Influential Article Review - Innovation as a Driver of the Economy

Silvia Beck

Alonzo Miles

Angelo Lindsey

This paper examines economics and innovation. We present insights from a highly influential paper. Here are the highlights from this paper: The paper examines the long-run relationship between innovation and per capita economic growth in the 19 European countries over the period 1989–2014. This study uses six different indicators of innovation: patents-residents, patents-non-residents, research and development expenditure, researchers in research and development activities, high-technology exports, and scientific and technical journal articles to examine this long-run relationship with per capita economic growth. Using cointegration technique, the study finds evidence of long-run relationship between innovation and per capita economic growth in most of the cases, typically with reference to the use of a particular innovation indicator. Using Granger causality test, the study finds the presence of both unidirectional and bidirectional causality between innovation and per capita economic growth. These results vary from country to country, depending upon the types of innovation indicators that we use in the empirical investigation process. Most importantly, the study finds that all these innovation indicators are considerably linked with per capita economic growth. This particular linkage is either supply-leading or demand-following in some occasions, while it is the occurrence of both in some other occasions. The policy implication of this study is that countries should recognize the differences in innovation and per capita economic growth in order to maintain sustainable development in these countries. For our overseas readers, we then present the insights from this paper in Spanish, French, Portuguese, and German.

Keywords: Innovation, Per capita economic growth, Cointegration, Granger causality, European countries

SUMMARY

- The discussion begins with order of integration and cointegration between innovationFootnote14 and per capita economic growth. Using unit root , we reject the null hypothesis of unit root at the first difference but not at the level data. Table 5 presents these unit root test results, both for individual country and for the European panel.
- Results of unit root test. In the succeeding step, we deploy the Johansen Maximum Likelihood cointegration test at the individual country and Fisher cointegration test at the panel setting for checking the cointegration between innovation and per capita economic growth. The results of both the test statistics are reported in Tables 6, 7, and 8.

- The incidence of cointegration suggests that there is a long-run equilibrium relationship between innovation and per capita economic growth . On the contrary, the absence of cointegration indicates that there is no long-run relationship between these two variables. The summary of these cointegration test results are reported in Table 8.
- In the next section, we detect the Granger causality by deploying vector error correction model for the presence of cointegration between innovation and per capita economic growth, and simple vector autoregressive model for the absence of cointegration between the two.
- For countries like Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Romania, and the UK, we find the unidirectional causality from innovation to per capita economic growth , whereas for countries like Czech Republic, Denmark, Hungary, Ireland, and Norway, we find unidirectional causality from per capita economic growth to innovation , whereas for Finland, Germany, Greece, and Norway, we find unidirectional causality from per capita economic growth to innovation .
- For countries like Belgium, Denmark, Finland, France, Germany, Italy, Norway, Poland, Portugal, Sweden, and the UK, we detect the unidirectional causality from innovation to per capita economic growth , whereas for countries like Austria, Czech Republic, Ireland, the Netherlands, Romania, and Spain, we find the unidirectional causality from per capita economic growth to innovation .
- For Austria, Belgium, Czech Republic, France, Germany, Hungry, Italy, Portugal, and the UK, there is a unidirectional causality from innovation to per capita economic growth , whereas for Denmark, Finland, Ireland, the Netherlands, Norway, Poland, and Spain, we find per capita economic growth Granger-causes innovation , whereas for countries like Hungary, Italy, Norway, Poland, Portugal, Romania, and Spain, we find the presence of unidirectional causality from per capita economic growth to innovation .
- For countries like Finland, France, Hungary, Romania, and Spain, we detect the presence of unidirectional causality from innovation to per capita economic growth , whereas for countries like Austria, Belgium, Denmark, Germany, Ireland, Italy, and the UK, and the European panel, we find the presence of unidirectional causality from per capita economic growth to innovation .

HIGHLY INFLUENTIAL ARTICLE

We used the following article as a basis of our evaluation:

Maradana, R. P., Pradhan, R. P., Dash, S., Gaurav, K., Jayakumar, M., & Chatterjee, D. (2017). Does innovation promote economic growth? Evidence from European countries. Journal of Innovation and Entrepreneurship, 6(1), 1–23.

This is the link to the publisher's website:
https://innovation-entrepreneurship.springeropen.com/articles/10.1186/s13731-016-0061-9

INTRODUCTION

Why do some regions grow continuously for many years whereas others stagnate? Why do some regions grow faster than others? The theoretical breakthrough in answering these questions started by Solow (1956) and Romer (1990) has lost its momentum, leaving some important questions unanswered. Following the neoclassical growth and endogenous growth theories, technological advance is believed to be the major driver of economic growth, yet how exactly new knowledge translates into superior economic performance by regions was neither described by the growth theories nor found unequivocal empirical explanation. Empirical studies, lacking theoretical underpinnings, looked into networks (Wal and Boschma 2009), labour mobility (Almeida and Kogut 1999), and other potential facilitators of spillovers (Tsvetkova 2015).

In the recent years, both researchers and policymakers have increasingly paid attention to investigate the link between innovation, entrepreneurship, and regional outcomes (Galindo and Mendez-Picazo 2014; Grossman 2009; Howells 2005; Malerba and Brusoni 2007; Tsvetkova 2015; Wang et al. 2005). However, in this paper, we specificallyFootnote1 look into the linkage between innovationFootnote2 and economic growth in the selected European countries. Innovation is considered as one of the key drivers of the economy (Andergassen et al. 2009; Bae and Yoo 2015; Mansfield 1972; Nadiri 1993; Romer 1986; Santacreu 2015; Solow 1956), particularly since the seminal work of SchumpeterFootnote3 (1911). It affects the economy in multiple channels, such as economic growth, global competitiveness, financial systems, quality of life, infrastructure development, employment, trade openness, and hence, spawns high economic growth.Footnote4 All these above studies mostly focus on the impact of innovation towards economic growth, indicating the supply-driven approach of innovation-growth nexus. But in reality, it is the economic growth that can also increase the level of innovation in the development process. That means there is a feasibility of bidirectional causality between innovation and economic growth (Pradhan et al. 2016). Hence, the main objective of this paper is to examine the bidirectional linkage between innovation and economic growth. In sum, we would like to assess the importance of innovation-economic growth linkage, by investigating whether the level of innovation has contributed to economic growth, or whether the extension of the innovation is simply a consequence of rapid economic growth.

In this paper, we utilize the Granger causality approach to examine the dynamics between innovation and economic growth for a sample of 19 European countries. The main contribution of the study is twofold. First, we specifically assess the importance of innovation activities on economic growth, by investigating whether the innovation activities have contributed to economic growth, or whether the expansion of innovation activities are simply a consequence of rapid economic growth. The Granger causality approach has been deployed to carry out this investigation.Footnote5 Second, our data set is more recent and comprehensive (i.e. 1989–2014) in contrast to existing studies.

The rest of the paper is sketched as follows. The “Theoretical basis and literature review” section presents the theoretical basis and literature review. The “An outline of innovation in the European countries” section summarizes the status of innovation in the European countries. The “Proposed hypotheses, variables, data structure, and model” section describes the proposed hypothesis, variables, data, and model. The “Results and discussion” section presents the results and discussion. Finally, we summarize and conclude in the “Conclusion” section.

