to the exclusion of Sudan from the regression analysis. The sustained consistency across different model specifications affirms the reliability of these findings with respect to HDI.

Overall, as a result of the robustness analysis the core determinants of GDP and HDI that consistently remain significant across the model specifications have been identified. A periphery of variables whose significance varies based on the model specification has also been revealed. This provides insight into the reliability of the findings.

9. Conclusions

In conclusion, this research demonstrates a positive relationship between gender equality and economic performance. In particular, the findings show that gender equality has positive implications for economic and social development, and that different aspects of gender equality may be more or less significant depending on the level of economic development.

The results regarding HDI as the indicator for economic performance prove to be the most reliable after the robustness analysis. The findings demonstrate that gender equality in all three areas investigated, positively impact HDI in developed economies. As the development of an economy becomes lesser, so does the impact of gender equality on HDI. This highlights the importance of the promotion of gender equality in achieving increased levels of social development in economies pertaining higher levels of development. Gender equality in education was revealed to be the most important in improving HDI growth for economies of lesser development, meaning that policy investments in this area could have positive impacts not only on the economy but also on the standard of living in this context.

The findings regarding GDP were less robust. However, even prior to such analysis gender equality had less importance regarding GDP compared to its impacts on HDI. As a result, it can be concluded that gender equality has greater positive impacts on social development, captured by HDI, than solely economic development. The variable which withstood the robustness analysis was gender equality in the labour force for large developing economies. This therefore signifies the importance of creating equal opportunities in the labour force for both genders in achieving higher levels of GDP growth in this type of economy.

Other possibilities for further research can stem from this research paper. This paper focuses on gender equality in health care, education and the labour force. New studies could expand the research to further areas of gender equality, such as political representation, access to credit and finance, property rights, and cultural and social norms. These areas are important components of gender equality that can have a significant impact on economic performance. In addition, future research could also explore the interaction between gender equality and other factors that affect economic performance, such as income inequality, trade openness, and institutional quality. These factors can affect the relationship between gender equality and economic performance and can provide insights into the mechanisms through which gender equality affects economic outcomes.

10. Limitations

Some limitations of this research paper are as follows. Firstly, this paper investigates the impact of gender equality on economies of lesser development. These economies often face challenges in data collection and reporting, meaning that data constraints were encountered. As a result, a smaller sample size of countries representing large developing economies and least developed economies was used. This could impact the robustness of the findings. Results may be subject to sampling bias as the small sample may not accurately capture the true impact of gender equality in these economies.

Secondly, there may be concerns of endogeneity. This may arise due to the creation of the gender equality indices, whereby weights are assigned to each variable included in the index based on their contribution to the variance in the data. Endogeneity can occur when feedback loops arise between the gender equality index and the independent variable, economic performance. For example, if higher levels of gender equality in education lead to higher levels

of economic performance, which in turn lead to further improvements in gender equality in education, then the variables included in the index become endogenous. As a result, coefficients in the regression results may be biased, affecting the robustness of the results.

Lastly, the indices were created using a select few variables to reflect each area of gender equality in society. Gender equality is multifaceted, and as such the use of a select few variables to create the indices may not fully capture the nuances of gender equality. Therefore, there may be limitations in the comprehensiveness of the measurement of gender equality.

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12. Appendix

Table 1 – Countries used in sample for each level of economic development

Developed economies	**Large developing economies**	**Least developed economies**
• Luxembourg • Ireland • Norway • Switzerland • Belgium • New Zealand • Denmark • Netherlands • Sweden • Austria	• India • Mexico • South Africa • Brazil • Indonesia	• Burundi • Nepal • Uganda • Bangladesh • Sudan

Table 2 – Variables used in the construction of each index		
Gender equality in education index	**Gender equality in health care index**	**Gender equality in labour market**
• School enrolment, primary, female (% gross) • School enrolment, secondary, female (% gross) • School enrolment, tertiary, female (% gross) • Gender ratio of mean years in school (women % men, 25-34 years)	• Maternal mortality ratio (modelled estimate, per 100,000 live births) • Prevalence of anaemia among pregnant women (%) • Life expectancy at birth, female (years) • Adolescent fertility rate (births per 1,000 women ages 15-19)	• Cost of business start-up procedures, female (% of GNI per capita) • Employment in agriculture, female (% of female employment) (modelled ILO estimate) • Labour force participation rate, female (% of female population ages 15-64) (modelled ILO estimate) • Proportion of seats held by women in national parliaments (%) • Contributing family workers, female (% of female employment) (modelled ILO estimate)