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Gender Diversity, Innovation, and Economic Growth: A Multi-Country Analysis

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ABSTRACT

Studies show that gender diversity promotes creativity and innovative ideas. This paper highlights the link through which gender diversity affects the generation of innovative ideas. The paper modified the Jones (1995) R & D model by assuming that a team consisting of females would be able to generate more ideas and explicitly included gender diversity in the innovation function along with other factors. The paper used a robust check to identify the relevant estimation econometrics method and the results indicated that the Dynamic System Generalized Method of Moment (GMM) is suitable for estimating the impact of gender diversity on economic growth. To lend support to theoretical linkages, the paper employed the dynamic system Panel GMM to examine how gender diversity at the workforce impacts growth via its impact on the generation of innovative ideas using a sample of fifty-four countries for the period 1984-2017. The correlation analysis shows that gender diversity positively affects the economic growth performance of the panel countries. After considering the effect of gender diversity, the coefficient of patents granted improved, which confirms the hypothesis that gender diversity contributes to the growth process through its impact on the generation of innovative ideas. The results show that internet use, mobile usage, and trade liberalization work as channels of diffusion of innovation. The paper also finds gender diversity to be a proxy of informal institutions. Our findings suggest that gender diversity has a significantly positive impact on economic growth through the generation of novel ideas by a gender-diverse team at the workplace. The results have policy implications for policymakers and business managers.

Keywords: Gender Diversity, Dynamic Panel GMM, R&D, Endogeneity, Patent

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INTRODUCTION

Women make up a minority of researchers worldwide, with only 33% of scholars being female across 107 countries between 2015-2018 (Bello et al., 2021). Nonetheless, women have the potential to significantly contribute to the creation and development of novel ideas, making them valuable resources for innovation. Empirical studies have consistently shown that gender diversity[1] in group work fosters creativity and innovation (Hoever & van Knippenberg, 2020; Na & Shin, 2019; Xie et al., 2020). Furthermore, studies suggest that women tend to be more cooperative, friendly, and agreeable than men, enhancing collaboration at the workplace which results in the development of new ideas (Karakowsky & Siegel, 1999; Nielsen et al., 2018).

Innovation is a crucial factor in economic growth (Kawabata & Camargo Junior, 2020), as it guarantees the organization's survival and is hence considered a source of economic growth (Carrasco, 2014). Innovation is defined as the development of a new product or new ways of doing things, and the application of innovative ideas to the production, process, and other aspects of firms (Rogers, 1995). With globalization and global competition in the product market, a country's competitiveness is not only determined by specialization in a particular field, spending more in the research and development (R&D) sector, or through low-cost inputs, but by their efforts for innovation.

In recent decades, the concept of gender equality in the workplace and workplace innovation has attracted the attention of policymakers, business managers, and researchers. Existing literature indicates that the recruitment and retention of women in scientific and technical domains have led to notable advancements in generating new ideas and innovation (Servon & Visser, 2011) As a result, there is a growing impetus to develop policies aimed at increasing female

[1] Gender diversity refers to the ratio of females to males in the workplace (Mishra & Jhunjhunwala, 2013).

representation in the technology and innovation sectors within the business world. Innovation depends on the group of workers in an organization. The diverse types of workers when interacting with one another generate new knowledge and ideas. Therefore, the composition of diverse workers within an organization is a crucial factor in understanding innovation. It is found that enterprises with gender equality are twice as likely to innovate than most segregated enterprises (Rietveld & Patel, 2022).

There is plenty of evidence that increased participation by women improves the innovation performance of organizations and societies (del Mar Fuentes-Fuentes et al., 2023; Sun, 2018). Research shows that diverse, inclusive teams are more innovative, and diverse companies are more profitable. Previous studies identify R&D expenditure (Griffith et al., 2006), formal and informal institutions (Kawabata & Junior 2020), human capital, and existing stock of knowledge as a determinant of innovation (Griffith et al., 2006. According to Nelson & Winter, (1982), the organization of the daily running of a business is easier compared to the development of ideas and innovations, which requires greater planning and decision (Kesting & Ulhøi, 2010). At the same time, the development of innovative ideas does not necessarily require planned decisions or laboratory experiments. It can be generated from the minds of the common workers in the organization. Ideas flow among people, and workers when they randomly meet with each other (Buera & Lucas, 2018; Pentland, 2020). Sharing ideas among individuals and workers of different organizations is difficult and may not be allowed by the policies of the organization, but the sharing of ideas among coworkers of the same organization is possible. Brainstorming among coworkers is easy where worker-trust exists, and workers share common norms and values that result in cooperative behavior.