CONCLUSION

The level and structure of innovation should not be ignored because it plays an imperative role in stimulating economic growth (Pradhan et al. 2016; Hassan and Tucci 2010). This study explored the Granger causal nexus between innovation and per capita economic growth for the 19 European countries using time series data from 1989 to 2014. The pivotal message from our study for the policymakers and academicians alike is that implications drawn from research on per capita economic growth that disregard the dynamic interrelation of the two variables will be imperfect. It is the conjoined back-and-forth relationship between innovation and per capita economic growth that builds our study and guides the future research on this topic.

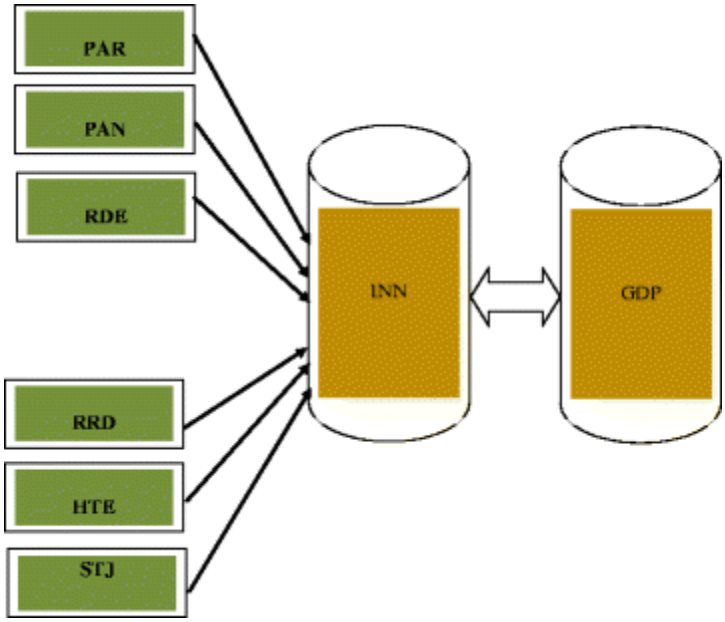
Our study acknowledges mixed evidence on the relationship between the innovation and per capita economic growth in the 19 European countries, both at the individual country and at the panel setting. In some instances, per capita economic growth leads to innovation, lending support to demand-following hypothesis of innovation-growth nexus. In some other instances, it is innovation that regulates the level of per capita economic growth, lending support to supply-leading hypothesis of innovation-growth nexus. There are also circumstances, where innovation and per capita economic growth are mutually interdependent. That is the situation where both are self-reinforcing and offer support to feedback hypothesis of innovation-growth nexus. Additionally, there are also cases where innovation and per capita economic growth are independent of each other. That is the situation where both are neutral and offer support to neutrality hypothesis of innovation-growth nexus.

The study accordingly suggests that in order to promote per capita economic growth, attention must be paid to policy strategies that promote innovation. Given the possibility of reverse causality or bidirectional causality for some cases, policies that increase per capita economic growth (such as actions to increase investment) would be desirable to bring more innovation in the economy. Consequently, it is suggested that government should play a more positive role in order to foster innovation and then integrate it with per capita economic growth. No doubt, in recent times, many countries including European countries have recognized the importance of innovation for high economic growth and consequently, they have increased their effort to have more innovation in their countries. Nonetheless, what is needed is that government of the respective countries should pay higher attention to bring the steady environment in order to promote the link between innovation and per capita economic growth. This requires the followings. First, government everywhere can acknowledge the importance of innovation for long-term growth. This is most evident in those countries where the easy options have been exhausted and future growth depends on more efficient ways of combining inputs or producing new or improved outputs. Second, government can nurture innovation indirectly by providing an appropriate environment for firms that are willing to invest more and innovate. They can also support innovation directly, by either funding public research or encouraging private investment in research and innovation. The cited examples are through innovation-related tax incentives and grants. Third, there is requirement of policy options for sector-wise level importance, depending upon the particular requirement of country's development. This requires governments to make difficult choices, striking a balance between improvements in the general environment for innovation and direct support for innovation, targeted or not to specific (groups of) actors. The combination of policy objectives and instruments should be tailored to a country's level of development and the strengths and weaknesses of its innovation system, so it should vary both across countries and over time (see, for instance, Veugelers and Schweiger 2016).

Over and above, our study is strictly constrained to examine the causal nexus between innovation activities and economic growth. So, we have not included other relevant factors, such as capital, labour, infrastructure, entrepreneurship, and venture capital (see, for instance, Galindo and Mendez-Picazo (2014), Navas (2015), Samila and Sorenson (2011), Santacreu (2015)), in our empirical investigation process. The inclusion of these factors may affect our main findings and this could be a subject of future research. Additionally, the other limitations do exist in this study. First, no indirect or complementary effects on the nexus between innovation activities and economic growth; second, exclusion of sector-wise impact of innovation activities on economic growth; third, small time-dimension of data, i.e. from 1989 to 2014; and fourth, the findings are regulated to European countries only. Consequently, further study in these mutable areas can produce more inspiring and spontaneous findings to the nexus between innovation and economic growth.

APPENDIX

FIGURE 1
CONCEPTUAL FRAMEWORK OF THE CAUSALITY BETWEEN INNOVATION AND PER CAPITA ECONOMIC GROWTH



Note 1: GDP is per capita economic growth and INN is innovation and used as a proxy for PAR, PAN, RDE, RRD, HTE, and STJ. Note 2: PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is the researchers in research and development activities, HTE is the high-technology exports, and STJ is the scientific and technical journal articles

TABLE 1
DEFINITION OF VARIABLES

Variable code	Variable definition
GDP	Per capita economic growth: expansion of a country's economy, expressed in per capita gross domestic product.
PAR	Patents filed by residents: expressed in numbers per thousand population.
PAN	Patents filed by non-residents: expressed in numbers per thousand population.
RDE	Research and development expenditure: expressed as a percentage of real gross domestic product.
RRD	Researchers in research and development activities: expressed in numbers per thousand population.
HTE	High-technology exports: expressed as a percentage of real gross domestic product.
STJ	Scientific and technical journal articles: expressed in numbers per thousand population.

