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IMPACT OF GENDER DEVELOPMENT INDEX ON HUMAN DEVELOPMENT INDEX AND GROSS DOMESTIC PRODUCT PER CAPITA

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Abstract

In this paper, author wishes to find out the relationship among the Gender Development Index, Human Development Index and the Gross Domestic Product per capita of the 12 developed countries during 1990-2015 with the help of econometric models such as fixed effect panel regression, Fisher-Johansen panel co-integration, panel vector error correction model and Wald test. The paper concludes that one per cent increase in GDI per year led to 0.1143% increase in GDP per capita and 0.0191% increase in HDI per year significantly during 1990-2015 which were found by fixed effect panel regression. Fisher-Johansen panel co-integration test confirms that there is one co-integrating equation among GDP per capita, HDI and GDI during the survey period. The co-integrating equation tends to equilibrium which indicates that there is long run association among them. From the System equation of VECM it was verified that there are long run causalities running from HDI and GDP per capita to GDI. Error correction process showed that the speed of adjustment is 95.25% per year which is significant. The Wald test shows that there are no short causalities running from HDI and GDP per capita to GDI and vice versa but there is short run causality running from HDI to GDP per capita. Over all, the VECM is stable, non-stationary, non-normal and serially correlated.

Key Words: Gender Development Index, Human Development Index, GDP per capita, Fisher-Johansen Co-Integration, Panel Vector Error Correction Model, Short-Run and Long-Run Causality.

JEL Classification–C23, J16, O15

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Introduction

According to the United Nations, women's empowerment mainly has five components: [i]Generating women's sense of self-worth; [ii]Women's right to have and to determine their choices; [iii]Women's right to have access to equal opportunities and all kinds of resources; [iv]Women's right to have the power to regulate and control their own lives, within and outside the home; and [v]Women's ability to contribute in creating a more just social and economic order. Thus, women empowerment is nothing but recognition of women's basic human rights and creating an environment where they are treated as equals to men. The educational and radical perspective of empowerment changed when it entered the wider development - as well as the gender and development (GAD) discourse in the 1980s. The Women in Development (WID) approach of the 1970s aimed at the inclusion of women in the development processes. Gender and development looked into power dynamics in gender relations and social norms and conducted deeper analysis in structural causes of women's subordination.

The basic indicator by which women can be empowered is the Gender Development Index. The Gender-related Development Index (GDI) adjusts the Human Development Index (HDI) for gender inequalities in the three dimensions covered by the Human Development Index (HDI), i.e., life expectancy, education, and income. The GDI measures differences between male and female achievements in three above basic dimensions. The GDI shows how much women are lagging behind their male counterparts and how much women need to catch up within each dimension of human development. Secondly, the Gender Inequality Index is an index for measurement of gender disparity which is a composite measure to quantify the loss of achievement within a country due to gender inequality. It was introduced by UNDP in 2010.

Thirdly, Gender Gap Index examines the gap between men and women in four fundamental categories (sub-indices) and 14 different indicators that compose them. The sub-indices are economic participation and opportunity, educational attainment, health and survival and political empowerment. The highest possible score is 1 and the lowest is 0. There are three basic concepts: (i) The index focuses on measuring gaps rather than levels, (ii) It captures gaps in outcome variables rather than gaps in input variables, and (iii) It ranks countries according to gender equality rather than women as empowerment. Lastly, the Gender Empowerment Measure (GEM) is an index which measures gender equality calculated by UNDP. It is based on the estimates of women's relative economic income, participation in high paying positions with economic power and access to professional and parliamentary positions. GEM is considered as a valuable policy instrument because it allows certain dimensions that were previously difficult to compare between countries to come into international comparison. The Women's

Empowerment Matrix of Wieringa (1994) also includes the state, regional and global level and looks at the interconnections of each level with physical, socio-cultural, religious, political, legal and economic spheres.

Generally, the higher the HDI, the higher is the GDI (and vice versa) which stipulates the value of GEM. All these imply the additions in GDP or GDP per capita. The paper makes an attempt to look into this phenomenon empirically.