This study explores the deep determinant of generation of new ideas by individual or joint work of two or more workers in an organization. The study further investigates which type of workers are more cooperative in sharing ideas and also explores the impact of gender diversity on economic growth via the generation of new ideas. Micro-level studies show that gender diversity promotes the innovation performance of R&D teams of organizations (Díaz-García et al., 2013). Countries that are efficient in the generation of new ideas at the micro level would also be efficient at the macro level. The present paper uses an aggregate knowledge production approach to analyze the impact of gender diversity on innovation. Thus, the main contribution of this research is to explore the role of gender diversity in promoting a cooperative work environment which is conducive to the generation of new ideas and the growth countries; and overall to contribute to the literature on innovation and growth from a gender perspective.

LITERATURE REVIEW

Gender diversity in R&D teams has been found to foster an environment that cultivates novel ideas and encourages innovative thinking. When different perspectives, experiences, and approaches collide, they spark creative solutions and fresh insights that drive economic growth. By embracing gender diversity in R&D teams, businesses can tap into a rich pool of talent, boost productivity, and reap the rewards of increased competitiveness and success. Business leaders and economists hold the view that employers benefit from a diverse workforce as it unlocks innovation by creating an environment where outside-the-box ideas drive economic growth. It is found that companies with gender diversity innovate more and outperform their competitors (Ann Hewlett et al., 2013). Gender diversity in the workplace is considered as a source of information that is an important element in the development of new ideas.

Studies show that diversity in groups improves the performance of team members because diversity brings information, knowledge, and different attributes which improve the cognitive performance of the team (Martins & Sohn, 2022). Gender diversity with diverse educational backgrounds is found to be important for the team and is pivotal for inventiveness because a variety of knowledge, skills, and problem-solving approaches accumulate to encourage cross-pollination of ideas, create a dynamic learning environment, and ignite innovative thinking. By embracing gender diversity and diverse educational backgrounds, organizations can tap into a wellspring of creativity, enhancing their capacity for groundbreaking discoveries, and stay at the forefront of innovation in a rapidly evolving world (Dahlin et al., 2005; Kearney et al., 2009). It has also been found that women take a keen interest in entrepreneurship. Hewlett and colleagues (2013) highlighted that women bring diverse perspectives, distinct skill sets, and different approaches to problem-solving along with an ability to identify market gaps which can result in the development of innovative products, services, and strategies.

The presence of females in R&D teams encourages open and inclusive communication, dissemination of knowledge, and the creation of a collaborative and friendly environment, which fosters novel ideas and innovation (Díaz-García et al., 2013). Firms outperform others in innovative performance when they have gender diversity in their workforce (Turner, 2009). The Echelon Theory holds that executive style and individual characteristics such as experience, belief, and personality affect corporate decision-making. Studies show that firms with females as their chief executives perform better in innovation than others (Wu et al., 2021). Diversity in scientific teams is found to be a catalyst for innovation and creativity and studies have also found that the presence of females in scientific teams is important for development and innovation (Love et al., 2022).

Johnson & Johnson (2018) examined the relationship between gender and idea-generation within teams. Their findings indicated that female team members actively engaged in cooperative behaviors that fostered idea-sharing, brainstorming, and collaborative problem-solving. This cooperative approach created an environment conducive to generating a diverse range of novel ideas. Moreover, a study explored the association between gender diversity, cooperation, and idea generation in innovation teams. The research revealed that teams with a higher proportion of females demonstrated greater cooperative behaviors, resulting in a broader range of original ideas. This diversity of ideas, stemming from increased cooperation among female team members, was attributed to different perspectives, experiences, and communication styles. The study highlights that social cohesion is the mechanism through which women in the research team facilitate the generation of new ideas (Davcheva & González-Romá, 2023). Thus, a high proportion of women in R&D team make a difference because females have more social sensitivity. Women are also found to be more democratic and enthusiastic in search of ideal solutions to problems (Love et al., 2022).

Prior research based on the idea that the novelty of ideas is the result of combined efforts that emerge from social interaction indicates that gender diversity in teams has a strong influence on the team's creative output (Baer et al., 2015). The results indicated that the cooperative behaviors of female team members positively affect idea-generation and creative outcomes. Another study suggests that females are polite and have constructive communication skills compared to males, which significantly affects the innovative performance of an organizations (Park et al., 2021).

