Cilt/Volume 7 | Sayı/Issue 2 | Aralık/December 2018 | 1-32

Investigating the Mediating Role of Innovation in the Relationship Between Entrepreneurship and Regional Economic Development[1]

İsmail DEMİRDAĞ*

ABSTRACT

Purpose: This study aims to show how innovation plays as a mediator in the link between entrepreneurship and economic development level.

Methodology: Using data of 26 NUTS II regions of Turkey and mediation analysis technique, the study has examined the associations among the variables for four periods: 1995, 2000, 2005, and 2010.

Findings: The results, supporting the mainstream arguments in the literature and the main hypothesis, illustrate that the interaction between entrepreneurship and innovation has a positive and significant effect on the level of regional economic development.

Practical Implications: The results of this paper provide ample evidence indicating that entrepreneurship has a crucial impact on the economic development level of NUTS-II regions of Turkey through the innovation.

Originality: By providing empirical evidence, this study shows that the interaction between entrepreneurship and innovation has play a critical role in determining the level of economic development of the regions in Turkey.

Keywords: Regional Economic Development Level, Entrepreneurship, Innovation
JEL Codes: R11, L26, O31

Girişimcilik ve Bölgesel Ekonomik Kalkınma Arasındaki İlişkide Yeniliğin Aracı Rolünün İncelenmesi

ÖZ

Amaç: Bu çalışma, girişimcilik ve ekonomik kalkınma düzeyi arasındaki ilişkide yeniliğin nasıl bir aracı rol oynadığını ortaya koymaya çalışmaktadır.

Yöntem: Çalışma, Türkiye'deki 26 İBBS Düzey 2 bölge verilerini ve aracılık analizi tekniğini kullanarak, değişkenler arasındaki ilişkiyi dört dönem için incelemiştir: 1995, 2000, 2005 ve 2010.

Bulgular: Literatürdeki temel tartışmaları ve ana hipotezi destekleyen sonuçlar, girişimcilik ve yenilik arasındaki etkileşimin, bölgesel ekonomik kalkınma düzeyi üzerinde pozitif ve anlamlı etkiye sahip olduğunu göstermektedir.

Sonuç ve Öneriler: Bu çalışmanın sonuçları yeterli kanıt sağlayarak, girişimciliğin, yenilik yoluyla Türkiye'nin İBBS Düzey-2 bölgelerinin ekonomik kalkınma düzeyleri üzerinde önemli bir etkiye sahip olduğunu göstermektedir.

Özgün Değer: Ampirik kanıtlar sağlayarak, bu çalışma, girişimcilik ve yenilik arasındaki etkileşimin, Türkiye'deki bölgelerin ekonomik kalkınma düzeyinin belirlenmesinde kritik bir rol oynadığını göstermiştir.

Anahtar Kelimeler: Bölgesel Ekonomik Kalkınma Düzeyi, Girişimcilik, Yenilikçilik
JEL Sınıflandırması: R11, L26, O31

[1] A part of this article is derived from Master Thesis titled as "Entrepreneurship and Regional Economic Development: Evidence on Turkish Regions".

* Arş. Gör., Orta Doğu Teknik Üniversitesi, Şehir ve Bölge Planlama Bölümü, Ankara, Türkiye, demirdag@metu.edu.tr, ORCID: 0000-0002-6241-8547

Araştırma Makalesi (Research Article)
Geliş (Submitted) : 02/04/2018
Düzeltme (Revision) : 09/06/2018
Kabul (Accepted) : 14/10/2018

1. Introduction

In recent years, entrepreneurship and innovation are widely recognized as essential stimuli and drivers for the economic development[2] and growth[3] of countries and regions. In particular, with the reduction of economic and political barriers between countries, globalization of economy and increasing competitiveness, the issues of entrepreneurship and innovation have gradually become important. According to Baptista et al. (2008), since the importance of economies of scale has declined and the life cycle of product and services has become quite short, the role of entrepreneurship and innovation activities in the economic development process has become even more important. Audretsch and Thurik (2001) also assume that due to increasing degree of uncertainties and risks in economic environment and providing more space for innovative activities, entrepreneurship has been a crucial actor in economic development and growth processes.

In his book *The Theory of Economic Development*, Joseph Schumpeter (1934) draws attention to the role of the entrepreneurship in innovative activities. Schumpeter puts the theory of long waves which explained how new and small firms struggle with established large firms by developing new inventions and ideas that make existing products and technologies obsolete. According to him, entrepreneurs are key actors in the creative destruction process in the economy by carrying out creative activities and innovations.

Similarly, in recent years many scholars have highlighted the importance of the association between entrepreneurship and innovation for economic growth and development. For instance, Stam (2008) argues that through the introduction of new products, new firms play a direct role in economic growth, while by stimulating old firms to develop or reorganize their activities play an indirect role. Similarly, Audretsch and Keilbach (2004) suggest that to achieve economic growth, a region must be equipped with entrepreneurship capital, which allows

[2] Economic Development is generally defined as the increase in the economic well-being of residents in a particular country or region. Economic development may represent the development in many areas such as improvement of living standards, technological development, development of technological production capacity, improvements in education and health, improvement in life expectancy rate, and etc.

[3] On the other hand, economic growth corresponds to the increase in the value produced in the economy. In other words, economic growth refers to the percentage of a country's annual rate of increase in GDP or GNP in a particular span of time. It indicates a significant increase in national product per capita.
However, it should be noted that economic growth is an important component of economic development. With the growth of economic growth, the economic development level of a country or region may increase.

innovations to enter the market. González et al. (2012) indicate that innovation and entrepreneurship capital of a region can influence the achievement of higher productivity, competitiveness and economic prosperity. Besides, Szirmai, Naudé and Goedhuys (2011) assert that entrepreneurs influence the rate of technological change and the structural transformation of the economy by innovating and commercializing inventions and innovations developed by others.

Within this framework, this paper aims to investigate the relationships between entrepreneurship, innovation, and economic development levels in the context of 26 NUTS II regions of Turkey, for the periods of 1995, 2000, 2005, and 2010. The study tries to answer to the question '*how does innovation play as a mediator in the link between entrepreneurship and regional economic development levels of NUTS II regions of Turkey*'. Based on this research question and ample evidence in the literature, the main expectation of the paper is that the interaction between innovation and entrepreneurship has positive and significant influence the level of regional economic development[4].

To explore the role of innovation in the link between entrepreneurship and regional economic development, the paper used mediation analysis through macro PROCESS producer in SPSS. Empirical evidence shows that innovation played a crucial role in the nexus between entrepreneurship and the level of regional economic development. In other words, the findings suggested that through the mediating role of innovation, entrepreneurship has positive and significant effect on the economic development levels of the NUTS II regions of Turkey.

The structure of this paper is as follows: The second section of this paper provides the theoretical literature about the relationship among entrepreneurship, innovation and regional economic development. The third section presents the entrepreneurial and innovative capacities of NUTS II regions, as well as their economic development levels. Section four deals with the methodological approach of the study, and section five displays the results of the empirical analyses. The final section draws a conclusion.

[4] Although the level regional economic development comprises many components, the level of regional economic development was measured as Gross Domestic per Capita, because there were no other data in Turkey to reflect the level of regional economic for this study.