Literature Review

Oxaal and Baden (1997) defined power and empowerment as a process and analysed the indicators of women empowerment and evaluated the selected policies of women empowerment and dwell upon its several policy implications. Bardhan and Klasen (1999) critically examine GDI and GEM as two gender-related indicators of UNDP and argue that there are serious conceptual and empirical problems with both the measures and suggest some modifications to the measures including a revision of the earned income component of the GDI. Accordingly, based on their suggestions UNDP modify the procedure for calculating the GDI since 1999. Dijkstra (2002) has calculated a new measure which is the Standardized Index of Gender Equality (SIGE) to avoid the methodological limitations of the GDI, the GEM and in order to advance research. Moreover, Dijkstra (2006) opines that the GEM is an odd combination of relative female and male empowerment which is softened by taking the harmonic mean of the female and male scores and their per capita absolute income levels.

Ministry of Women and Child Development, Government of India (2009) prepared a report which compiles and presents HDI, GDI and GEM for India and the States/UTs for the years 1996 and 2006. The scores of HDI, GDI and GEM of the States/UTs are needed for the attention of stake-holders at all levels so that gender-based disparities in different stages of development and empowerment could be modified through plans, policies and interventions.

Branisa, Klasen and Ziegler (2009) constructed the Social Institutions and Gender Index (SIGI) and its five sub-indices, i.e., Family code, Civil liberties, Physical integrity, Son Preference and Ownership rights using data of the variables of the OECD Gender, Institutions and Development. Instead of measuring gender inequalities in education, health, economic or political participation, SIGI presents a new perspective on gender issues in developing countries. It measures long-lasting social institutions which are mirrored by societal practices and legal norms that might produce gender inequalities. The sub-indices measure each dimension of the concept and the SIGI combines the sub-indices into a multidimensional index of deprivation of women. It is a new technique of aggregating gender inequality in several dimensions, penalizing high inequality in each dimension and allowing only for partial compensation between dimensions. The SIGI and the sub-indices are useful tools to identify countries and dimensions of social institutions that deserve attention. Empirical results confirm that the SIGI is an improved index over other well-known gender-related indices.

Klasen and Schüler (2009) proposed to include the calculation of a male and female HDI, as well as a Gender Gap Index (GGI) to replace the GDI. The GEM should be improved through changes in the measurement of earned income. Using the above concept authors calculated GDI and GEM and found different ranking of countries.

The study of Nayak and Mahanta (2009) reveals that women of India are relatively disempowered and they enjoy somewhat lower status than that of men in spite of many efforts undertaken by government. Gender gap exists regarding access to education and employment. Household decision making power and freedom of movement of women vary considerably with their age, education and employment status. It is found that acceptance of unequal gender norms by women are still prevailing in the society. The study concludes that access to education and employment are only the enabling factors to empowerment. But achievement towards the goal, however, depends largely on the attitude of the people towards gender equality.

Ferrant (2010) aims to develop a new methodology to calculate an aggregate index of gender inequalities in developing countries (the Gender Inequalities Index (GII)). Using Multiple Correspondence Analysis (MCA), the GII aggregates different dimensions of gender inequalities in order to determine endogenously of the weight of each variable. He checked correlation between the GII, SIGE, GDI and GEM indices. All these are correlated negatively with the GII because the larger gender inequalities are, the higher GII and lower the SIGE, GDI and GEM indices. These results suggest a correlation between GII, SIGE, GDI and GEM, so it can be concluded that the GII measures the same phenomenon as other gender specific indices, and is not redundant. Nelasco (2012)? compared Gender Related Development Index and Gender Empowerment Measure for a point of time and found that women are not in equal status throughout the South Asian Region. Again, Gender Development Index ranking and Human Development Ranking alone are compared over a period of time, i.e., from 1994 to 2011. The overall analysis concluded that South Asia needs special attention from the world and international agencies for its gender empowerment and human development as the rank is 134th in Human Development Index and is 98th in Gender Development Index. Roy Choudhury (2013) claimed that the GDI and GEM can be higher in a particular country due to high female labour force participation rate of that country. This high value of GDI and GEM may reveal betterment of women there. She shows the changes in ranks of Indian states as per GDI and GEM before and after the push factors. In the states where push factors are absent, their ranks in GDI and GEM increase. Similarly, the states having all four push factors lose their ranks. Mokta (2014) analysed the dimensions and parameters of women empowerment, discrimination against women, status of empowerment of women in

India and prescribed useful policies**.** Empirical?study of Rao (2014) debunks certain assumptions, such as, the economic empowerment will lead to overall empowerment or that the participation in decision-making processes will empower women. These qualitative studies provide a more nuanced understanding of factors influencing and mediating empowerment. Such an understanding of empowerment is related to other concepts in gender and development research.