Variables above are defined in the World Development Indicators of World Bank

TABLE 2
TREND OF INNOVATION (PER THOUSAND POPULATION) IN EUROPEAN COUNTRIES

Countries	PAR				PAN				RDE			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
Austria	0.25	0.26	0.27	0.26	0.06	0.03	0.03	0.05	1.77	2.29	2.76	2.28
Belgium	0.07	0.05	0.06	0.06	0.04	0.02	0.01	0.03	1.87	1.90	2.12	1.95
Czech Republic	0.06	0.06	0.08	0.07	0.33	0.19	0.01	0.19	1.07	1.23	1.51	1.26
Denmark	0.25	0.32	0.27	0.28	0.14	0.03	0.03	0.08	1.99	2.49	2.99	2.53
Finland	0.44	0.38	0.32	0.39	0.38	0.04	0.02	0.20	2.93	3.43	3.77	3.38
France	0.22	0.22	0.22	0.22	0.06	0.05	0.03	0.05	2.18	2.15	2.23	2.18
Germany	0.48	0.59	0.58	0.54	0.11	0.14	0.16	0.13	2.32	2.51	2.83	2.55
Greece	0.02	0.04	0.06	0.04	0.02	0.01	0.01	0.01	0.53	0.58	0.68	0.59
Hungary	0.13	0.08	0.07	0.10	0.18	0.23	0.01	0.15	0.70	0.95	1.17	0.94
Ireland	0.23	0.21	0.14	0.20	0.35	0.02	0.01	0.18	1.22	1.19	1.64	1.33
Italy	0.13	0.16	0.14	0.15	0.01	0.01	0.01	0.15	1.02	1.11	1.25	1.13
Netherlands	0.14	0.13	0.15	0.14	0.04	0.03	0.02	0.03	1.96	1.89	1.92	1.91
Norway	0.26	0.25	0.23	0.25	1.04	1.08	0.32	0.88	1.63	1.59	1.67	1.62
Poland	0.08	0.06	0.09	0.08	0.06	0.09	0.01	0.05	0.66	0.57	0.74	0.64
Portugal	0.01	0.01	0.05	0.02	0.10	0.01	0.01	0.05	0.63	0.84	1.55	0.99
Romania	0.09	0.05	0.06	0.07	0.02	0.01	0.01	0.01	0.51	0.42	0.50	0.47
Spain	0.06	0.07	0.07	0.06	0.02	0.01	0.01	0.01	0.85	1.09	1.36	1.09
Sweden	0.43	0.33	0.24	0.35	0.10	0.06	0.03	0.07	3.52	3.70	3.50	3.59
United Kingdom	0.33	0.32	0.25	0.31	0.16	0.17	0.19	0.15	1.77	1.73	1.77	1.75
European panel[#]	3.68	3.59	3.35	3.59	3.22	2.23	0.93	2.47	1.49	1.66	1.93	1.80

PAR is number of patents by residents, PAN is number of patents by non-residents, and RDE is research and development expenditure. P1 is 1989–2000, P2 is 2001–2007, P3 is 2008–2014, and P4 is 1989–2014
#The figures are average of all 19 European countries

TABLE 3
TREND OF INNOVATION (PER THOUSAND POPULATION) IN EUROPEAN COUNTRIES

Countries	RRD				HTE				STJ			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
Austria	0.29	0.41	0.51	0.45	24.7	49.1	48.7	36.9	0.43	0.57	0.59	0.50
Belgium	0.27	0.30	0.34	0.30	58.0	67.4	87.6	73.2	0.55	0.62	0.68	0.61
Czech Republic	0.12	0.19	0.27	0.19	0.88	2.56	4.79	2.84	0.23	0.30	0.39	0.30
Denmark	0.63	0.89	1.21	0.95	4.24	6.09	5.28	5.01	0.82	0.93	1.01	0.89
Finland	1.17	1.45	1.42	1.37	67.8	70.8	34.3	48.3	0.90	0.95	0.93	0.85
France	0.04	0.05	0.06	0.05	38.1	38.2	49.2	37.9	0.51	0.49	0.49	0.48
Germany	0.04	0.04	0.05	0.04	35.5	54.9	63.9	45.7	0.51	0.53	0.55	0.50
Greece	0.12	0.15	0.20	0.15	4.77	4.78	5.15	4.01	0.26	0.37	0.43	0.29
Hungary	0.11	0.15	0.21	0.16	0.57	0.24	0.64	0.44	0.19	0.24	0.24	0.22
Ireland	0.54	0.64	0.73	0.64	294.8	201.6	134.6	201.2	0.38	0.48	0.64	0.43
Italy	0.02	0.02	0.03	0.02	15.6	16.1	17.4	16.4	0.35	0.42	0.45	0.41
Netherlands	0.16	0.18	0.19	0.18	73.3	102.2	96.2	86.9	0.75	0.81	0.91	0.81
Norway	0.92	1.01	1.12	1.07	1.37	1.51	1.57	1.53	0.69	0.76	0.92	0.85
Poland	0.03	0.04	0.04	0.04	1.04	2.09	5.65	2.98	0.13	0.17	0.19	0.16
Portugal	0.14	0.20	0.41	0.24	8.51	15.5	10.4	11.9	0.14	0.27	0.40	0.26
Romania	0.05	0.04	0.04	0.05	4.70	3.22	6.10	4.59	0.04	0.04	0.07	0.05
Spain	0.04	0.05	0.06	0.05	11.3	10.5	11.8	11.1	0.34	0.41	0.47	0.41
Sweden	0.51	0.61	0.56	0.59	6.51	5.26	4.52	4.98	1.12	1.10	1.02	1.06
United Kingdom	0.04	0.06	0.06	0.06	68.9	60.1	34.7	54.1	0.80	0.76	0.74	0.77
European panel[#]	0.27	0.33	0.40	0.33	52.2	38.2	34.5	44.1	1.01	0.57	0.62	0.53

RRD is researchers in research and development activities, HTE is high-technology exports, and STJ is scientific and technical journal articles. P1 is 1989–2000, P2 is 2001–2007, P3 is 2008–2014, and P4 is 1989–2014
#The figures are average of all 19 European countries

TABLE 4
DESCRIPTIVE STATISTICS OF THE VARIABLES

Countries	**Variables**					
	PAR	**PAN**	**RDE**	**RRD**	**THE**	**STJ**
Austria	−0.57/0.03	−1.44/0.07	0.38/0.06	−0.36/0.08	0.68/0.08	−0.24/0.02
Belgium	−1.27/0.05	−1.81/0.13	0.29/0.02	−0.51/0.03	0.85/0.07	−0.20/0.03
Czech Republic	−1.20/0.06	−0.10/0.73	0.08/0.06	−0.75/0.15	−0.69/0.30	−0.53/0.10
Denmark	−0.53/0.04	−1.50/0.08	0.40/0.07	−0.04/0.11	−0.25/0.06	−0.03/0.03
Finland	−0.41/0.07	−1.42/0.16	0.53/0.04	0.13/0.05	0.77/0.15	−0.03/0.01
France	−0.65/0.01	−1.35/0.14	0.34/0.01	−1.29/0.05	0.60/0.05	−0.31/0.01
Germany	−0.24/0.02	−0.86/0.05	0.40/0.03	−1.40/0.05	069/0.12	−0.28/0.02
Greece	−1.40/0.13	−2.57/0.18	−0.24/0.05	−0.85/0.11	−0.35/0.10	−0.47/0.12
Hungary	−1.14/0.04	−1.26/0.80	−0.04/0.09	−0.82/0.11	−1.32/0.25	−0.64/0.04
Ireland	−0.69/0.10	−1.67/0.19	0.11/0.06	−0.20/0.05	1.31/0.14	−0.32/0.10
Italy	−0.86/0.05	−1.74/0.12	0.06/0.05	−1.60/0.07	0.22/0.03	−0.38/0.05
Netherlands	−0.84/0.03	−1.54/0.15	0.28/0.02	−0.75/0.04	0.98/0.06	−0.08/0.03
Norway	−0.60/0.04	−0.15/0.35	0.21/0.02	0.01/0.03	−0.82/0.02	−0.10/0.10
Poland	−1.19/0.07	−1.40/0.57	−0.20/0.05	−1.40/0.03	−0.69/0.30	−0.79/0.08