2. Literature Review

Innovation, inherent in human development, has played an important role in the development of human history. Despite its vital role for the history of mankind, economists and researchers ignored innovations and often referring the broad concepts of the subject indirectly (Galindo and Méndez, 2014) until the second half of the twentieth century. Innovation which was completely ignored in the classical economic growth theories took place for the first time in the neoclassical economic growth theory developed by Robert Solow in 1950s. According to the economic growth model developed by Solow (1956), half of the total economic growth was explained by the main factors of economic growth, namely capital and labour, while the remaining half, which is the unexplained Solow residual, was explained by the contribution of innovation or technical progress. In this growth model, innovation was defined as an exogenous economic factor and measured as a "residue" for a long time. Although technological progress or innovation was key economic growth factor in Solow model, the theory dealt with innovation superficially and gave almost no information about the process of innovation and how and in what ways innovation contributes to economic growth.

However, the endogenous growth theories developed after 1980s, represented by Romer (1986) and Lucas (1988), have adopted a new approach by proposing that the emergence of new accumulation factors, such knowledge, innovation, etc., stimulate economic growth (van Hemert and Nijkamp, 2014). In contrast to their neoclassical counterparts, endogenous growth theorists have internalized the accumulation of technological know-how and considered innovation as one of the key factor of economic growth. In other words, it is emphasized that innovation is not an external factor but an endogenous factor (i.e., Romer, 1986, Grossman and Helpman, 1991, Aghion and Howitt, 1992). In this sense, the endogenous growth models have highlighted the importance of knowledge accumulation, knowledge spillover and technological progress in the economic growth process (Wong et al., 2005). For example, Romer (1990) argues that technological innovations are the engine of long-term economic growth and technological innovations in an economy arise as a result of R&D activities. Romer has also emphasized that economic growth can increase if the amount of human capital allocated to research and development is increased. He explains endogenously the source of technological change and long-term

growth. Therefore, he argues that there is a strong correlation between R&D, innovation and economic growth. Besides, Aghion and Howitt (1992), who developed an endogenous economic growth model based on Schumpeter's creative destruction process, claim that vertical innovations created by the competitive research sector constitute the main source of growth.

While technological change or innovation in the neoclassical theory is explained by coincidences during production activities, endogenous growth theory tries to explain it by human capital accumulation and activities in the R&D sector. Although the above mentioned economic growth theories emphasized the importance of innovation and technological progress for economic growth, both failed to provide sufficient information about the formation of innovation and its transformation into economic values. In this regard, it is worthwhile to give a place to Schumpeter's assumptions about economic growth.

The work of Joseph Schumpeter, probably the first researcher stressing the importance of innovation for economic growth, has significantly influenced innovation theories (OECD, 2005). Schumpeter (1934) argues that innovation is an essential driver of economic dynamics and competitiveness. He also believes that innovation is at the centre of economic change which leads to the creation of the "creative destruction" process, in which the new technologies replace the old. In other words, Schumpeter (1942, p.83) indicates that innovation is a *"process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one".*

Unlike the neoclassical growth theory, in which there is no room for an entrepreneur, Schumpeter puts entrepreneur at the centre of his analysis. Schumpeter argues that the entrepreneur is a vehicle that transforms ideas and innovations into economic assets which bring gains. He also defines entrepreneurship as innovation and the actualization of innovation (Śledzik, 2013). Schumpeter (1939) emphasizes that innovation is necessary to explain economic growth, while entrepreneurship is necessary to explain innovation. Schumpeter (1912) also states that the main function of the entrepreneur is to allocate available resources to create "new uses and new combinations". Schumpeter, in this regard, defines the entrepreneur as the most important driving force of innovation and economic growth.

The 1970s crisis, which led to the recognition of the weaknesses of Ford-

ist-type production (Plummer and Taylor, 2001), and the path-breaking developments in information and communication technologies (ICTs) after the 1980s were being major events that led to fundamental changes in economic theories and models. Audretsch and Thurik (2004) define this period as the transition from the "Managed Economy" to the "Entrepreneurial Economy"[5]. In particular, the successes achieved by regions (e.g., Silicon Valley, Third Italy, and Baden-Württemberg.) based on new and smaller firms in terms of economic growth and innovation activities have attracted the attention of many researchers. Numerous researchers have begun to develop models of economic growth, (such as Innovative Miliue (Aydalot, 1986; Maillat and Lecoq, 1992), Learning Regions (Piore and Sabel, 1984), and Regional Innovation System (Cooke and Morgan, 1998) based on local characteristics, unlike traditional theories of economic growth ignoring the characteristics of space. One of the most important common features of these theories is that innovation and entrepreneurship resulting from locally embedded knowledge have widely been accepted as key drives of regional economic growth and development. Especially since the 2000s, innovation and entrepreneurial activities have begun to take place among the indispensable economic policies of almost all countries and international economic associations such as OECD, NAFTA and the EU. Almost half a century after Schumpeter, innovation and entrepreneurship are considered as the most important actors of economic growth again. Thus, the number of theoretical and empirical studies examining the impact of entrepreneurship and innovation on economic growth and development have increased considerably.

Many researchers have recently suggested that entrepreneurial activities are important driving forces behind regional economic development, not only by paving the way for greater productivity, but also by delivering higher innovation through the development of new technologies (Wennekers and Thurik 1999, Acs, 2006; Audretsch et al., 2006). Drucker (1998) points out that innovation is a specific instrument of entrepreneurial activity, entrepreneurs create new innovations which offer new opportunities for other entrepreneurs, thereby contribute to economic growth. In addition, Guerrero and Peña-Legazkue (2013) argue that investment in R&D and innovation is not enough to induce economic

[5] In the former model scale economies and the dominance of large firms were prominent, while in the later model entrepreneurs are regarded as micro drivers of innovation and economic growth. In other words, the importance of economies of scale and scope has declined and the role of new and small firms in innovation and economic development has increased again.

growth alone, if there is not an ability to turn them into economic value. The ability they mean here is entrepreneurship. Braunerhjelm (2010) points to another feature of entrepreneurship, expressing that entrepreneurship serves as a conduit for knowledge spillover, transforms knowledge into innovations and it is a crucial vehicle for transforming them into useful goods and services that result in economic growth. As a result, entrepreneurship and innovation are interdependent (Svensson, 2010) and have widely been recognized as two essential phenomena that realize economic growth. As asserted by Keilbach, Tamvada and Audretsch (2009) lack of understanding of entrepreneurship means lack of understanding of modern economic growth. There are also a number of studies which provide empirical evidence suggesting that both entrepreneurship and innovation have crucial impact on economic growth and development (see Acs et al., 2004; Acs and Szerb, 2007; Audretsch and Keilbach, 2008; van Stel, Carree, and Thurik, 2005).

3. Economic Development Levels and Entrepreneurship and Innovation Rates of the Regions

The main purpose of this section is to provide information on the economic development levels and entrepreneurship and innovation capacities of the 26 NUTS II regions of Turkey. Changes in the regional levels and capacities were addressed over four years such as 1995, 2000, 2005, and 2010.

3.1. Economic Development Levels of the Regions

As an important indicator of economic development level, the Gross Domestic Product per capita (GDP per capita) were used to demonstrate the economic development levels of NUTS II regions of Turkey. The data of this indicator were derived from Turkish Statistical Institute (TurkStat) and it was available for the period of 1987 to 2011. GDP per capita was calculated by dividing the GDP value by the total population of each region.

Figure 1 shows the annual changes in GDP per capita of Turkey. The level of GDP per capita slowly increased up to 1998, while it decreased between the period of 1998-2001. The Marmara Earthquake happened in 1999 and the financial crises experienced in 2001 played important roles in that reduction.

However, compared to the previous periods, especially after 2001 the growth rate of GDP per capita considerably increased. As experienced in the whole world

the 2008 mortgage crisis had a declining effect on the economic development level of Turkey. After that crisis, the GDP per capita level has steadily increased.