Huis, Hansen, Otten and Lensink (2017) propose a Three-Dimensional Model of Women's Empowerment to gain a deeper understanding of women's empowerment in the field of micro-finance services. This model proposes that women's empowerment can take place on three distinct dimensions: (1) the micro-level, referring to an individuals' personal beliefs as well as actions, where personal empowerment can be observed, (2) the meso-level, referring to beliefs as well as actions in relation to relevant others, where relational empowerment can be observed and (3) the macro-level, referring to outcomes in the broader, societal context where societal empowerment can be observed. Three-Dimensional Model of Women's Empowerment should guide future programs in designing, implementing, and evaluating their interventions. Authors offered two main practical implications. First, the future research should differentiate between the three dimensions of women's empowerment to increase the understanding of women's empowerment and to facilitate comparisons of results across studies and cultures. Second, the program designers should specify how an intervention should stimulate the dimension(s) of women's empowerment. Thus, authors inspired longitudinal and cross-cultural research to examine the development of women's empowerment on the personal, relational, and societal dimension.

Objective of the paper

In this paper, the author makes an attempt to find out the relationship among the Gender Development Index, Human Development Index and the Gross Domestic Product per capita of the 12 developed countries during 1990-2015 with the help of econometric models using panel data. The countries are: Finland, USA, UK, Switzerland, Sweden, Russia, Norway, Netherland, Japan, Germany, France and China whose GDI are generally high. How much GDI influences HDI and GDP per capita is the main objective of the study. It also examines the short and long run causalities among the three variables during 1990-2015.

Methodology and Data

Panel data during 1990-2015 for 12 cross sections which are: Finland, USA, UK, Switzerland, Sweden, Russia, Norway, Netherland, Japan, Germany, France and China have been used in the fixed effect model of regression to relate Gender Development Index, Human Development Index and GDP per capita after verifying Hausman test (1978) of the random effect model.

Fisher (1932)-Johansen (1991) Panel co-integration test is used to find co-integrating equation after checking Trace statistic and Max Eigen statistic at 5% level of significance. The figure of the co-integrating equation is plotted to check the long run stability and long run causality among the variables. The panel vector error correction model for three variables has been estimated to study the short run and long run causalities and the speed of adjustment of the error correction process and the stability of the system where the Wald Test (1943) is applied for verification of short run causality. Even, the autocorrelation problem, stability, stationarity and normality of the VECM were found out through correlogram, unit circle, and Doornik-Hansen (1994) normality test respectively.

The data on Gender Development Index and Human Development Index from 1990 to 2015 have been collected from the Human Development Reports of UNDP for those 12 countries. Gross Domestic Product per capita in current US $ for all 12 countries during 1990-2015 have been collected from the World Bank.

Once (i) the components of Gender Development Index (GDI), (let GDI=x_1) and (ii) the components of Human Development Index (HDI), (let HDI=x_3?) are known, only then conceptually the causal relation between GDI and HDI will be clear.

Observations from Econometric Models

Fixed Effect panel least square estimate between Gender Development Index and Gross Domestic Product per capita among 12 developed countries during 1990-2015 states that one percent increase in the GDI per year led to 0.1143% increase in the GDP per capita per year which is significant at 5% level.

$$\text{Log}(x_2) = 9.818443 + 0.114385 \log(x_1)$$
$$(370.615)^* \quad (2.448)^*$$

$R^2 = 0.87$, F = 175.58*, DW = 0.101, x_1 = Gender Development Index, x_2 = GDP per capita in current US$, Total panel observations=312, Period included=26, cross sections included=12, *=significant at 5% level. The Chi-Square (2) =4.0827(p=0.0433) for Hausman test which is rejected at 5% level for random effect model.