Portugal	−1.79/0.31	−2.29/0.18	−0.05/0.16	−0.68/0.19	0.05/0.17	−0.62/0.19
Romania	−1.28/0.11	−2.14/0.49	−0.34/0.08	−1.35/0.06	−0.37/0.17	−1.31/0.11
Spain	−1.17/0.05	−2.10/0.18	0.03/0.09	−1.30/0.10	0.03/0.04	−0.40/0.06
Sweden	−0.51/0.12	−1.27/0.17	0.56/0.02	−0.24/0.04	−0.29/0.07	0.03/0.02
United Kingdom	−0.51/0.06	−0.82/0.10	0.24/0.01	−1.24/0.07	0.74/0.12	−0.12/0.01
European panel[#]	−0.89/0.42	−1.47/0.62	0.16/0.26	−0.79/0.53	0.13/0.74	−0.37/0.34

PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. Values reported here are natural logs of the variables

#The reported statistics are calculated at the panel level

TABLE 5
RESULTS OF UNIT ROOT TEST

Countries	**Variables**						
	PAR	**PAN**	**RDE**	**RRD**	**HTE**	**STJ**	**GDP**
	LD/FD	**LD/FD**	**LD/FD**	**LD/FD**	**LD/FD**	**LD/FD**	**LD/FD**
Austria	0.14/−5.40*	1.82/−7.46*	3.81/−2.39**	−0.67/−3.22*	1.57/−5.10*	−1.30/−2.64**	−0.74/−5.64*
Belgium	0.05/−4.65*	1.06/−5.89*	1.81/−2.56**	−0.62/−2.46**	2.28/−2.96*	−1.32/−10.0*	−0.54/−5.84*
Czech Republic	−0.23/−2.33**	0.52/−2.36**	2.85/−1.89***	−1.31/−2.73**	−0.43/−2.06***	−0.69/−4.03*	−0.82/−6.61*
Denmark	−0.40/−5.90*	0.62/−6.66*	1.87/−1.98***	−0.99/−5.07*	−1.64/−6.91*	−0.34/−4.42*	−0.68/−7.68*
Finland	1.02/−4.07*	0.92/−3.91*	−0.22/−1.65***	0.43/−3.33*	−0.49/−3.32*	−1.25/−12.5*	−0.55/−3.49*

France	−0.31/−5.96*	0.63/−2.90*	−0.09/−3.52*	1.02/−5.83*	1.75/−5.14*	−0.76/−3.74*	−0.74/−5.73*
Germany	−1.11/−2.44**	−1.21/−3.09*	3.12/−2.44**	−1.63/−2.28**	1.99/−3.55*	−0.38/−3.81*	−1.16/−4.60*
Greece	−1.06/−5.36*	1.23/−5.27*	–/–	–/–	−1.56/−6.67*	−0.88/−2.39***	0.80/−3.63*
Hungary	1.63/−2.96*	0.73/−3.54*	−1.12/−2.84**	−1.79/−5.70*	1.41/−4.81*	−1.16/−4.44*	−1.40/−4.71*
Ireland	1.90/−2.83*	0.69/−3.75*	1.43/−1.88***	−3.93/−1.88***	−0.62/−2.96*	−0.77/−2.42**	−0.80/−3.12*
Italy	0.15/−3.03*	−0.94/−4.40*	1.46/−2.65**	−1.13/−3.88*	0.90/−7.60*	−0.29/−2.32**	−0.92/−6.04*
Netherlands	0.04/−4.52*	0.89/−3.21*	0.43/−2.47**	−1.54/−4.54*	1.08/−3.96*	−1.91/−2.23**	−0.65/−5.87*
Norway	0.17/−6.18*	−0.70/−2.83**	0.04/−2.47**	0.10/−2.72**	−0.24/−5.46*	−0.43/−3.54*	−0.23/−5.89*
Poland	0.22/−3.34*	0.47/−3.75*	−0.90/−2.02**	−2.49/−4.00*	−0.95/−2.37**	−0.46/−1.87***	−0.33/−5.20*
Portugal	−1.81/−4.83*	0.71/−3.88*	−1.59/−1.59***	−3.54/−1.84***	−2.10/−4.74*	−0.90/−2.88*	−1.10/−5.81*
Romania	0.80/−4.88*	0.47/−4.10*	0.23/−2.70**	0.82/−4.02*	−4.62/−2.51**	−1.92/−5.11*	1.58/−4.88*
Spain	−0.78/−5.21*	2.30/−4.59*	−1.67/−2.14**	−2.66/−2.66**	−0.93/−3.69*	−0.54/−2.53**	−0.67/−6.30*
Sweden	1.08/−3.28*	1.53/−5.36*	−1.27/−4.47*	0.14/−3.80*	−0.74/−4.93*	−1.46/−1.94***	−2.32/−7.96*
United Kingdom	0.90/−2.25**	−0.08/−2.32**	−0.54/−4.16*	−1.11/−2.50**	−0.97/−2.18***	−1.08/−4.06*	−0.69/−6.84*
European panel[#]	50.5/136.7*	14.8/129.1*	23.4/122.7*	18.0/95.4*	50.7/144.1*	113.3/104.1*	34.2/197.5*

PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. The investigation is done at three levels—no trend and intercept, with intercept, and with both intercept and trend. The results are more or less uniform; however, the reported statistics in the table present the ADF statistics at no trend and no intercept

*Statistical significance at 1% level; **statistical significance at 5% level; ***statistical significance at 10% level
#The reported statistics are calculated at the panel level

TABLE 6
RESULTS OF JOHANSEN-JUSELIUS COINTEGRATION TEST (MAX TEST)

Countries	**Cointegration with GDP**					
	PAR	**PAN**	**RDE**	**RRD**	**HTE**	**STJ**
Austria	14.5*/4.55*	15.9/* 7.73*	24.1*/10.2*	13.7/3.35	14.8/0.85	18.3*/5.67*
Belgium	28.8*/1.95	8.97/2.87	9.75/0.81	13.8/1.26	10.2/0.16	14.7*/5.74*
Czech Republic	9.93/0.07	12.3/0.48	14.1/2.52	13.3/0.57	13.9/4.34	10.4/0.67
Denmark	9.43/1.55	36.6*/7.46*	23.9*/3.18	1.9/1.61	20.7*/3.51	16.1*/0.83
Finland	13.5/0.11	17.1*/5.76*	18.4*/4.52*	7.43/0.15	17.*/0.15	38.2*/14.6*
France	18.8*/3.53	22.0*/0.97	12.3/2.74	15.5*/0.20	13.9/1.51	22.2*/7.72*
Germany	16.4*/7.96*	15.4*/0.81	12.2/0.48	11.4/0.78	17.4*/0.37	20.2*/5.09*
Greece	9.43/0.01	10.9/1.17	–/–	–/–	3.99/0.01	9.63/2.46
Hungary	11.4/3.60	18.96*/2.89	9.52/0.01	15.0*/0.43	13.7/5.46*	13.7/2.29
Ireland	5.78/0.14	10.2/0.18	12.0/0.31	12.5/0.11	10.2/0.78	7.45/2.56
Italy	–/–	–/–	13.1/0.19	12.3/0.01	16.2*/0.74	30.9*/8.71*
Netherlands	8.80/3.55	20.5*/5.00*	20.3*/2.88	11.3/0.01	18.4*/5.07*	15.0*/1.07
Norway	14.7*/3.25	13.4/0.04	18.3*/3.96*	20.2*/5.26*	18.5*/3.40	11.7/0.41
Poland	12.2/0.04	8.28/0.58	12.8/0.01	14.2*/0.18	10.2/0.30	13.9/2.54
Portugal	14.8*/0.46	8.83/3.38	13.4/1.78	10.3/0.03	11.5/2.66	17.4*/4.45*
Romania	10.10/4.31	8.50/0.45	24.4*/0.01	39.9*/9.95*	17.2*/4.97*	8.05/0.06
Spain	13.3/1.53	10.05/1.61	17.0*/3.79	20.2*/6.72*	15.0*/4.55*	20.3*/4.82*