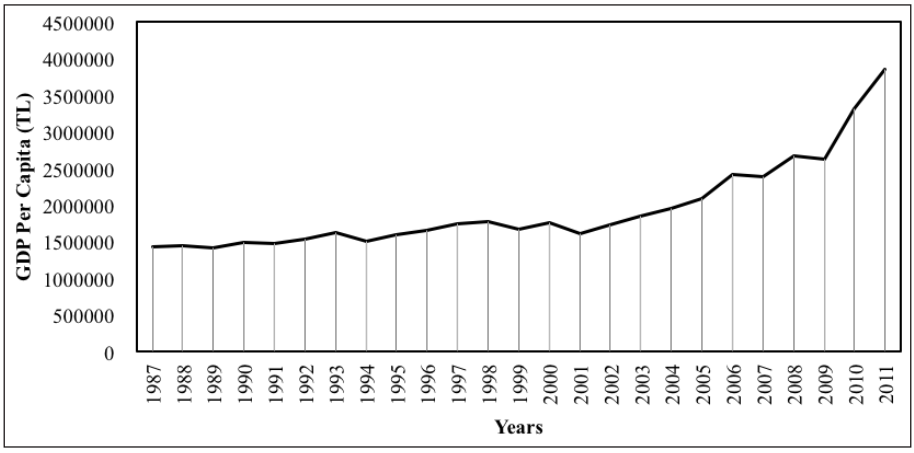

Figure 1. GDP per Capita of Turkey (1987 fixed price), between 1987 to 2011
(Source: TurkStat)

The spatial distribution of GDP per capita levels of NUTS II regions is shown in Figure 2. The figure indicates four different periods and gives opportunity to compare both the differences between the regions and the periods. As indicated in the figure and descriptive statistics (see Appendix Table 1A), the levels of GDP per capita vary substantially between both the regions and the periods. Descriptive statistics indicate that the average GDP per capita level has substantially increased over time (e.g., increased by 105.9 percent between 1995 and 2010), but on the other side, the variance among the economic development levels of the regions has also increased, such as the variance raised by 122.5 percent between 1995 and 2010. These results, in fact, show that on the one hand, the regions have developed over the years, on the other hand, the gap between the economic development levels of the regions has not declined, but it has increased. In other words, as seen in the figure, while the regions in the East and Southeast of Turkey, mainly based on basic economic activities such as agriculture, have always the lowest levels of GDP per capita, the regions in the Marmara, Aegean, and Mediterranean, specialized on service and manufacturing sectors, have the highest levels of GDP per capita.

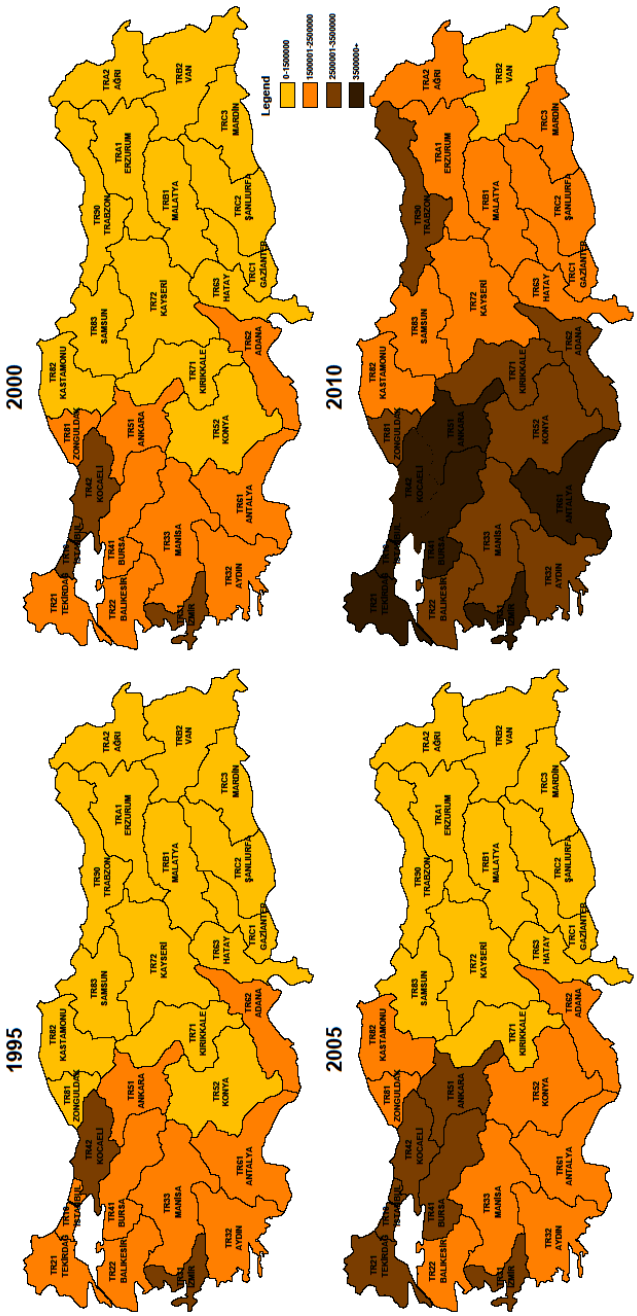

Figure 2. The economic development levels of the NUTS II regions (measured by GDP per capita, 1987 fixed prices)
(Source: Created by author using TurkStat data)

3.2. Entrepreneurial Capacities of the Regions

The concept of entrepreneurship is a multidimensional and there are different definitions of the term. Many researchers have focused on diverse aspects of the functional role of entrepreneurship in the economic development theories and models, and thus there is a number of definition of entrepreneurship in the literature. Schumpeter (1934), for example, has defined the entrepreneur as innovator and creative destructor, while Knight (1942) has identified the entrepreneur as a person taking risks and bearing uncertainties, and Kirzner (1979) identifies the entrepreneur as opportunity seeker. Therefore, the measurement issue of entrepreneurship has become a major topic of debate among researchers. Researchers, in that sense, have used different proxies of entrepreneurship while measuring entrepreneurship in empirical analyses.

In the empirical literature, self-employment rate (or business ownership rate) and the rate of new firm entries are the most commonly used measures of the entrepreneurship (Acs and Armington, 2004; van Stel and Suddle, 2008; Audretsch and Keilbach, 2007). In this respect, this paper used firm birth rate as a proxy of entrepreneurship. Data on new firm entries and exits were taken from the Turkish Statistical Institute (TurkStat) and The Union of Chambers and Commodity Exchanges of Turkey (TOBB). This study calculated the entrepreneurial capacities of each region based on Labor Market Approach which means that dividing the total number of firm entries by the total number of labor force and then, multiplying by one thousand.

The Figure 3 demonstrates the spatial patterns of entrepreneurship levels of the NUTS II regions. As indicated in the figure and Appendix Table 1A, there are significant differences between both entrepreneurship levels of the regions and the years. The figure and the descriptive statistics show that the entrepreneurship levels of the regions have raised over the years, such as while the average firm birth rate was 0.35 in 1995, it was 0.45, 0.71, and 0.75 in 2000, 2005, and 2010, respectively. This development can be explained by the increase in the number of new incentives and regulations that have facilitated the formation of new firms in Turkey since the 1990s. It is also clear that the variations in the rates of new firm formation of the regions have substantially changed across the years. The variance in the rate of new firm formation was 0.07 in 1995, while it increased up to 0.13 in 2000 and 0.20 in 2005, and declined to 0.13 in 2010. Furthermore, data on firm formation rates show that the top five regions in 1995 had 6 times larger firm birth rate than the bottom five regions.