Again, one percent increase in GDI per year led to 0.0191% increase in Human Development Index per year in 12 developed countries during 1990-2015 in fixed effect panel regression model.

$$\text{Log}(x_3) = -0.1751 + 0.01917 \log(x_1)$$
$$(-61.63)^* \quad (3.82)^*$$

R^2 =0.82, F=115.96*, DW=0.10068, x_3 =? Human Development Index, *= significant at 5% level. The Chi-Square (2) =6.6344(p=0.010) for Hausman test in random effect model which is rejected at 5% level.

After verifying the Hausman test, the random effect panel regression among GDI (x_1), GDP per capita (x_2) and HDI (x_3)? of 12 developed countries of the globe during 1991-2015 confirmed that one percent increase in GDI and HDI per year led to 0.00479 % decrease and 18.05% increase in GDP per capita per year respectively where former is insignificant and later is significant at 5% level.

$$\text{Log}(x_2) = 11.2879 - 0.004796\log(x_1) + 8.376\log(x_3)$$
$$(117.82)^* \quad (-0.05) \qquad\qquad (18.05)^*$$

R^2 = 0.57, F=14.19*, DW=0.011 and The Chi-Square (2) =0.0599 (p=0.9705) in Hausman test.

After verifying unit root test, assuming linear deterministic trend, Fisher –Johansen Panel cointegration test among GDI, HDI and GDP per capita during 1990-2015 with one period lag states that both Trace statistic and Max Eigen statistic contain one cointegrating equation which is significant. In the Table1, the test results are presented.

Table 1 : Cointegration test

Hypothesized Number of Cointegrating Equations	Fisher Stat.© (from Trace test)	Probability	Fisher Stat.© (from Max-Eigen test)	Probability
None	67.76	0.0000	54.84	0.0003
At most 1	30.71	0.1623	28.52	0.2386
At most 2	17.91	0.8074	17.91	0.8074

© =Probabilities are computed using asymptotic Chi-square distribution.
Source: Calculated by author

The normalised cointegrating equation is found as:

$$Z_{t-1} = \log x_1 t_{-1} - 0.000547\log x_2 t_{-1} - 1.32144\log x_3 t_{-1} - 0.000658t - 0.047139$$
$$(-0.012) \qquad (-2.34)^* \qquad\qquad (-1.46)$$

This cointegrating equation is plotted below in Figure 1.

The estimated equations of the Vector Error Correction Model are given below.

$$[1]\text{dlog}x_{1t} = -0.95508EC - 0.02369\text{dlog}x_{1t-1} - 0.00895\text{dlog}x_{1t-2} - 0.0169\text{dlog}x_{2t-1}$$
$$(-6.79)^* \qquad (-0.203) \qquad\qquad (-0.106) \qquad\qquad (-0.076)$$
$$+0.07409\text{dlog}x_{2t-2} + 9.716\text{dlog}x_{3t-1} + 2.866\text{dlog}x_{3t-2} - 0.0414$$
$$(0.209) \qquad (1.18) \qquad\qquad (0.34) \qquad\qquad (-0.702)$$

R^2? ?=0.34, F=19.43, AIC=1.88, SC=1.98, *=significant at 5% level, EC=Error Correction