Sweden	15.7*/0.44	12.3/0.03	8.61/2.36	10.9/1.19	16.6*/4.56*	21.8*/5.57*
United Kingdom	11.57/0.26	17.6*/3.83	20.5*/4.77*	19.9*/7.82*	14.2*/0.01	20.2*/4.87*
European panel	107.9*/77.8*	104.5*/58.6*	99.56*/79.17*	108.9*/76.37*	128.5*/68.73*	96.1*/64.6*

PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. We observe statistical significance at 5% level

*Indicates the statistical significance of the cointegrating vector and confines the presence of cointegration between innovation and per capita economic growth

TABLE 7
RESULTS OF JOHANSEN-JUSELIUS COINTEGRATION TEST (TRACE TEST)

Countries	**Cointegration with GDP**					
	PAR	**PAN**	**RDE**	**RRD**	**HTE**	**STJ**
Austria	19.6*/4.55*	21.2*/7.30*	13.9*/10.2*	10.3/3.35	13.9/0.90	16.6*/5.66*
Belgium	30.7/1.95	11.8/2.87	8.93/0.82	12.5/1.26	10.0/0.16	8.91/5.74
Czech Republic	9.99/0.07	12.8/0.48	11.6/2.52	12.7/0.57	9.61/4.34	9.75/0.67
Denmark	10.9/1.55	44.1*/7.46*	20.7*/3.18	10.3/1.61	17.1*/3.50	18.2*/0.83
Finland	13.6/0.11	22.9*/5.76*	18.8*/4.52*	7.29/0.15	17.1*/0.15	23.5*/14.6*
France	18.3*/3.43	23.1*/0.97	9.55/2.74	15.3*/0.20	12.4/1.51	13.5*/7.72*
Germany	24.3*/7.96*	16.2*/0.81	11.7/0.48	10.6/0.78	17.0*/0.37	15.1*/5.09*
Greece	9.43/0.01	12.0/1.17	–/–	–/–	3.99/0.01	7.17/2.46
Hungary	14.9*/3.60	21.9*/2.89	9.56/0.01	15.0*/0.43	8.24/5.46*	11.4/2.29
Ireland	5.92/0.14	10.4/0.18	11.7/0.31	12.4/0.11	9.39/0.78	4.89/2.56
Italy	–/–	–/–	12.97/0.16	12.3/0.01	15.5*/0.75	22.2*/8.71*
Netherlands	14.4*/3.55	20.5*/5.00*	17.4*/2.88	11.3/0.01	18.3*/5.07*	14.8*/1.07
Norway	17.9*/3.26	13.45/0.04	14.5*/3.96*	17.9*/5.26*	15.1*/3.40	11.7/0.41
Poland	12.2/0.04	8.28/0.58	12.8/0.01	14.0*/0.18	9.85/0.30	11.3/2.54
Portugal	15.3*/0.46	14.2/3.38	11.6/1.78	10.3/0.03	8.79/2.66	12.97*/4.45*

Romania	14.4/3.31	8.95/0.45	24.4*/0.01	29.9*/9.95*	12.2*/4.97*	4.99/0.06
Spain	14.9*/1.53	11.6/1.61	17.3*/3.79	13.5*/6.72*	20.5*/4.55*	15.2*/4.82*
Sweden	16.2*/0.44	12.4/0.03	6.25/2.37	9.67/1.19	12.0*/4.56*	16.3*/5.57*
United Kingdom	11.8/0.26	21.4*/3.83	15.76/4.77*	22.0*/7.82*	14.6/0.01	15.3*/4.87*
European panel	128.3*/77.83*	112.2*/58.63*	80.21*/79.17*	88.87*/76.37*	112.5*/68.73*	96.1*/64.6*

PAR is number of patents by residents; PAN is number of patents by non-residents; RDE is research and development expenditure; RRD is researchers in research and development activities; HTE is high-technology exports; STJ is scientific and technical journal articles; and GDP is per capita economic growth. We observe statistical significance at 5% level

*Indicates the statistical significance of the cointegrating vector and confines the presence of cointegration between innovation and per capita economic growth

TABLE 8
SUMMARY OF COINTEGRATION TEST RESULTS

Cointegrated status					
Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
Austria (2)	Austria (2)	Austria (2)	Austria (0)	Austria (0)	Austria (2)
Belgium (1)	Belgium (0)	Belgium (0)	Belgium (0)	Belgium (0)	Belgium (2)
CR (0)	CR (0)	CR (0)	CR (0)	CR (0)	CR (0)
Denmark (0)	Denmark (2)	Denmark (1)	Denmark (0)	Denmark (1)	Denmark (0)
Finland (0)	Finland (2)	Finland (2)	Finland (0)	Finland (1)	Finland (2)
France (1)	France (1)	France (0)	France (1)	France (0)	France (2)
Germany (2)	Germany (1)	Germany (0)	Germany (0)	Germany (1)	Germany (2)
Greece (0)	Greece (0)	Greece (0)	Greece (0)	Greece (0)	Greece (0)
Hungary (0)	Hungary (1)	Hungary (0)	Hungary (1)	Hungary (1)	Hungary (0)
Ireland (0)	Ireland (0)	Ireland (0)	Ireland (0)	Ireland (0)	Ireland (0)
Italy (0)	Italy (0)	Italy (0)	Italy (0)	Italy (1)	Italy (2)
Netherlands (0)	Netherlands (2)	Netherlands (1)	Netherlands (0)	Netherlands (2)	Netherlands (1)
Norway (1)	Norway (0)	Norway (2)	Norway (2)	Norway (1)	Norway (0)
Poland (0)	Poland (0)	Poland (0)	Poland (1)	Poland (0)	Poland (0)

Portugal (1)	Portugal (0)	Portugal (0)	Portugal (0)	Portugal (0)	Portugal (2)
Romania (0)	Romania (0)	Romania (1)	Romania (2)	Romania (2)	Romania (0)
Spain (0)	Spain (0)	Spain (2)	Spain (2)	Spain (2)	Spain (2)
Sweden (1)	Sweden (0)	Sweden (0)	Sweden (0)	Sweden (2)	Sweden (2)
UK (0)	UK (2)	UK (2)	UK (2)	UK (1)	UK (2)
EP (2)	EP (2)	EP (2)	EP (2)	EP (2)	EP (2)

Case 1: cointegration between PAR and GDP; case 2: cointegration between PAN and GDP; case 3: cointegration between RDE and GDP; case 4: cointegration between RRD and GDP; case 5: cointegration between HTE and GDP; case 6: cointegration between STJ and GDP. PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. 0 stands for absence of cointegration between innovation (PAR/PAN/RDE/RRD/HTE/STJ) and per capita economic growth, 1 stands for presence of one cointegrating vector between innovation (PAR/PAN/RDE/RRD/HTE/STJ) and per capita economic growth, and 2 stands for presence of two cointegrating vectors between innovation (PAR/PAN/RDE/RRD/HTE/STJ) and per capita economic growth. Parentheses indicate number of cointegrating vector (s). Results are derived on the basis of Tables 6 and 7 results
CR Czech Republic, UK United Kingdom, EP European panel