Recent studies have shed light on how gender diversity impacts innovation and, consequently, economic growth. These studies highlight the positive influence of gender diversity

on fostering innovation within organizations and its subsequent implications for overall economic growth. Research by Hong & Page (2004) examined the relationship between gender diversity and innovative outcomes in teams. Their findings highlight that diverse teams, including a balanced representation of all genders, tend to generate more innovative ideas and solutions compared to homogeneous teams. The study emphasized that diverse perspectives brought by gender diversity the ability to challenge conventional ideas which combine to drive innovation.

Nielsen and colleagues (2018) investigated the impact of gender diversity on innovation performance in firms. The research revealed a positive association between gender diversity at both the managerial and employee levels and innovation outcomes. The study highlighted that a diverse workforce, particularly in terms of gender, creates a more inclusive and stimulating environment that cultivates diverse ideas and approaches, leading to enhanced innovation capabilities. Moreover, a report by the World Intellectual Property Organization (WIPO) (2023) explored the link between gender diversity and patenting activity—an indicator of innovation. The report found that companies with a higher gender diversity in their innovation teams demonstrated greater patenting rates, indicating a stronger propensity for innovation. The study emphasized that gender-balanced teams foster a culture of innovation and drive economic growth. Carter and colleagues (2021) synthesized multiple studies on the relationship between gender diversity and firm-level innovation. Their findings revealed that gender-diverse organizations were more likely to introduce and successfully implement innovative practices, products, and services. The study highlighted the importance of heterogeneous perspectives and collaborative problem-solving in driving innovation within diverse teams.

In summary, Gender diversity in R&D teams drives innovation, economic growth, and productivity. Companies with gender-diverse workforces benefit from greater innovation and

outperformance. Women's active engagement, unique critical thinking skills, and open communication contribute to idea generation and innovative outcomes. Gender-balanced teams cultivate a culture of innovation, leading to greater patenting rates and successful implementation of innovative practices.

CONCEPTUAL FRAMEWORK

Studies in the field of industrial economics highlight internal and external factors of innovation. R&D expenditure, availability of skilled labor the stock of knowledge, and organizational competence, determine the innovative capacity of organizations (Romer, 1990). In the same line of argument, other researchers found the internal absorptive capacity of organizations as the main determinant of the innovative capacity of the firms (Cohen & Levinthal, 1989). Firms often copy or imitate the product of other firms and produce the same product at low cost which reduces the development of new products or innovation in the sector. Studies show that firms that protect their product enjoy the benefit of innovation, and this boosts the firms' profitability (Cohen & Levinthal, 1989). Other studies find that overemphasis on protection reduces innovation as such firms spend more on secrecy rather than on exploring modern technologies and sharing knowledge (Lewin et al., 2011). In another study, firm technological competence derived from a firm's in-house R&D was found to be a significant determinant of a firm's innovation (Vega-Jurado et al., 2008).

Not only are internal factors an important determinant of innovation, but external factors also play a significant role in the development of new ideas and products. Studies have found that user cooperation with other firms has a significant positive impact on the firm's development of new products and incremental products. Moreover, the positive impact of user cooperation on the development of the new product is more significant in the case of small firms (Sánchez-González

& Herrera, 2015). Firms should constantly assimilate external ideas to produce market-oriented products depending on their R&D activities (Chesbrough, 2003; Dodgson et al., 2006). According to the open innovation model (Chesbrough, 2003), innovation requires an interactive process in which cooperation with a diverse group is beneficial for the firms as it enables firms to assimilate ideas and knowledge from diverse groups (Pittaway et al., 2004). Firms give increasing importance to relations and cooperation with the user as they provide accurate and updated information to firms regarding market needs and demand for innovative technologies (Amara & Landry, 2005).

Besides the internal and external factors, ideas flow among employees when they interact with one another within organizations, such as during lunch, during social interaction, or when they interact with friends in other organizations (Buera & Lucas, 2018; Kesting & Ulhøi, 2010). According to Khan and colleagues (2017), when workers face any production-related problem at the workplace they resort to help from other coworkers and find a solution to the problem which is at least new to the workers. Studies also indicate that gender diversity improves group members' relations with external members and allows group members to acquire knowledge and ideas from external groups (Jackson et al., 2003). Literature also shows that radical innovation in products requires team members to have cohesion, coordination, communication, and mutual support among themselves (Díaz-García et al., 2013). Groups with such aspects are found to perform better than others. Few studies have focused on cooperation among coworkers from a gender perspective (Díaz-García et al., 2013; Pittaway et al., 2004). Based on the literature it is hypothesized that:

H1: The increase in the female-to-male ratio in the R&D research team has a significant positive effect on economic growth via its effect on innovative ideas development.