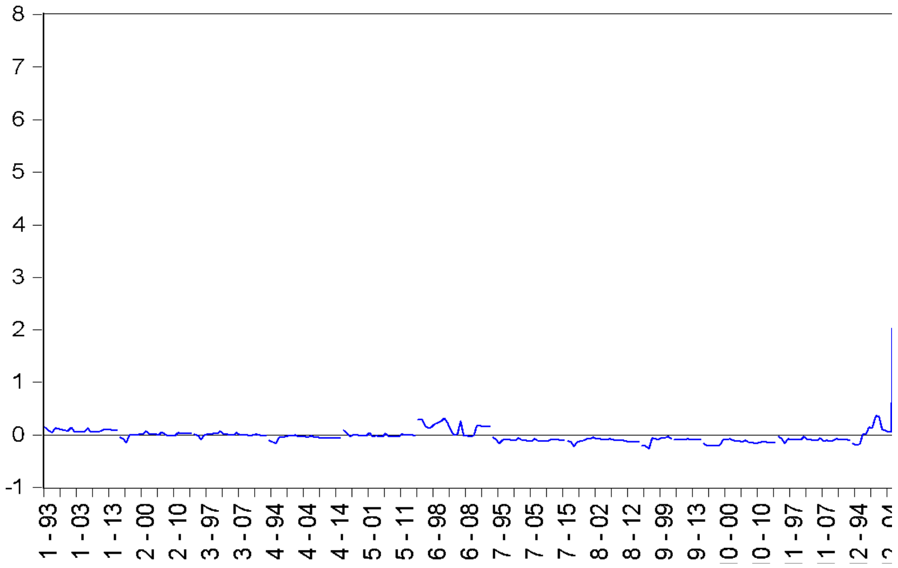

Fig. 1: Cointegrating equation
Source: Plotted by author

Term

[2] $dlogx_{2t}$=0.02287EC-0.0222$dlogx_{1t-1}$-0.0142$dlogx_{1t-2}$+0.2991$dlogx_{2t-1}$

(0.93) (-1.09) (-0.97) (4.73)*

-0.1531$dlogx_{2t-2}$ +5.285$dlogx_{3t-1}$+0.446$dlogx_{3t-2}$-0.001125

(-2.49)* (3.709)* (0.308) (-0.109)

R^2=0.185, F=8.58, AIC=-1.62, SC=-1.57, *=significant at 5% level, EC=Error Correction Term

[3] $dlogx_{3t}$=0.00192EC-0.00099$dlogx_{1t-1}$-0.000193$dlogx_{1t-2}$-0.00487$dlogx_{2t-1}$

(1.94) (-1.24) (-0.335) (-1.54)

+0.00304$dlogx_{2t-2}$ +0.357$dlogx_{3t-1}$+0.2908$dlogx_{3t-2}$+0.00187

(1.25) (6.32)* (5.07)* (4.63)*

R^2=0.39, F=25.05, AIC=-8.07, SC=-7.97, *=significant at 5% level, EC=Error Correction Term

Equation-[1] is not a good fit since R^2? is low and all the coefficients are not significant except the error correction term which is significant and approaching towards equilibrium with the speed of adjustment of 95.95% per year. Equation-[2] is a very poor fit with low R^2? and some of the t values of the coefficients are not significant but x_2t is related significantly with x_{2t-}

$_1$, x_{2t-2} and x_3t_{-1} significantly. The error correction is insignificant and divergent. Equation-[3] is also a very poor fit with low R^2? . Yet x_3t is significantly related with previous periods. The error correction term is insignificant and divergent.

The system equation-1 of VECM is as follows:

$d(\log(x_{1t}))=C(1)*(\log(x_{1t-1})-0.000546936663351*\log(x_{2t-1}) - 1.32144244092*\log(x_{3t-1}) - 0.000657516088436*@Trend(90)- 0.047138726261))+ C(2)*d(\log(x_{1t-1}) +C(3)*d(\log(x_{1t-2}) + C(4)*d(\log(x_{2t-1}) + C(5)*d(\log(x_{2t-2}) + C(6)*d(\log(x_{3t-1}) + C(7)*d(\log(x_{3t-2}) + C(8)$

After estimation of the system equation-1, it was found that C(1) = -0.914060 and its t value is -6.519302 which is significant at 5% level. Thus, the cointegrating equation is shown below.

$Z_{t-1} =-0.914060\log x_{1t-1}-0.000547\log x_{2t-1}-1.32144\log x_{3t-1}-0.000658t-0.047139$

(-6.51)* (-0.012) (-2.34)* (-1.46)

So, there is long run causalities running from HDI and GDP per capita to GDI in 12 developed countries during 1990-2015. It is convergent and moves towards equilibrium and its speed of adjustment is 91.4% per year.

The Wald test confirms that the Chi-square (2) = 0.099206 whose probability is 0.9516 when C (4) =C (5) =0. It indicates that the null hypothesis of no causality is accepted which implies that there is short run causality running from GDP per capita to GDI. If C (6) =C (7) =0, then the Chi-square (2) = 3.883516 whose probability is 0.1435 which states that there is no causality in short run running from HDI to GDI during1990-2015.

The estimated VECM-1 in Figure 2 is plotted below. It approaches towards equilibrium.

The system equation of VECM-2 is shown below.