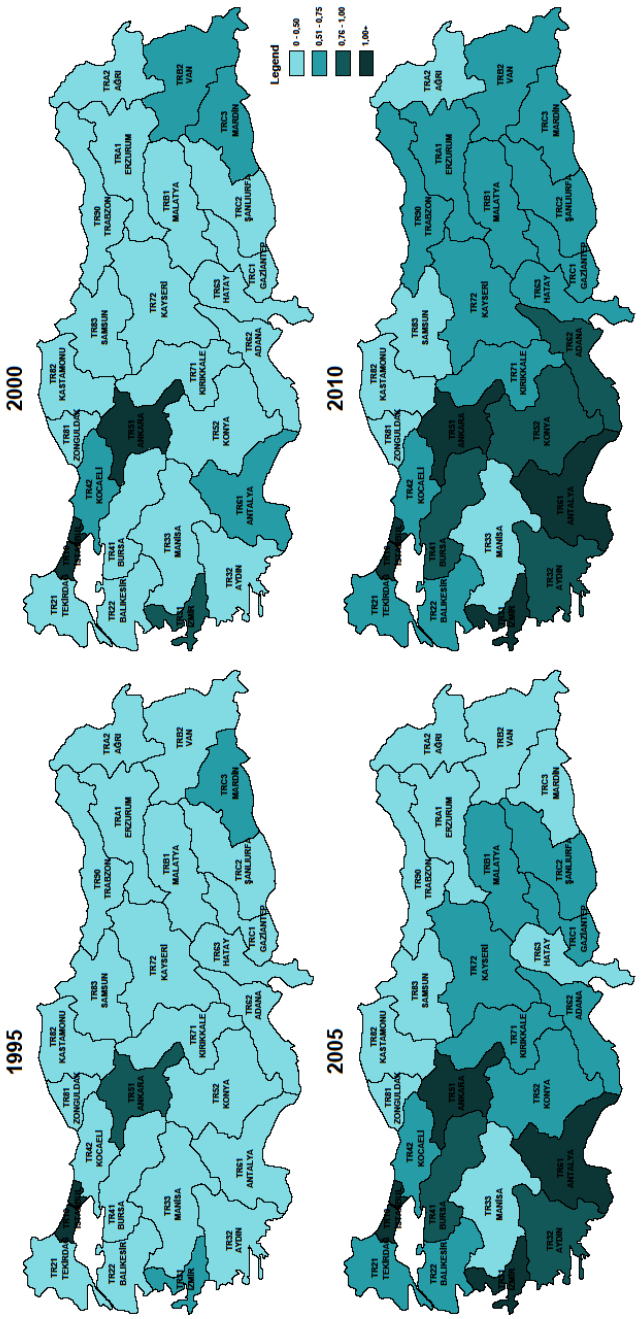

Figure 3. Entrepreneurship capacities of the NUTS II regions (measured as firm birth rate per 1000 labour force)

(Source: Created by author using TurkStat and TOBB data)

However, this variation has decreased over the years and it was about 5 in 2000, 4 in 2005 and less than 3 in 2010. All these show that the entrepreneurial capacities of all regions have gradually developed, but on the other side, the gap between the regions is slowly closing. As a result, while the regions located in the western Turkey, which also have the highest economic development levels, have the highest entrepreneurship levels, the backward regions which mostly located in the eastern and south-eastern part of the country have the lowest levels.

Besides these, Figure 4 indicates the relationship between GDP per capita and new firm birth rates for the year 2010. In this respect, regions are categorized into four groups. As seen in the figure, there is a strong association between the economic development levels and entrepreneurship rates of the regions. As reported in Table 5, the correlation between the two variables is positive and statistically significant, ($r(24) = 0.54,\ p < 0.01$). These results are highly consistent with the rhetoric of "*entrepreneurship is the essential driver of regional economic development*", which is frequently emphasized in the literature.

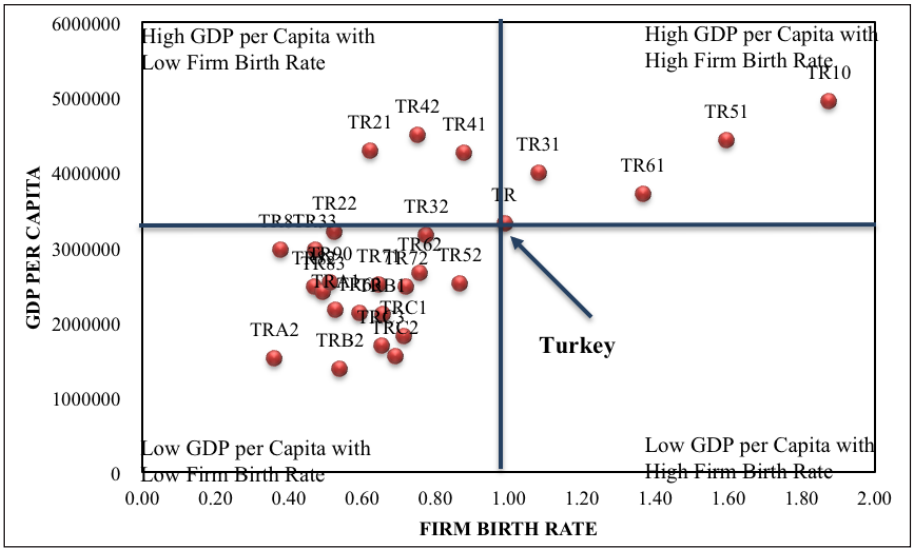

Figure 4. The relationship between GDP per Capita levels and firm birth rates, 2010

(Source: Created by author using TurkStat and TOBB data)

3.3. Innovative Capacities of the Regions

Entrepreneurship is widely considered as the source of changes and innovations that lead to productivity enhancement and economic competitiveness. According to the literature, as technological development is necessary to boost the efficiency of resource and growth, technological improvements are seen as the primary source of economic development. Hence, technological changes and innovations have become the most important determinants of regional economic growth. In this regard, the levels of innovative activities are included in this study.

The empirical literature has used different proxies for measuring innovation. The most common measures of innovation are the number of patents, total R&D expenditures, the percent of productions that occur with high-tech sector, and the share of high-tech firms (Camp, 2005). In this study, the number of patent applications, as well as utility model, trademark and industrial design applications were used as the measure of innovation. Data of innovation were obtained from Turkish Patent Institute (TPI) which was available for the period of 1995-2010 both at national and regional (NUTS 2) levels. The innovation capacity of the regions was found by dividing the number of patent, utility model, trademark and industrial design applications by total population, and then multiplied by a hundred thousand.

Figure 5, indicating spatial distribution of the innovation capacities of the regions, demonstrates that there are significant variations among the innovation capacities of the regions and between the years. For example, the highest innovation rate in 1995 was 99.83, while the lowest rate was only 0.16. In other words, the most innovative regions, İstanbul, had a 641 times higher innovation rate than the least innovative region, Ağrı, in 1995. However, the difference between the most innovative and the least innovative regions gradually declined over time and it became 98, 38, and 36 in 2000, 2005, and 2010, respectively. On the other hand, the average innovation rate of Turkey has showed a significant improvement such as; while the average innovation rate was 20 in 1995, it was 26, 49, and 66 in 2000, 2005, and 2010, respectively. Considering the variances between the regions, there was a ten-fold difference between 1995 and 2010 (see Appendix Table 1A). In fact, all these show that although all regions have paid a special emphasize on the improvement its innovative capability, the developed regions have made much more progress in innovation activities.