DATA AND METHODOLOGY

The neoclassical growth model explains long-term economic growth in terms of the accumulation of physical capital, technological progress, and labor force growth. In the neoclassical growth model, technological progress is exogenous, meaning that it is not influenced by economic factors. However, some extensions of the model incorporate endogenous technological change, in which technological progress is influenced by factors such as R&D, institutions, and innovation (David, 2012). Endogenous growth theorists assume that technological progress or knowledge production is endogenous. They assume two sectors, a good producing sector and a R&D sector (David, 2012). It is assumed that a fraction of labor and capital are used in production and the R&D sector while assuming knowledge or ideas as non-rival goods, therefore full stock of knowledge is used in both sectors. The production function is identical to that of the Solow model and the only difference is that endogenous growth theorists assume knowledge as an endogenous variable (Aghion & Howitt, 1992; Grossman & Helpman, 1991). Following Jones (1995), we express the production function as:

$$Y(t) = F[K(t), A(t)L(t)] \quad \text{.....(1)}$$

Where $Y(t)$ denotes Gross Domestic Product (GDP) measure of national output, $K(t)$ denotes Physical Capital, $L(t)$ denotes labor used for production, and $A(t)$ denotes stock of knowledge or technological progress.

Endogenous growth literature indicates that the generation of new ideas and development of new products is dependent on the stock of already existing knowledge, here denoted by $A(t)$, labor devoted to in R&D sector (Aghion et al., 2009; Romer, 1990), formal and informal

institutions such property right (Cvetanović et al., 2019; Khan et al., 2017; Li et al., 2020; Schout & North, 1991), denoted by $T(t)$, and social capital (Chou, 2006; Thompson, 2018) denoted by S(t). Literature indicates that great ideas come from differences, which is possible when the workforce is diverse and when both females and males work in the R&D team. Gender diversity is defined as the ratio of female to male (Mishra & Jhunjhunwala, 2013) denoted by $G(t)$ within R&D teams generate certain dynamics that foster novel solutions leading to radical innovation (Becker, 2023; Capozza & Divella, 2023; Díaz-García et al., 2013; Xie et al., 2020). Studies show that gender diversity improves collaborative decisions (Bear & Woolley, 2011; Curşeu et al., 2018; Fenwick & Neal, 2001), contributes to the building of social relations and a cooperative work environment characterized by open discussion (Nielsen & Huse, 2010), which are preconditions of innovation. Literature also shows that a workplace with dense social networking helps generate more novel ideas. Organizations that combine tacit knowledge with a high level of social capital produce more radical innovations (Pérez-Luño et al., 2011). Firms located in regions characterized by high levels of social capital in terms of high social interaction are found to be more innovative as this is complementary to internal R&D (Laursen et al., 2012). Studies also show that high social capital affects innovation through the transfer of knowledge (Zhou et al., 2022). This paper incorporates informal institutions as a proxy of social capital in the knowledge production function. The final knowledge production function for this study, taking into consideration gender diversity (Schout & North, 1991) is given below:

$$\frac{A(t)}{dt} = F[A(t-1), L(t), G(t), T(t), S(t)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

From equation (2), it is clear that knowledge (the creation of new ideas) depends on the already existing stock of knowledge $A(t-1)$, number of workers in the R&D sector denoted by $L(t)$, gender diversity (ratio of female to male) denoted by $G(t)$, formal institutions $T(t)$ and informal institutions $S(t)$. Studies shows that already available stock of ideas increases the productivity of all inputs in a country (Hall et al., 2010) and literature indicates that if sufficient ideas are already discovered than the generation of new ideas becomes difficult (fishing out effect) and the opposite case also holds (Jones, 1995; P. M. Romer, 1990).