$d(\log(x_2))=C(9)*(\log(x_{1t-1}) - 0.000546936663351*\log(x_{2t-1}) - 1.32144244092*\log(x_{3t-1}) - 0.000657516088436*@Trend(90)- 0.047138726261))+C(10)*d(\log(x_{?1t-1})+$

$C(11)*d(\log(x_{1t-2}) + C(12)*d(\log(x_{2t-1}) + C(13)*d(\log(x_{2t-2}) + C(14)*d(\log(x_{3t-1}) +$

$C(15)*d(\log(x_{3t-2}) + C(16)$

After estimation of the system equation, the value of C (9) = 0.021772 whose t value is found as 0.899942 which is insignificant at 5% level. Now the co-integrating equation can be written as,

$Z_{t-1}=0.021772\log x_{1t-1}-0.000547\log x_{2t-1}-1.32144\log x_{3t-1}-0.000658t-0.047139$

(0.89) (-0.012) (-2.34)* (-1.46)

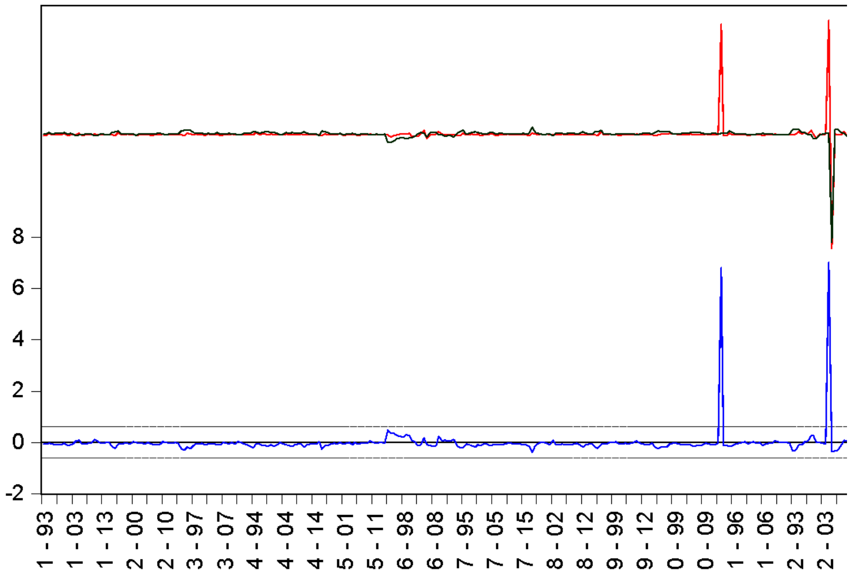

Fig. 2: VECM-1

Source: Plotted by author

It revealed that Z_{t-1} is divergent and there are no long run causalities running from GDI and HDI to GDP per capita in the 12 developed countries during 1990-2015.

Now, the Wald test showed that Chi-square (2) = 1.233328 whose probability is 0.5397 when C (10) =C (11) =0 which indicates that there is no short causality running from GDI to GDP per capita. And if C (14) = C (15) =0, Chi-square (2) = 20.50809 whose probability is 0.0000 as confirmed by the Wald test. It proves that there is short run causality running from HDI to GDP per capita.

The estimated VECM-2 in Figure 3 is shown below.

Again, the system equation of VECM-3 is shown below.

$d(\log(x_3))=C(17)*(\log(x_{1t-1})-0.000546936663351*\log(x_{2t-1})-1.32144244092*\log(x_{3t-1})-0.000657516088436*@Trend(90)-0.047138726261))+C(18)*d(\log(x_{1t-1})+C(19)*d(\log(x_{1t-2})+C(20)*d(\log(x_{2t-1})+C(21)*d(\log(x_{2t-2})+C(22)*d(\log(x_{3t-1})+C(23)*d(\log(x_{3t-2})+C(24)$

The estimated value of C (17) = 0.002257 which is significant at 5% level since its t value is 2.359327 and therefore the co-integrating equation becomes as follows:

$$Z_{t-1} = 0.002257\log x_{1t-1} - 0.000547\log x_{2t-1} - 1.32144\log x_{3t-1} - 0.000658t - 0.047139$$

(2.35)* (-0.012) (-2.34)* (-1.46)

Since C (17) is significant but positive then it tends away from the equilibrium and there are no