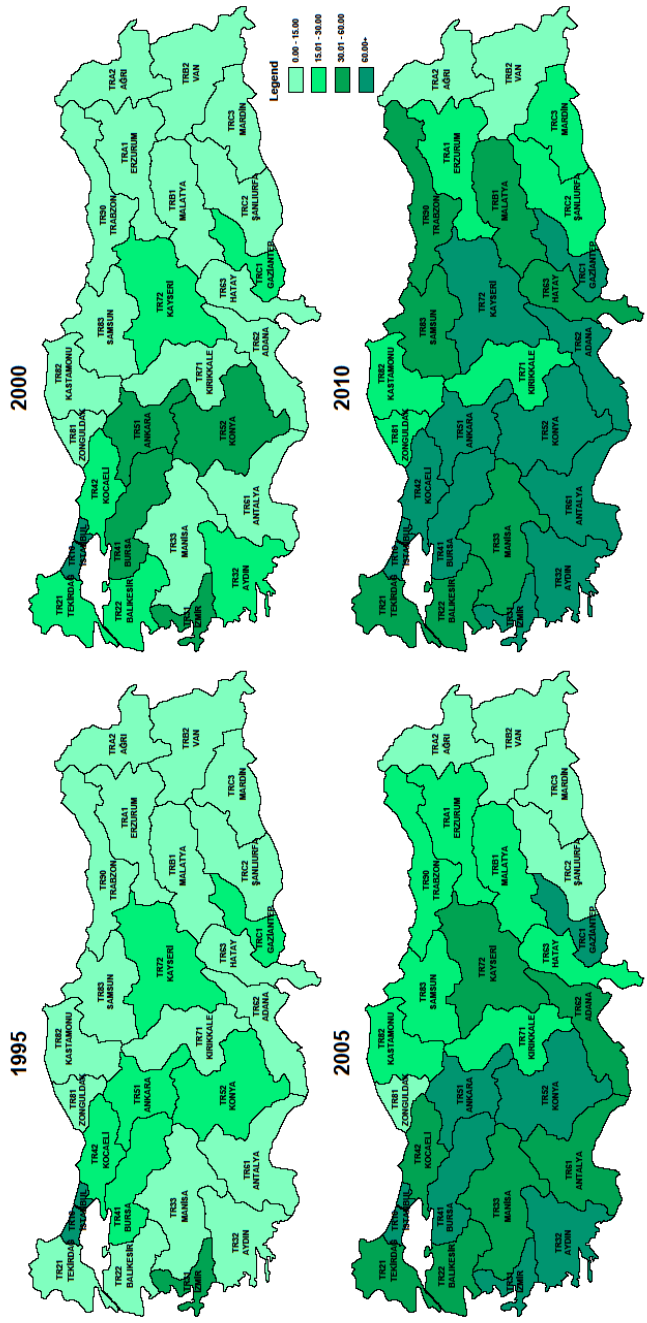

Figure 5. Innovative capacities of the NUTS II regions
(Source: Created by author using TPI data)

In addition, the relationship between innovation rates and regional economic development levels were demonstrated in Figure 6 for the year 2010. The regions are categorized into four groups in terms of their innovation capacities and economic development levels. Figure 6 strongly suggests that the relationships between GDP per capita levels and innovation rates of the regions were highly strong. The correlation table (see Table 5) also confirmed this relationship, indicating a positive and significant association among the variables, ($r(24) = .779$, $p < .01$). These results are highly consistent with innovation literature and support the hypotheses of the paper. However, only three regions, TR21, TR42, and TR61, had high GDP per capita levels and low innovation rates. This implies that these regions had different economic development drivers and sources. According to the figure there were no regions with high innovation rates and low GDP per capita levels.

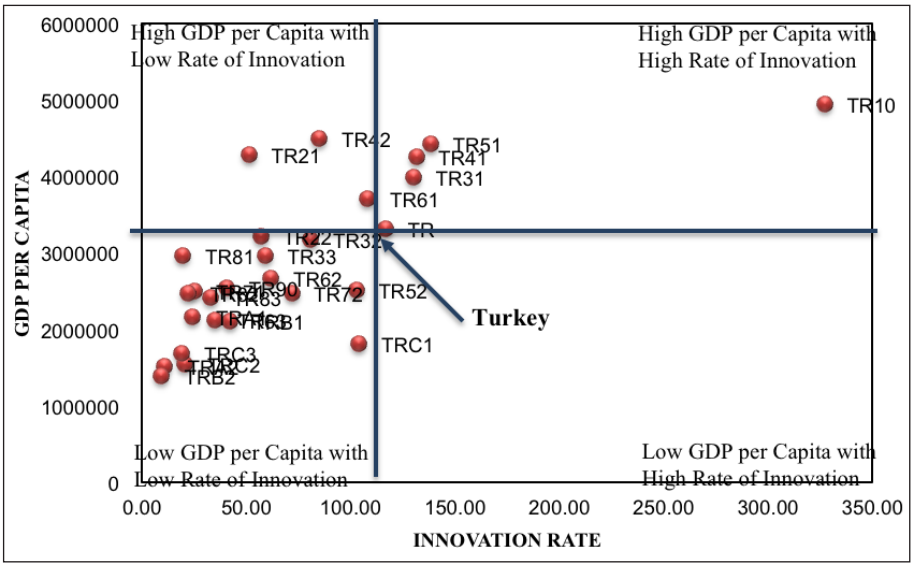

Figure 6. The relationship between GDP per capita levels and innovation rates, 2010

(Source: Created by author using TurkStat and TPI data)

Besides, to illustrate the link between entrepreneurship and innovation rates of the regions Figure 7 was created. Similar to above figure, there is a strong as-

sociation between entrepreneurship and innovation levels of the regions. Table 5 also shows a positive and significant association between the variables, ($r(24) = .759$, $p < .01$). This result confirms the arguments in both the entrepreneurship and innovation literature and supports the main hypothesis of this paper. Moreover, to evaluate together with the above results, these analyses show that there are strong and positive relationships between the three variables: entrepreneurship, innovation and economic development level. In other words, region with high rate of entrepreneurship and innovation also have high level of economic development.

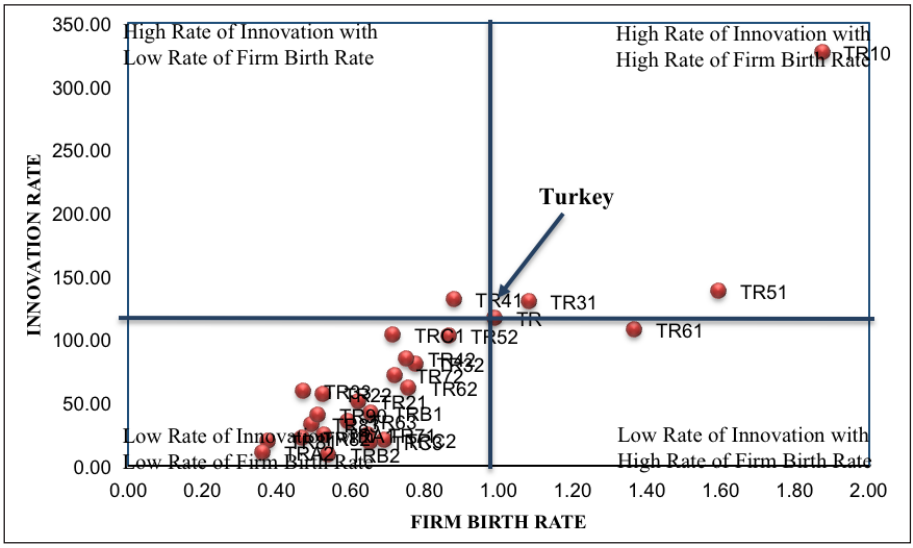

Figure 7. The relationship between firm birth rates and innovation rates, 2010
(Source: Created by author using TurkStat, TOBB and TPI data)