Taking into consideration the indirect effect of new idea generation, the final output is determined by capital, stock of already existing stock of knowledge, gender diversity, and institutions. This paper uses a sample panel of countries, and we estimate the following dynamic panel regression model, to examine the impact of gender diversity on economic growth:

$$GDPPC_{it} = \beta_0 + \beta_1 GDPPC_{it-1} + \beta_2 GenderDiversity_{it} + \beta_3 Institutions_{it} + \beta_4 Patent_{it} + \beta_5 (Patent_{it} * GenderDiversity_{it}) + \theta X + \eta_i + \gamma_t + \varepsilon_{it} \quad \text{.....(3)}$$

Here $GDPPC_{it}$ denotes GDP per capita $GDPPC_{it-1}$ lag GDP per capita, $GenderDiversity_{it}$ denotes gender diversity which is defined as the ratio of female to male labor force participation, $Institutions_{it}$ denotes formal institutions (property rights) and informal institutions (average of happiness and school friendship), $(Patent_{it} * GenderDiversity_{it})$ is an interaction term and "X" represents control variables such as internet usage, mobile, broadband, and trade openness. We utilized data from different sources to estimate the impact of gender diversity on economic growth. The data of GDP per capita, Gross fixed capital formation (as % of GDP), population growth, the ratio of female to male labor force participation, internet usage, mobile users, broadband, patents, and trade openness are taken from world development indicators (WDI, 2017). The data on

happiness and school friendship is taken from the World Value Survey (Inglehart et al., 2017). Property rights data is taken from the World Intellectual Property right (WIPO, 2017). In all, we investigated the role of gender diversity in the creation of new ideas and its impact on economic growth from a sample of 54 countries (Appendix A) over the period of 1984-2017.

Growth literature shows that economies converge to a steady state and therefore, the coefficient of lag GDP per capita is expected to be negative. Similarly, studies on gender and innovation indicate that gender diversity leads development of innovative ideas and hence the coefficient is expected to have a positive sign (Díaz-García et al., 2013). Theories and empirical work on innovation and economic growth show that patents have a positive effect on the growth performance of economies. The coefficient of interaction term ($Patent_{it} * GenderDiversity_{it}$) is also expected to have a positive sign as hypothesized.

The lag-dependent variable creates an endogeneity issue in estimating the above model but in cases when the time is small and the cross section is large then the fixed effect model works. In that case, researchers use dynamic panel GMM to estimate the model. In the present case, the data period is from 1984-2017, which constitutes 33 years, and the number of cross sections is fifty-four. Although "T" is large but still $T < N$ and in that case, dynamic GMM is better (Holtz-Eakin, 1988; Roodman, 2015). Robustness tests are performed to know which technique is good among pooled OLS, Fixed effect, and system GM. Growth literature indicates, that if the coefficient of the lagged dependent variable of $Pooled\ OLS > System\ GMM > Fixed\ Effect$, then dynamic GMM is better to employ(Caselli et al., 1996; Mehrhoff, 2021; Nickell, 1981; Blundell & Bond, 1998).

RESULT AND DISCUSSIONS

Table 1 presents the pairwise correlations among the variables in the study. The correlation coefficient between Property Rights and GDP Per Capita is 0.776, indicating a strong positive correlation. This suggests a significant positive relationship between property rights and GDP per capita. Additionally, the correlation coefficient between Patent Granted and GDP Per Capita is 0.912, indicating a strong positive correlation. This implies a high positive relationship between the number of patents granted and GDP per capita.

Table 1
Matrix of Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) GDP Per Capital	1.000					
(2) Physical Capital	0.075*	1.000				
	(0.001)					
(3) Property Right	0.776*	0.235*	1.000			
	(0.000)	(0.000)				
(4) Patent Granted	0.912*	-0.009	0.779*	1.000		
	(0.000)	(0.711)	(0.000)			
(5) Gender Diversity	0.404*	-0.011	0.400*	0.487*	1.000	
	(0.000)	(0.657)	(0.000)	(0.000)		
(6) Population Growth	-0.565*	0.035	-0.429*	-0.463*	-0.300*	1.000
	(0.000)	(0.139)	(0.000)	(0.000)	(0.000)	

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

The theoretical model and cited literature show that countries with gender diversity outperform other countries in the field of innovation and hence growth. The correlation coefficient between Gender Diversity and GDP Per Capita is 0.404, indicating a moderate positive correlation. This suggests a moderate positive relationship between gender diversity and GDP per capita. The correlation analysis shows that gender diversity and patented granted are positively correlated which implies that gender diversity affects economic growth through its impact on innovation performance of a country. It is observed that women do not get the same property rights that men receive in many countries. Studies show that women's property rights are significantly associated

with growth even after controlling for the effects of men's property rights (O'Reilly & Sheehan, 2023).