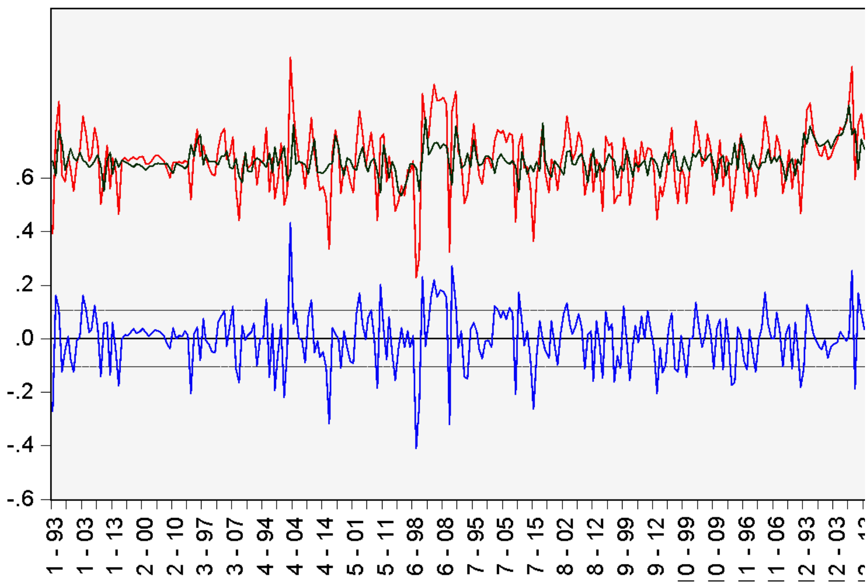

Fig. 3: VECM-2

Source: Plotted by author

long run causalities running from GDI and GDP per capita to HDI in 12 developed countries during 1950-2015.

In the Wald test, it is found that Chi-square (2) = 2.895489 whose probability is 0.2351 when C (18) =C (19) =0 which indicates that there is no short run causality running from GDI to HDI. Similarly, if C (20) = C (21) =0 and Chi-square (2) = 4.375483 whose probability is 0.1122 then it proves that there is no short run causality running from GDP per capita to HDI during 1990-2015.

The VECM-3 is depicted in Figure 4 clearly.

This panel VECM is stable and non-stationary because its two roots are one, two roots are less than one, one root is less than zero and the rest four roots are imaginary which are shown in the Table 2.

The unit circle indicated that all the roots lie on or inside the unit circle which implies that VECM is stable. It is shown in Figure 5.

Limitations and future scope of research

The relation between Human Development Index, GDP per capita and the developing countries' Gender Development Index is not considered here for comparative study. The relationship with GDP is another area which is untouched. How much women labour force is affected by increased GDI is the important research area which is absent in this paper. Even, if the Gender