4. Methodology

4.1. Methods and Data Measurements

As a practitioner of creative destruction, entrepreneurship is widely recognized as the source of new ideas, knowledge spillover, inventions and innovations and thus, it is accepted as a key driver of regional economic development and competitiveness. In this respect, the main aim of this study is to examine the relationship between entrepreneurship and regional economic development lev-

el through the mediator role of innovation. The paper tries to answer the question "*how does innovation influence the association between entrepreneurship, measured as firm birth rate, and regional economic development level, measured as GDP per capita*". Based on this research question the study hypothesized that *regions with higher rates of entrepreneurship and innovation are expected to have higher levels of economic development*. The paper has conducted analyses for 26 NUTS II regions of Turkey and for four different periods, namely 1995, 2000, 2005, and 2010.

4.2. Empirical Models

In order to explore the mediator role of innovation in the link between entrepreneurship and regional economic development level, the study has used mediation analysis through the macro PROCESS Procedures in SPSS with 5,000 resamples (Preacher and Hayes, 2004). The macro PROCESS Procedures calculates confidence intervals of the indirect effects of independent variables on dependent variables through mediators by a 95 percent bootstrap confidence interval (Preacher and Hayes, 2008).

The structure of the mediation analysis for this paper will be as follows:

- Outcome (Y) = Regional economic development level (measured by GDP per capita)
- Predictor (X) = Entrepreneurship Rate (measured by firm birth rate)
- Mediator (M) = Innovation Rate (measured by aggregate rate of patent, utility model, trademark and industrial design applications).

Figure 8 shows the mediated relationship between firm birth rate, innovation rate and GDP per capita.

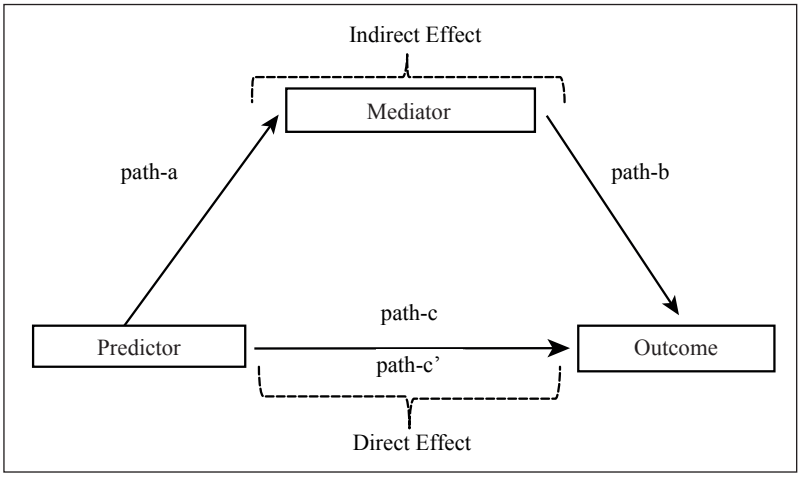

Figure 8. Mediated relationship *(Source: Hayes, 2013)*

While path-a, -b, and -c demonstrates the direct association between variables, the combination of path-a and path-b shows the indirect effect of entrepreneurship on regional economic development through innovation. The significances of all these direct effects are not required for the significance of indirect effect. In other words, an indirect effect can exist in the absence of direct effects in the model (Rucker et al., 2011).

The data used in these analyses were taken from different sources such as Turkish Statistical Institute (TurkStat), The Union of Chambers and Commodity Exchanges of Turkey (TOBB), and Turkish Patent Institute (TPI). The data of Gross Domestic Products (GDP), total number of new firms, and innovation (patent, utility model, and industrial design applications) were available for the four different periods of analyses. The definitions and normalization methods of data are indicated in Table 1.

Table 1. Definition and data sources of variables

Dependent Variable	GDPpc	Gross Domestic Products (GDP) per capita, 1987 fixed prices	TurkStat
Independent Variable	Firm Birth Rate	Firm births per 1000 labour force	TurkStat and TOBB
Mediator	Innovation Rate	Total innovative activities (patent, utility model, trademark and industrial design applications) per one hundred thousand population	TPI

5. Empirical Analyses and Results

Prior to analyses, the study performed the normality tests and the findings showed that the data of firm birth rate and innovation rate were not normally distributed and their skewness and kurtosis outside the rage of -1 to +1. Therefore, the natural logarithm was used to reduce skewness and kurtosis of the variables (Tabachnick and Fidell, 1996). In addition, the study checked the missing data, outliers, heterogeneity, heteroscedasticity, autocorrelation, and multicollinearity of the variables for different periods.

5.1. Mediating Role of Innovative Activity in Predicting Regional Economic Development Level, period of 1995

Table 2 demonstrates the mean, standard deviation and correlations among entrepreneurship, economic development level and innovation. As shown in the table, while innovation rate was positively and significantly correlated with firm birth rate and GDP per capita, the correlation between firm birth rate and economic development level (GDPpc) was not significant, but the coefficient was positive. This implies that regions with higher rates of innovation had higher levels of GDP per capita and entrepreneurship rates. The results are highly consistent with entrepreneurship literature and the hypotheses.

Table 2. Means, standard deviations and correlations among variables, period of 1995

	Variables	Mean	Std. Deviation	1	2	3
1	**Firm Birth Rate**	0.350	0.270	1		
2	**GDP per Capita**	1389383	689184	0.358	1	
3	**Rate of Innovation**	12.86	20.05	0.399*	0.814**	1

Note: **p<0.01; *p<0.05 (2-tailed)

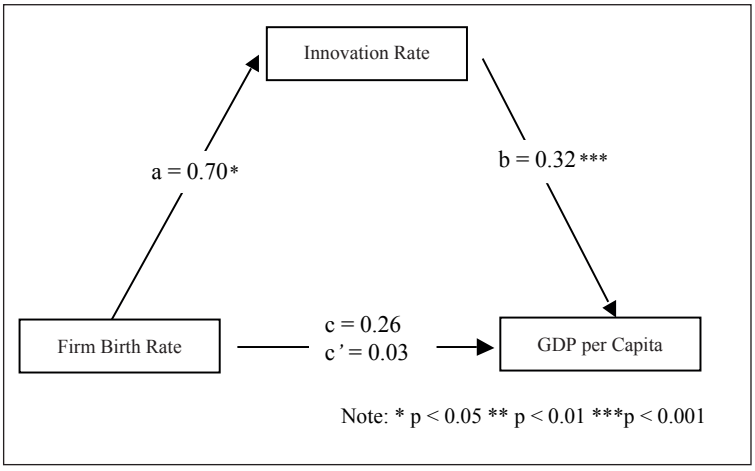

Figure 9. Mediation analysis results, period of 1995

Figure 9 presents the findings of mediation analysis. Mediation analysis with 5000 resamples (Preacher and Hayes, 2008) was performed to examine how the association between new firm formation and economic development level (GDPpc) was mediated by innovation. Firstly, the results indicated that firm birth rate was positively and significantly related to innovation rate (path-a) (B= 0.70, $t(24) = 2.13$, $p < 0.05$). It was also found that the relationship between mediator, innovation rate, and GDP per capita was positive and significant (path-b) (B= 0.32, $t(23) = 6.05$, $p < 0.001$). On the other hand, the direct and total effect of firm birth rate on GDP per capita was found to be non-significant (path-c') (B= 0.03, $t(23) = 0.30$, $p > 0.05$), and (path-c) (B= 0.26, $t(24) = 1.88$, $p > 0.05$), respectively. The results of the mediation analysis suggested that as confidence interval for

the indirect effect of innovation rate include zero, the mediator role of innovative activity between new firm formation and regional economic development was not statistically significant (B= 0.23; C.I. = -0.01 to 0.53). In other words, the results imply that the interaction between innovation and entrepreneurship did not result in a higher level of economic development for 1995.