TABLE 9
RESULTS OF TEST FROM ERROR CORRECTION MODEL

Countries	**Granger causality test between**					
	PAR and GDP		**PAN and GDP**		**RDE and GDP**	
	Short-run	**Long-run**	**Short-run**	**Long-run**	**Short-run**	**Long-run**
Austria	4.90*/4.16*	−3.39*/−1.33	8.97*/−1.90	−1.79/−1.03	0.634/6.37*	−0.25/−4.17*
Belgium	18.9*/1.21	−2.46/−0.53	3.62**/1.48	−2.12/1.13	3.55*/0.28	NA/NA
Czech Republic	1.62/4.35*	NA/NA	3.27**/0.74	NA/NA	1.17/4.91*	NA/NA
Denmark	0.42/4.32**	NA/NA	3.16**/9.69*	−1.83/−3.21**	20.6*/0.11	−6.03*/−2.67
Finland	4.32*/0.31	NA/NA	0.57/5.29*	−1.20/2.03	4.39*/1.08	−1.56/1.75
France	3.19**/0.60	−2.83/−1.12	13.8*/2.57	2.91/−1.41	3.93*/2.00	NA/NA
Germany	3.34**/1.01	−3.27*/−0.82	0.72/12.2*	−4.03*/−2.92**	9.32*/1.24	NA/NA

Greece	6.73*/0.12	NA/NA	1.09/8.64*	NA/NA	–/–	–/–
Hungary	1.51/5.58*	NA/NA	4.50*/5.28*	−2.03/−1.57	4.77*/1.94	NA/NA
Ireland	0.63/3.95*	NA/NA	3.25**/5.63*	NA/NA	0.33/4.33	NA/NA
Italy	6.74*/0.71	NA/NA	0.49/1.87	NA/NA	5.09*/1.50	NA/NA
Netherlands	3.26**/0.90	NA/NA	3.64**/2.23	−2.38/−1.57	0.34/4.44*	−2.52/−0.33
Norway	2.83/14.5*	−0.85/−5.06*	1.62/23.8*	NA/NA	4.72*/0.79	0.30/−1.60
Poland	14.3*/5.46*	NA/NA	0.67/1.42	NA/NA	3.97*/1.78	NA/NA
Portugal	5.19*/1.20	−3.69***/1.28	4.09**/16.8*	NA/NA	10.3*/0.21	NA/NA
Romania	5.10*/0.86	NA/NA	3.69*/2.07	NA/NA	0.80/5.37*	−4.41/−3.07**
Spain	4.21*/4.56*	NA/NA	5.42*/0.96	NA/NA	0.23/7.71*	−1.73/−3.03**
Sweden	8.93*/13.5*	−4.10*/−2.33	7.15*/0.13	NA/NA	3.36*/2.28	NA/NA
United Kingdom	2.99**/0.33	NA/NA	10.1*/3.81**	−4.69*/−2.97**	3.69*/1.94	−1.16/−2.19
European panel	5.91*/10.1*	−6.09*/−2.60	0.45/6.61*	−6.23*/−2.38	2.84*/6.08*	−5.34*/−1.14

GDP is per capita economic growth; PAR is the number of patents by residents; PAN is the number of patents by non-residents; and RDE is research and development expenditure. The short-run causality is detected through the Wald statistics, while long-run causality is detected through the statistical significance of error correction term. For both short-run and long-run, the first value represents GDP as the dependent variable and the second value represents innovation (PAR/PAN/RDE) as the dependent variable

*Indicates the statistical significance at 5% level; **indicates the statistical significance at 10% level

TABLE 10
RESULTS OF TEST FROM ERROR CORRECTION MODEL

Countries	**Granger causality test between**					
	RRD and GDP		**HTE and GDP**		**STJ and GDP**	
	Short-run	**Long-run**	**Short-run**	**Long-run**	**Short-run**	**Long-run**

Austria	3.20**/0.40	NA/NA	0.89/0.63	−3.18**/−0.99	1.64/6.54*	−1.53/−2.13
Belgium	13.6*/1.19	NA/NA	3.40*/0.48	NA/NA	0.32/5.03*	−1.29/−2.85
Czech Republic	5.14*/0.41	NA/NA	1.76/0.01	NA/NA	1.27/0.43	NA/NA
Denmark	0.46/5.28*	NA/NA	0.51/0.19	−1.92/−2.26	0.06/21.1*	−1.96/−4.13*
Finland	0.07/25.3*	NA/NA	18.3*/3.73**	−3.46**/−0.32	36.8*/0.92	−6.10/−2.12
France	3.12**/2.12	−2.35/−1.13	3.41*/0.09	NA/NA	8.21*/0.44	−0.66/−5.31*
Germany	5.31*/0.18	NA/NA	12.2*/3.07**	−5.94*/−1.82	0.40/4.06*	−2.65/−1.93
Greece	–/–	–/–	1.33/1.85	–/–	8.49*/5.33*	–/–
Hungary	7.12*/0.46	−4.14*/−1.26	1.20/19.6*	−2.25/−4.37*	5.29*/0.97	NA/NA
Ireland	0.99/3.62**	NA/NA	18.1*/0.26	NA/NA	2.02/4.19*	NA/NA
Italy	4.43*/0.47	NA/NA	2.10/9.59*	−3.64*/−2.07	0.02/11.4	−0.65/−4.68*
Netherlands	1.34/6.33*	NA/NA	7.60*/1.18	0.22/−2.65	3.51*/5.59*	NA/NA
Norway	0.01/5.86*	NA/NA	0.90/4.97*	−0.16/−3.90*	2.89**/6.04*	NA/NA
Poland	0.75/5.68*	−0.86/−1.90	0.67/3.03**	NA/NA	3.48**/3.05**	NA/NA
Portugal	9.83*/1.46	NA/NA	1.33/3.53*	NA/NA	17.9*/3.57**	−4.52*/−1.35
Romania	3.84*/3.74*	−7.97*/1.96	0.50/3.66*	−1.26/−3.61**	3.87*/1.85	NA/NA
Spain	0.15/6.46*	−0.62/−3.14	1.04/11.3*	NA/NA	5.58*/2.05	−1.15/−4.73*

Sweden	1.45/0.15	NA/NA	3.26*/0.87	−3.52**/−0.66	8.15*/4.55*	NA/NA
United Kingdom	9.47*/2.25	NA/NA	25.9*/0.82	NA/NA	1.14/9.10*	NA/NA
European panel	3.03*/2.95*	−6.15*/−1.23	7.95*/4.41*	−6.31*/−1.69	2.13/6.88*	−7.09*/−2.56

RRD is the researchers in research and development activities; HTE is the high-technology exports; STJ is the scientific and technical journal articles; and GDP is per capita economic growth. The short-run causality is detected through the Wald statistics, while long-run causality is detected through the statistical significance of error correction term. For both short-run and long-run, the first value represents GDP as the dependent variable and the second value represents innovation (RRD/HTE/STJ) as the dependent variable

*Indicates the statistical significance at 5% level; **indicates the statistical significance at 10% level