The positive correlation coefficient supports the result of the study that countries where women's property rights are protected experience higher economic growth. Property rights are a proxy of formal institutions and the correlation between property rights and GDP per capita is highly significant which supports the cited studies. As noted by Nobel laureate North (1989), formal institutions and ownership matters in the development of economies (North, 1989). Property rights indirectly affect the economic growth of countries through its effect on accumulating factors such as R&D (Gould & Gruben, 1996; Park & Ginarte, 1997; Tripathi, 2023).

The paper employed three different econometrics methods i.e. Pooled method, Fixed effect method, and System dynamic GMM method to estimate the impact of gender diversity on the economic growth of the panel countries. Comparing the coefficients of the lagged dependent variable from the three methods (Table 2), it is clear that the estimated coefficient of lagged dependent variable follows the pattern $Pooled\ OLS > System\ GMM > Fixed\ Effect$ which justifies the use of panel dynamic system GMM as suggested by earlier studies (Caselli et al., 1996; Mehrhoff, 2021; Nickell, 1981; Blundell & Bond, 1998). Therefore, this paper employs the dynamic panel system GMM for estimating the relationship between GDP per Capita, innovation, and gender diversity.

Table 2
Robustness Results using GDP Per Capita as Dependent Variable

Variables	(1) Pooled OLS	(2) Fixed Effect	(3) SYS GMM
GDP Per Capita(lag_1)	1.264***	1.159***	1.194***
	(0.029)	(0.030)	(0.077)
GDP Per Capita(lag_2)	-0.271***	-0.179***	-0.215***
	(0.029)	(0.030)	(0.073)
Physical Capital	0.152***	0.171***	0.162***
	(0.010)	(0.010)	(0.030)
Physical Capital(lag_1)	-0.163***	-0.174***	-0.165***
	(0.014)	(0.014)	(0.041)
Physical Capital(lag_2)	0.022**	0.012	0.016
	(0.011)	(0.011)	(0.024)
Property Right	-0.014*	0.010	0.012
	(0.008)	(0.014)	(0.014)
Informal Institution	-0.028	0.048	0.049
	(0.021)	(0.042)	(0.035)
Property Right ##Informal Institution	0.006*	-0.003	-0.003
	(0.004)	(0.006)	(0.006)
Gender Diversity	0.010***	0.006	0.015***
	(0.003)	(0.008)	(0.005)
Patent Granted	0.000	-0.002	0.002
	(0.001)	(0.002)	(0.002)
Population Growth	-0.003***	-0.005***	-0.006***
	(0.001)	(0.001)	(0.002)
Constant	0.070	0.011	
	(0.047)	(0.102)	
Observations	1,189	1,189	1,189
R-squared	1.000	0.987	
No. of instruments			29.000
Number of C_No		54	54
AR1 p-value			0.000
AR2 p-value			0.044
Sargan p-value			0.103
			0.547

The results of the two-step panel dynamic system GMM are presented in Table 3. It is clear from the table that lagged GDP Per Capita has a significant effect on current GDP per capita which provides evidence of persistence in GDP per capita. Physical Capital shows a significant positive effect on GDP Per capita which is in line with growth theories (Li et al., 2015; Maitra, 2018). Traditional growth theories show that an increase in population negatively affects the economic growth of an economy, and the result also supports the theories as is clear from the negative significant coefficient of population growth (Garza-Rodriguez et al., 2016). The generation of new

ideas increases the productivity of factors input and hence contributes to accelerating economic growth (Li & Jiang, 2016).The finding of this paper also reveals that patented granted exert a significant positive effect on the economic growth of sample countries (See column 1), which supports the findings of previous studies (Bakari, 2022; Dereli, 2019). Property rights institutions also play an important role in the economic development of countries. Property right influences the incentive to innovate and hence contribute to the growth process (Falvey et al., 2006; Gould & Gruben, 1996; Park & Ginarte, 1997).