5.2. Mediating Role of Innovative Activity in Predicting Regional Economic Development Level, period of 2000

The correlations between variables (Table 3) were similar to the previous period.

Table 3. Means, standard deviations and correlations among variables, period of 2000

	Variables	Mean	Std. Deviation	1	2	3
1	**Firm Birth Rate**	0.453	0.362	1		
2	**GDP per Capita**	1540447	737883	0.309	1	
3	**Rate of Innovation**	21.64	25.99	0.437*	0.796**	1

Note: **p<0.01; *p<0.05 (2-tailed)

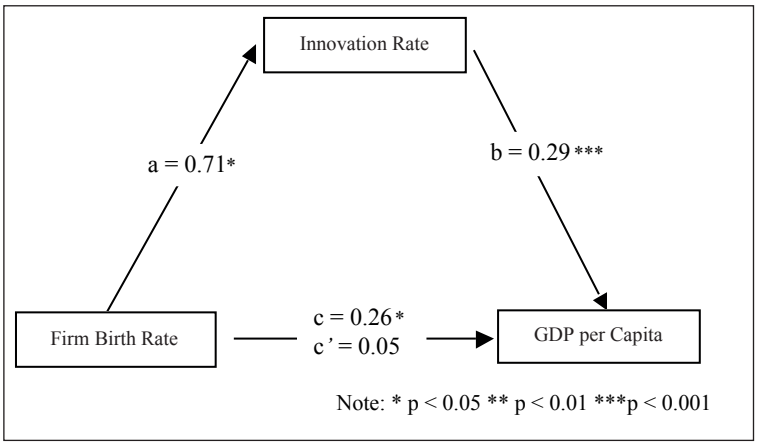

Figure 10. Mediation analysis results, period of 2000

As indicated in Figure 10, firm birth rate was positively and significantly related to the rate of innovation (path-a) (B= 0.71, $t(23) = 2.33$, $p < 0.05$), which in turn, the mediator had positive and significant effect on GDP per capita (path-b) (B= 0.29, $t(22) = 5.33$, $p < 0.001$). However, the direct effect of predictor, firm birth rate, on regional economic development was not statistically significant (path-c') (B= 0.05, $t(22) = 0.61$, $p > 0.05$), whereas its total effect was significant and positive (path-c) (B= 0.26, $t(23) = 2.21$, $p < 0.05$). The overall results indicated that because confidence interval for the indirect effect of innovative activity excluded zero, indirect effect of entrepreneurship on economic development was statistically significant and positive (B= 0.20; CI = 0.04 to 0.38). In other words, this implies the greater the rates of entrepreneurship and innovation, the higher the level of regional economic development. The model explained 17% of the variance; adjusted $R^2 = 0.17$, $F(1, 23) = 4.88$, $p < 0.05$.

5.3. Mediating Role of Innovative Activity in Predicting Regional Economic Development Level, period of 2005

The empirical results of the descriptive statistics and Pearson correlation are demonstrated in Table 4, and the results show that all variables were positively and significantly associated with each other. The results were consistent with entrepreneurship literature and the hypotheses of the paper.

Table 4. Means, standard deviations and correlations among variables, period of 2005

	Variables	Mean	Std. Deviation	1	2	3
1	**Firm Birth Rate**	0.709	0.449	1		
2	**GDP per Capita**	1780919	742301	0.691**	1	
3	**Rate of Innovation**	49.40	49.27	0.733**	0.775**	1

Note: **p<0.01; *p<0.05 (2-tailed)

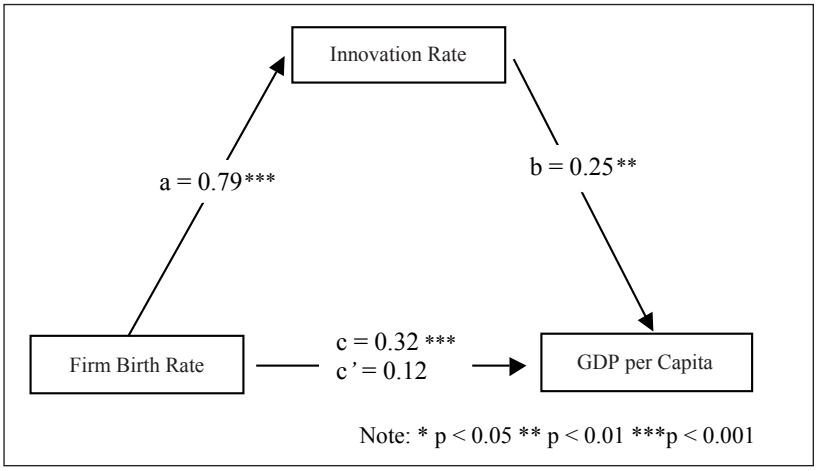

Figure 11. Mediation analysis results, period of 2005

The findings of the mediation analysis (Figure 11) demonstrated that there was a positive and significant relationship between new firm formation and innovative activity (path-a) (B= 0.79, t(24) = 5.27, p <0.001). It was also found that the mediator was positively and significantly associated with GDP per capita (path-b) (B= 0.25, t(23) = 3.12, p < 0.01). On the other hand, the direct effect of firm birth rate on regional economic development level was non-significant (path-c') (B= 0.12, t(23) = 1.44, p > 0.05), yet its total effect was positive and significant (path-c) (B= 0.32, t(24) = 4.69, p < 0.001). In addition, since confidence interval excluded zero, results of the mediation analysis confirmed the mediating role of innovation in the link between entrepreneurial activity and regional economic development level (B= 0.20; CI = 0.05 to 0.40), for the period of 2005. The model explained 48% of the variance; adjusted R^2 = 0.48, F(1, 24) = 21.98, p < 0.001.

5.4. Mediating Role of Innovative Activity in Predicting Regional Economic Development Level, period of 2010

The correlation results, which highly consistent with the literature, were similar to the previous period as indicated in Table 5.