TABLE 11
SUMMARY OF GRANGER CAUSALITY TEST

Countries	**Nature of Granger causality between**					
	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
	PAR and GDP	**PAN and GDP**	**RDE and GDP**	**RRD and GDP**	**HTE and GDP**	**STJ and GDP**
Austria	FBH	SLH	DFH	SLH	NEH	DFH
Belgium	SLH	SLH	SLH	SLH	SLH	DFH
Czech Republic	DFH	SLH	DFH	SLH	NEH	NEH
Denmark	DFH	FBH	SLH	DFH	NEH	DFH
Finland	SLH	DFH	SLH	DFH	FBH	SLH
France	SLH	SLH	SLH	SLH	SLH	SLH
Germany	SLH	DFH	SLH	SLH	FBH	DFH
Greece	SLH	DFH	–	–	NEH	FBH
Hungary	DFH	FBH	SLH	SLH	DFH	SLH
Ireland	DFH	FBH	DFH	DFH	SLH	DFH
Italy	SLH	NEH	SLH	SLH	DFH	DFH
Netherlands	SLH	SLH	DFH	DFH	SLH	FBH
Norway	DFH	DFH	SLH	DFH	DFH	FBH
Poland	FBH	NEH	SLH	DFH	DFH	FBH

Portugal	SLH	FBH	SLH	SLH	DFH	FBH
Romania	SLH	SLH	DFH	FBH	DFH	SLH
Spain	FBH	SLH	DFH	DFH	DFH	SLH
Sweden	FBH	SLH	SLH	NEH	SLH	FBH
United Kingdom	SLH	FBH	SLH	SLH	SLH	DFH
European panel	FBH	DFH	FBH	FBH	FBH	DFH

Case 1: cointegration between PAR and GDP; case 2: cointegration between PAN and GDP; case 3: cointegration between RDE and GDP; case 4: cointegration between RRD and GDP; case 5: cointegration between HTE and GDP; case 6: cointegration between STJ and GDP. PAR is number of patents by residents, PAN is number of patents by non-residents, RDE is research and development expenditure, RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. SLH indicates the unidirectional causality from innovation to economic growth, DFH indicates the unidirectional causality from economic growth to innovation, FBH indicates the bidirectional causality between innovation and economic growth, and NEH indicates no causal flow between innovation and economic growth. Results are derived on the basis of Tables 9 and 10 results

TABLE 12
SUMMARY OF GRANGER CAUSALITY TEST RESULTS

Supply-leading hypothesis of innovation-growth nexus			Demand-following hypothesis of innovation-growth nexus		
Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
	Austria				Austria
Belgium	Belgium	Belgium			Czech Republic
	Czech Republic		Czech Republic		Ireland
		Denmark			
Finland		Finland	Denmark		Netherlands
France	France	France		Finland	Romania
Germany		Germany		Germany	Spain
Greece		Hungary		Greece	
Italy	Italy	Italy	Hungary		
Netherlands	Netherlands	Norway	Ireland		
		Poland	Norway	Norway	

		Portugal		European panel	
Portugal		Sweden			
Romania	Romania	United Kingdom			
	Spain				
	Sweden				
United Kingdom					
Feedback hypothesis of innovation-growth nexus			Neutrality hypothesis of innovation-growth nexus		
Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Austria					
	Denmark	Finland			
		Greece			
	Hungary			Italy	
	Ireland	Ireland			
		Netherlands			
Poland					
	Portugal			Poland	
Spain					
Sweden					
	United Kingdom				
European panel		European panel			

Case 1: cointegration between PAR and GDP; case 2: cointegration between PAN and GDP; case 3: cointegration between RDE and GDP. PAR is the number of patents by residents, PAN is the number of patents by non-residents, RDE is research and development expenditure, and GDP is per capita economic growth. Results are derived on the basis of Table 11 results

TABLE 13
SUMMARY OF GRANGER CAUSALITY TEST RESULTS

Supply-leading hypothesis of innovation-growth nexus	Demand-following hypothesis of innovation-growth nexus

Case 4	Case 5	Case 6	Case 4	Case 5	Case 6
Austria					Austria
Belgium	Belgium				Belgium
Czech Republic		Finland	Czech Republic		
France	France	France	Denmark		Denmark
Germany		Hungary	Finland		
Greece				Finland	
Hungary					Germany
Italy	Italy			Hungary	Ireland
Portugal	Netherlands		Hungary	Norway	Italy
United Kingdom			Ireland	Poland	
			Netherlands	Portugal	
	Romania	Romania	Norway	Romania	
	Spain	Spain	Poland	Spain	United Kingdom
	Sweden		Portugal		European panel
Feedback hypothesis of innovation-growth nexus			Neutrality hypothesis of innovation-growth nexus		
Case 4	Case 5	Case 6	Case 4	Case 5	Case 6
Austria			United Kingdom	Austria	
	Finland	Netherlands		Czech Republic	Czech Republic
	Germany	Norway		Denmark	
		Poland		Greece	
	Ireland	Portugal			
		Sweden			
Poland					
	Portugal				
Spain					

Sweden					
	United Kingdom				
European panel	European panel				

Case 4: cointegration between RRD and GDP; Case 5: cointegration between HTE and GDP; Case 6: cointegration between STJ and GDP. RRD is researchers in research and development activities, HTE is high-technology exports, STJ is scientific and technical journal articles, and GDP is per capita economic growth. Results are derived on the basis of Table 11 results

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TRANSLATED VERSION: SPANISH

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSION TRADUCIDA: ESPAÑOL

A continuación se muestra una traducción aproximada de las ideas presentadas anteriormente. Esto se hizo para dar una comprensión general de las ideas presentadas en el documento. Por favor, disculpe cualquier error gramatical y no responsabilite a los autores originales de estos errores.

INTRODUCCIÓN

> ¿Por qué algunas regiones crecen continuamente durante muchos años mientras que otras se estanca? ¿Por qué algunas regiones crecen más rápido que otras? El avance teórico en la respuesta a estas preguntas iniciado por Solow (1956) y Romer (1990) ha perdido su impulso, dejando algunas preguntas importantes sin respuesta. Siguiendo el crecimiento neoclásico y las teorías de crecimiento endógena, se cree que el avance tecnológico es el principal motor del crecimiento económico, pero cómo exactamente los nuevos conocimientos se traducen en un desempeño económico superior por regiones no fue descrito por las teorías de crecimiento ni encontró una explicación empírica inequívoca. Los estudios empíricos, carentes de fundamentos teóricos, estudiaron redes (Wal y Boschma 2009), la movilidad laboral (Almeida y Kogut 1999) y otros facilitadores potenciales de los efectos de contagio (Tsvetkova 2015).