Table 3

Two-Step System Dynamic Panel GMM Results: GDP Per Capita as Dependent Variables

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GDP Per Capita(lag_1)	1.180***	1.119***	1.180***	1.139***	1.181***	0.997***	1.119***	1.116***	1.102***	1.079***
	(0.079)	(0.085)	(0.073)	(0.058)	(0.063)	(0.090)	(0.081)	(0.082)	(0.077)	(0.080)
GDP Per Capita (Lag_2)	-0.204***	-0.149*	-0.208***	-0.176***	-0.210***	-0.096	-0.138*	-0.197***	-0.133*	-0.165**
	(0.072)	(0.080)	(0.070)	(0.056)	(0.059)	(0.072)	(0.081)	(0.069)	(0.068)	(0.079)
Physical Capital	0.200***	0.192***	0.178***	0.152***	0.165***	0.203***	0.186***	0.143***	0.177***	0.177***
	(0.034)	(0.046)	(0.036)	(0.031)	(0.028)	(0.050)	(0.048)	(0.038)	(0.058)	(0.025)
Physical Capital(lag_1)	-0.179***	-0.170***	-0.172***	-0.147***	-0.174***	-0.147***	-0.179***	-0.121***	-0.165***	-0.146***
	(0.044)	(0.048)	(0.048)	(0.043)	(0.036)	(0.050)	(0.054)	(0.037)	(0.061)	(0.029)
Physical Capital(lag_2)	0.037	0.037	0.034	0.013	0.027	0.001	0.025	-0.006	0.012	0.006
	(0.023)	(0.026)	(0.028)	(0.026)	(0.023)	(0.026)	(0.026)	(0.027)	(0.028)	(0.024)
Population Growth	-0.004***	-0.007***	-0.007***	-0.008***	-0.006***	-0.007***	-0.005***	-0.006***	-0.006***	-0.007***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Patent Granted	0.006*	0.004	0.004**	0.004**	0.005***	0.005*	0.002	0.000	0.001	0.008***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Gender Diversity	0.035**	0.032***	0.020***	0.018***	0.062***	0.039**	0.021**	0.029***	0.024***	0.024**
	(0.016)	(0.009)	(0.005)	(0.005)	(0.012)	(0.016)	(0.009)	(0.008)	(0.007)	(0.009)
Property Right		0.006*		0.037***	0.046***	0.014***	0.008**	0.010*	0.012***	0.051***
		(0.003)		(0.013)	(0.009)	(0.004)	(0.003)	(0.005)	(0.004)	(0.012)
Informal Institution			0.058***	0.110***						
			(0.018)	(0.030)						
Property Right ##Informal Institution				-0.012**						
				(0.005)						
Gender Diversity## Property Right					-0.009***					
					(0.002)					
L3.GDP Per Capita						0.063	-0.001	0.058	0.009	0.043
						(0.040)	(0.043)	(0.048)	(0.038)	(0.036)
Internet user						0.010**			0.006**	
						(0.004)			(0.003)	
Internet users ## Property Right						-0.002***			-0.001**	
						(0.001)			(0.001)	
Mobile User							0.004***			
							(0.002)			
Mobile User##Property Right							-0.001***			
							(0.000)			
Broad Band								0.005		
								(0.003)		

Broad Band ## Property right								-0.001*		
								(0.001)		
Trade Openness										0.070***
										(0.018)
Trade Openness ## Property right										-0.011***
										(0.003)
Observations	1,189	1,189	1,189	1,189	1,189	992	1,136	707	1,033	1,163
Number of C_No	54	54	54	54	54	53	54	54	54	54
No. of instruments	10.000	26.000	27.000	29.000	28.000	30.000	29.000	29.000	29.000	29.000
AR1 p-value	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.002	0.000	0.000
AR2 p-value	0.089	0.046	0.100	0.033	0.051	0.133	0.088	0.200	0.089	0.108
Sargan p-value	0.400	0.190	0.051	0.095	0.211	0.000	0.072	0.000	0.000	0.328
Hansen p-value	0.494	0.150	0.294	0.558	0.672	0.215	0.122	0.157	0.166	0.736

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Property rights are one of the most important elements of institutional structure. Studies show that property right has a significant positive effect on economic growth in the long run (Haydaroğlu, 2015). Intellectual property rights are considered important in encouraging innovation, boosting technological progress, and stimulating economic growth as the intellectual property gives a temporary monopoly to the inventor to reap the benefit of the innovation (Arrow, 1962). The present paper finds significant positive effects of property rights on economic growth supporting the previous studies (Bielig, 2015; Torun, 2007).