Table 5. Means, standard deviations and correlations among variables, period of 2010

	Variables	Mean	Std. Deviation	1	2	3
1	**Firm Birth Rate**	0.750	0.363	1		
2	**GDP per Capita**	2860299	1028079	0.538**	1	
3	**Rate of Innovation**	69.52	65.83	0.759**	0.779**	1

Note: **p<0.01; *p<0.05 (2-tailed)

Looking the results of the mediation analysis (Figure 12), as expected, firm birth rate was found to be a significant and positive predictor of the innovation rate (path-a) (B= 1.20, $t(24) = 5.70$, $p < 0.001$). Besides, rate of innovation was positively and significantly associated with the level of regional economic development (path-b) (B= 0.30, $t(23) = 4.39$, $p < 0.001$). Yet, the direct effect of entrepreneurship variable was found to be negative and insignificant (path-c') (B= -0.07, $t(23) = -0.62$, $p > 0.05$). The negative coefficient may emerged due to the high correlation between firm birth rate and innovation rate. On the other hand, the total effect of firm birth rate on GDP per capita was highly significant and positive (path-c) (B=0.29, $t(24) = 3.13$, $p < 0.01$). The findings also indicated that as confidence interval for the indirect effect of new firm formation excluded zero, the mediator role of innovation between firm birth rate and GDP per capita was statistically significant (B= 0.36; CI = 0.18 to 0.54), for the period of 2010. The result suggest that the effect of entrepreneurship on regional economic development was mediated by innovation. The model explained 29 % of the variance; adjusted $R^2 = 0.29$, $F(1, 24) = 9.80$, $p < 0.001$.

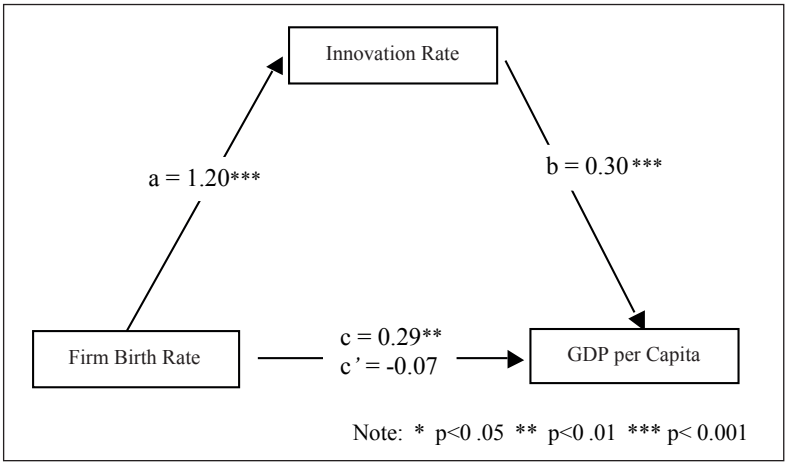

Figure 12. Mediation analysis results, period of 2010

6. Conclusion

Economists like Schumpeter (1942) and Baumol (1990) have determined the entrepreneur as an innovator and a vehicle of economic development and as the source of disequilibria in a market. Thus, entrepreneurship, which generates new opportunities in the market, has been widely recognized as an essential factor of regional economic development. In particular, after a shift form 'Managed Economy' to 'Entrepreneurial Economy' innovation and entrepreneurship have begun to be used as the key instruments of economic growth and development in many countries and regions.

This paper, in this regard, has investigated the relationship between entrepreneurial activity, innovation, and regional economic development. The paper has suggested that innovation is a mediator between new firm formation and regional economic development. In that sense, the study has tried to explore the contribution of innovative activities on the relationship between entrepreneurship and regional economic development in the context of 26 NUTS-II regions of Turkey.

The results of this paper provide ample evidence indicating that entrepreneurship has a crucial impact on the economic development of NUTS-II regions of Turkey through the innovation activities. In addition, the findings strongly

support the arguments in the literature and the main hypothesis of the paper suggesting that the interaction between entrepreneurship and innovation leads to higher economic development level. Consequently, the results of this paper have added new evidence on the importance of innovation and entrepreneurial activities for regional economic development.

The results of the paper may attract the attention of policymakers to develop new policies and strategies to support both innovation and entrepreneurial activities. In other words, to survive and grow in an increasingly competitive economic environment and to obtain a high level of economic development, regional entrepreneurship and innovation activities need to be supported. In this context, it is necessary to make important arrangements in legal environment and to introduce new incentive systems to facilitate the formation of new firms and innovation activities and to enable the survival and growth of the existing activities in regions.

In line with the EU acquis, Turkey, especially after the 2000s, has tried to create a favourable business environment for entrepreneurs by reducing the barriers in the market to the establishment of new firms. These efforts of Turkey has significantly contributed to the business environment in Turkey. According to the World Bank's Easy Doing Business Reports, in overall ranking Turkey improved from 84th among 175 countries in 2006 to 71st among 185 countries in 2012 and 2013, and then increased to 69th in 2014 and 55th in 2015, and finally decreased to 60th in 2017. These efforts also led to the development of innovation activities in Turkey. According to OECD (2017) Science and Technology data, the total R&D expenditure of Turkey in GDP was only 0.47 percent in 2000, but then it increased to 0.57 percent in 2005, and 0.80 percent in 2010, and 0.88 in 2017. Although Turkey has achieved an important progress in itself, these values remain very low compared to the average of OECD countries. For the same years, the average R&D expenditure of OECD countries in GDP was 2.12 percent in 2000, while it increased to 2.14 in 2005, 2.29 in 2010, and 2.38 in 2015. Similarly, compared to OECD countries, Turkey had a relatively low number of researchers per thousand labour force. For instance, while Turkey had 1.74 (2.51; 3.21) in 2005 (2010; 2015), the average of OECD countries was 6.55 (6.99; 7.75) in 2005 (2010; 2015).

These results suggest that especially after 2000s, Turkey has paid an increasing attention to the development of entrepreneurship and innovation activities. However, compared with other developed countries, the efforts and supports of Turkey aiming to create a conducive business environment for entrepreneurs seem to be inadequate. Therefore, policymakers in Turkey need to define specific procedures and supports for entrepreneurs, especially those who carry out innovative activities. In this respect, the government should make it easier for entrepreneurs to access financial resources, new markets, sufficient number of researchers, and consultancy services. In addition, the government should use public procurement instrument to stimulate innovation and entrepreneurial activities. Since the heavy tax burden is one of the most important problems faced by entrepreneurs in Turkey, the state should relieve the burden of entrepreneurs, especially for the first years of formation of the firms. Last but not least, the state should define a new and broader support system that can encourage young people, especially new university graduates, to produce innovative ideas and to put their ideas into practices.

The most important limitation of this study is the lack of adequate and appropriate data on innovation, entrepreneurship and economic development level. In Turkey there are no detailed data available regarding these three variables at the regional level (e.g., there is no innovation data based on the Oslo criteria, no entrepreneurship data based on the GEM, and no economic development data including social and cultural aspects of regions) so the proxies of these data described above were used. For further research, researchers may focus on the regional characteristics and factors that determine the levels and types of entrepreneurship and innovation. Another important issue worth investigating can be the impact of state subsidies and incentives on regional innovation and entrepreneurial activities.

Appendix

Table A. Descriptive statistics of the variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Variance
GDPpc_1995	26	317835	2983845	1389383	689184	474973979278
GDPpc_2000	26	417956	3091382	1540447	737883	544471574581
GDPpc_2005	26	775398	3372320	1780919	742301	551010542597
GDPpc_2010	26	1384745	4953090	2860299	1028079	1056945828416
Firm Birth Rate_1995	26	0.10	1.18	0.35	0.27	0.07
Firm Birth Rate_2000	26	0.16	1.65	0.45	0.36	0.13
Firm Birth Rate_2005	26	0.36	1.96	0.71	0.45	0.20
Firm Birth Rate_2010	26	0.36	1.87	0.75	0.36	0.13
Innovation Rate_1995	26	0.16	99.83	12.86	20.05	402.10
Innovation Rate _2000	26	1.23	119.76	21.64	25.99	675.26
Innovation Rate _2005	26	6.28	235.84	49.40	49.27	2427.67
Innovation Rate _2010	26	9.05	327.01	69.52	65.83	4334.08
Valid N (listwise)	26					

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