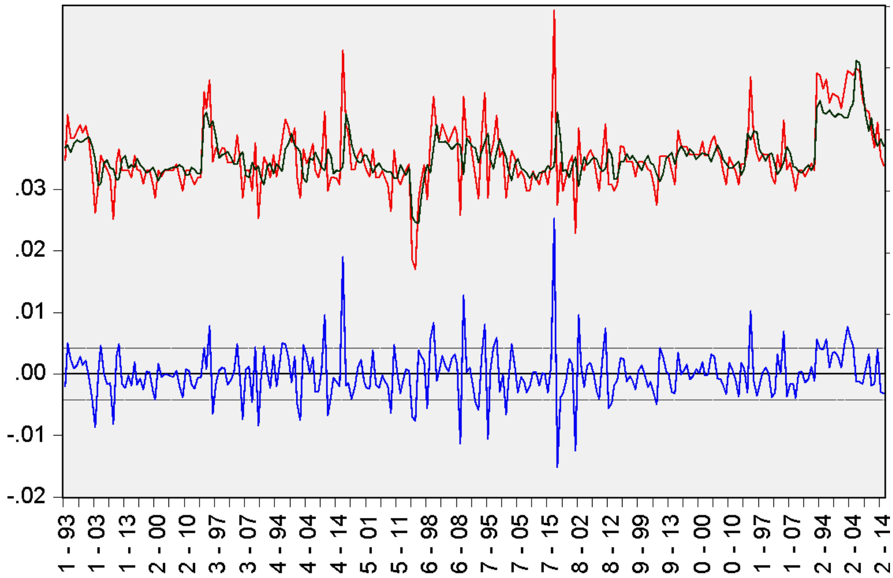

Fig. 4: VECM-4

Source: Plotted by author

Table 2 : Roots of Characteristic polynomial

Root	Modulus
1.000000	1.000000
1.000000	1.000000
0.767974	0.767974
0.148542 - 0.389096i	0.416486
0.148542 + 0.389096i	0.416486
-0.376102	0.376102
0.220435	0.220435
-0.116963 - 0.178502i	0.213409
-0.116963 + 0.178502i	0.213409

Source: Calculated by author

Empowerment Measure index (GEM), Gender Gap Index (GGI) and the Standardised Index of Gender Equality (SIGE) would be available in time series data, then the econometric results for women empowerment with development nexus might be better. Even, the short run analysis is excluded here due to non-availability of reliable data for above 12 countries. It is left for future research.

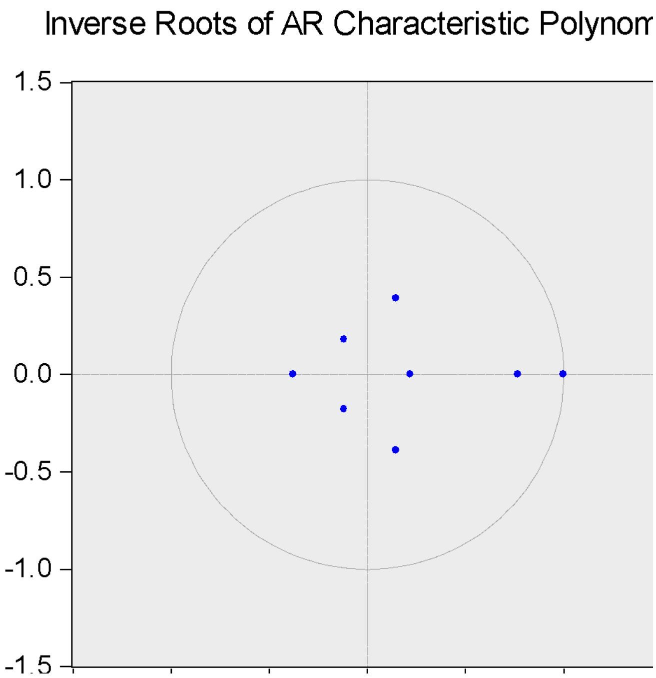

Fig. 3: VECM-2
Source: Plotted by author

Table 3 : Normality test. Null Hypothesis: residuals are multivariate normal

Component	Skewness	Chi-square	Degree of freedom	Probability
1	10.88113	362.8223	1	0.0000
2	-0.299646	4.117494	1	0.0424
3	0.981874	33.57811	1	0.0000
Joint		400.5179	3	0.0000
Component	Kurtosis	Chi-square	Degree of freedom	Probability
1	124.1760	24401.40	1	0.0000
2	4.784812	22.02453	1	0.0000
3	9.874063	76.13497	1	0.0000
Joint		24499.56	3	0.0000
Component	Jarque-Bera	Degree of freedom	Probability.	
1	24764.22	2	0.0000	
2	26.14202	2	0.0000	
3	109.7131	2	0.0000	
Joint	24900.08	6	0.0000	

Source: Calculated by author

Conclusion

The paper concludes that one per cent increase in GDI per year led to 0.1143% increase in GDP per capita and 0.0191% increase in HDI per year significantly during 1990-2015 which were found by fixed effect panel regression. Fisher-Johansen panel co-integration confirms that there is one co-integrating equation among GDP per capita, HDI and GDI during the survey period. The co-integrating equation tends to equilibrium which indicates that there are long run causalities among them. From the system equations of VECM it was verified that there are long run causalities running from HDI and GDP per capita to GDI. Error correction process showed that the speed of adjustment is 95.25% per year which is significant. The Wald test verified that there are no short run causalities running from HDI and GDP per capita to GDI and vice versa but there is short run causality running from HDI to GDP per capita. Overall, the VECM is stable, non-stationary, non-normal and serially correlated.

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