The variable of interest of the paper is gender diversity as it is hypothesized that in a workplace characterized by diverse genders, there would be a generation of new ideas that would lead to economic growth. The cited studies indicate that gender diversity in R&D teams fosters collaboration (Díaz-García et al., 2013) and that increase in the productivity of workers can create more ideas. From Table 3, we see that the gender diversity variable coefficient is significant in different specifications. As we introduce informal institutions as an additional variable in the model, the value of the coefficient of gender diversity decreases although it remains significant which implies that informal institutions are complementary to gender diversity and researchers can use gender diversity as a proxy of informal institutions in future research. The negative significant

coefficient of the interaction term (Gender Diversity## Property Right) indicates that property rights are more supportive of men's intellectual work in the present case which supports the findings of earlier work (O'Reilly & Sheehan, 2023). However, it is also clear that while considering intellectual property rights, the coefficient of gender diversity improves. Controlling the effects of intellectual property, informal institutions, and other control variables, we find that gender diversity has a significant positive impact on the economic growth of sample countries.

The paper also used control variables such as internet user, broadband and informal institutions, and trade openness to examine their impacts on economic growth in the presence of gender diversity, informal institutions, and formal institutions. The coefficients of interaction terms i.e. (Internet users ## Property Right, Mobile User##Property Right, Broad Band ## Property right) are negative significantly which implies that Information and Communication Technologies (ICT) are complementary to property rights that restrict sharing of information and ideas without the purchase of property right, while the ICT is considered as a diffusion channel of innovation and hence their effects are considered negative on innovation. It is now easy to reproduce and distribute others' work and ideas through the usage of ICT. Easy access through ICT provides the R&D workers with knowledge about the new developments which helps them develop more novel ideas (Deichmann et al., 2020).

It is also clear from the results that when we include the interaction of the internet and property rights, the coefficient is significant indicating that ICT reduces the gender gap by enabling easy access to information for women (Yufei et al., 2018). Studies show that well-connected firms are more productive in terms of the development of new ideas and ICT plays an important role in firms' connectivity(van Vlokhoven, 2023). The literature also shows that when an investor interacts with more productive inventors, it increases the productivity of the coworker and hence

growth (Akcigit et al., 2018; Jarosch et al., 2021) and ICT provides a channel of interaction for workers. The paper used the trade openness indicator to know whether trade openness has any significant effects on idea diffusions and hence growth. We find that trade openness has significant positive effects on economic growth supporting the findings of the studies which state that trade openness impacts economic growth through innovation (Belazreg & Mtar, 2020; Keho, 2017). Table 3 also shows that there is no issue of autocorrelation as evidenced by the value of AR (1) and AR (2). In addition, Sargen and Hansen test results show that the instruments are exogenous and are not overidentified.

CONCLUSION

This paper investigated the role of gender diversity in the creation of new ideas and its impact on economic growth from a sample of 54 countries over the period of 1984-2017. The study finds that the individual effect of patented granted on economic growth is significantly positive. However, after considering the effect of gender diversity, the coefficient of patent granted improved which confirms the hypothesis that gender diversity contributes to the growth process through its impact on the generation of new ideas which also confirms previous studies' findings. The study also examined the interaction effects of gender diversity, informal institutions, and property rights and we found that in both cases intellectual property rights are found complementary to informal institutions and gender diversity. This implies that informal institutions can also be employed as a proxy of gender diversity in future research because it results in creating a cooperative environment at the workplace. This study is an important contribution as it highlights the importance of females in creating a cooperative workplace environment and in generating new ideas. The world population consists of more than 50 percent females; therefore, policymakers and

business managers can boost new ideas and product innovation by engaging females in productive activities, particularly in research and development.

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Conflict of Interest:
It is hereby stated that the authors have no conflict of interest.

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Ethics and permissions
The authors have carried out the work independently.

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The corresponding author has agreed to share data upon request.

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Appendix-A:

List of Sampled Countries

S.No	Country	S.No	Country	S.No	Country
1	Albania	19	Iceland	37	Poland
2	Argentina	20	India	38	Portugal
3	Australia	21	Indonesia	39	Romania
4	Austria	22	Ireland	40	Saudi Arabia
5	Bangladesh	23	Italy	41	Singapore
6	Belgium	24	Japan	42	South Africa
7	Brazil	25	Jordan	43	Spain
8	Canada	26	Malaysia	44	Sweden
9	China	27	Mali	45	Switzerland
10	Colombia	28	Mexico	46	Tanzania
11	Denmark	29	Morocco	47	Thailand
12	Dominican Republic	30	Netherlands	48	Trinidad and Tobago
13	El Salvador	31	New Zealand	49	Turkey
14	Finland	32	Nigeria	50	United Kingdom
15	France	33	Norway	51	United States
16	Germany	34	Pakistan	52	Uruguay
17	Ghana	35	Peru	53	Zambia
18	Hungary	36	Philippines	54	Zimbabwe