En los últimos años, tanto los investigadores como los responsables políticos han prestado cada vez más atención para investigar el vínculo entre la innovación, el emprendimiento y los resultados regionales (Galindo y Méndez-Picazo 2014; Grossman 2009; Howells 2005; Malerba y Brusoni 2007; Tsvetkova 2015; 2005). Sin embargo, en este documento, concretamente, en pie de la innovaciónfootnote2 y el crecimiento económico en los países europeos seleccionados. La innovación se considera uno de los motores clave de la economía (Andergassen et al. 2009; Bae y Yoo 2015; Mansfield 1972; Nadiri 1993; Romer 1986; Santacreu 2015; Solow 1956), particularmente desde la obra seminal de schumpeterfootnote3 (1911). Afecta a la economía en múltiples canales, como el crecimiento económico, la competitividad mundial, los sistemas financieros, la calidad de vida, el desarrollo de la infraestructura, el empleo, la apertura comercial y, por lo tanto, genera un alto crecimiento económico. Nota a pie de página Todos estos estudios anteriores se centran principalmente en el impacto de la innovación hacia el crecimiento económico, lo que indica el enfoque impulsado por la oferta del nexo innovación-crecimiento. Pero en realidad, es el crecimiento económico lo que también puede aumentar el nivel de innovación en el proceso de desarrollo. Esto significa que existe una viabilidad de causalidad bidireccional entre la innovación y el crecimiento económico (Pradhan et al. 2016). Por lo tanto, el objetivo principal de este documento es examinar la vinculación bidireccional entre la innovación y el crecimiento económico. En resumen, nos gustaría evaluar la importancia de la vinculación entre la innovación y el crecimiento económico, investigando si el nivel de innovación ha contribuido al crecimiento económico o si la extensión de la innovación es simplemente una consecuencia del rápido crecimiento económico.

En este documento, utilizamos el enfoque de causalidad de Granger para examinar la dinámica entre innovación y crecimiento económico para una muestra de 19 países europeos. La principal contribución del estudio es doble. En primer lugar, evaluamos específicamente la importancia de las actividades de innovación en el crecimiento económico, investigando si las actividades de innovación han contribuido al crecimiento económico o si la expansión de las actividades de innovación es simplemente una consecuencia del rápido crecimiento económico. El enfoque de la causalidad de Granger se ha desplegado para llevar a cabo esta investigación. Nota al pie de página 5 En segundo lugar, nuestro conjunto de datos es más reciente y completo (es decir, 1989-2014) en contraste con los estudios existentes.

El resto del papel se esboza de la siguiente manera. La sección "Base teórica y revisión de la literatura" presenta la base teórica y la revisión de la literatura. La sección "Un esquema de innovación en los países europeos" resume la situación de la innovación en los países europeos. La sección "Hipótesis, variables, estructura de datos y modelo propuestos" describe la hipótesis, las variables, los datos y el modelo propuestos. La sección "Resultados y discusión" presenta los resultados y la discusión. Por último, resumimos y concluimos en la sección "Conclusión".

CONCLUSIÓN

El nivel y la estructura de la innovación no deben ignorarse porque desempeña un papel imperativo en la estimulación del crecimiento económico (Pradhan et al. 2016; Hassan y Tucci 2010). Este estudio exploró el nexo causal de Granger entre la innovación y el crecimiento económico per cápita para los 19 países europeos utilizando datos de series temporales de 1989 a 2014. El mensaje fundamental de nuestro estudio tanto para los responsables políticos como para los académicos es que las implicaciones extraídas de la investigación sobre el crecimiento económico per cápita que ignoran la interrelación dinámica de las dos variables serán imperfectas. Es la relación conjunta entre la innovación y el crecimiento económico per cápita lo que construye nuestro estudio y guía la investigación futura sobre este tema.

Nuestro estudio reconoce pruebas contradictorios sobre la relación entre la innovación y el crecimiento económico per cápita en los 19 países europeos, tanto en el país individual como en el establecimiento del panel. En algunos casos, el crecimiento económico per cápita conduce a la innovación, prestando apoyo a la hipótesis de la innovación y el crecimiento. En algunos otros casos, es la innovación la que regula el nivel de crecimiento económico per cápita, prestando apoyo a la hipótesis líder en la oferta de nexo innovación-crecimiento. También existen circunstancias en las que la innovación y el crecimiento económico per cápita son mutuamente interdependientes. Esa es la situación en la que ambos se auto-reforzan y ofrecen apoyo a la hipótesis de retroalimentación del nexo innovación-crecimiento. Además, también hay casos en los que la innovación y el crecimiento económico per cápita son independientes entre sí. Esta es la situación en la que ambos son neutrales y ofrecen apoyo a la hipótesis de neutralidad del nexo innovación-crecimiento.

En consecuencia, el estudio sugiere que, para promover el crecimiento económico per cápita, se debe prestar atención a las estrategias de política que promuevan la innovación. Dada la posibilidad de causalidad inversa o causalidad bidireccional para algunos casos, las políticas que aumentan el crecimiento económico per cápita (como las acciones para aumentar la inversión) serían deseables para traer más innovación en la economía. En consecuencia, se sugiere que el gobierno desempeñe un papel más positivo para fomentar la innovación y luego integrarla con el crecimiento económico per cápita. Sin duda, en los últimos tiempos, muchos países, incluidos los países europeos, han reconocido la importancia de la innovación para un alto crecimiento económico y, en consecuencia, han aumentado su esfuerzo por tener más innovación en sus países. No obstante, lo que se necesita es que el gobierno de los respectivos países preste mayor atención para lograr un entorno estable a fin de promover el vínculo entre la innovación y el crecimiento económico per cápita. Esto requiere lo siguiente. En primer lugar, el gobierno de todas partes puede reconocer la importancia de la innovación para el crecimiento a largo plazo. Esto es más evidente en aquellos países donde se han agotado las opciones fáciles y el crecimiento futuro depende de formas más eficientes de combinar insumos o producir productos nuevos o mejorados. En segundo lugar, el gobierno puede fomentar la innovación indirectamente proporcionando un entorno adecuado para las empresas que están dispuestas a invertir más e innovar. También pueden apoyar la innovación directamente, ya sea financiando la investigación pública o fomentando la inversión privada en investigación e innovación. Los ejemplos citados son a través de incentivos y subvenciones fiscales relacionados con la innovación. En tercer lugar, se exigencian opciones de política para la importancia a nivel sectorial, dependiendo del requisito particular del desarrollo del país. Esto requiere que los gobiernos tomen decisiones difíciles, logrando un equilibrio entre las mejoras en el entorno general para la innovación y el apoyo directo a la innovación, dirigidos o no a actores específicos (grupos de). La combinación de objetivos e instrumentos políticos debe adaptarse al nivel de desarrollo de un país y a las fortalezas y debilidades de su sistema de innovación, por lo que debe variar tanto entre los países como a lo largo del tiempo (véase, por ejemplo, Veugelers y Schweiger 2016).

Más allá, nuestro estudio está estrictamente limitado a examinar el nexo causal entre las actividades de innovación y el crecimiento económico. Por lo tanto, no hemos incluido otros factores relevantes, como el capital, el trabajo, la infraestructura, el emprendimiento y el capital riesgo (véase, por ejemplo, Galindo y Méndez-Picazo (2014), Navas (2015), Samila y Sorenson (2011), Santacreu (2015)), en nuestro proceso de investigación empírica. La inclusión de estos factores puede afectar nuestros principales hallazgos y esto podría ser un tema de investigación futura. Además, las otras limitaciones existen en este estudio. En primer

lugar, no hay efectos indirectos o complementarios sobre el nexo entre las actividades de innovación y el crecimiento económico; en segundo lugar, la exclusión del impacto sectorial de las actividades de innovación en el crecimiento económico; tercera, pequeña dimensión temporal de los datos, es decir, de 1989 a 2014; y en cuarto lugar, las conclusiones se regulan únicamente a los países europeos. En consecuencia, un mayor estudio en estas áreas mutables puede producir hallazgos más inspiradores y espontáneos en el nexo entre la innovación y el crecimiento económico.

TRANSLATED VERSION: FRENCH

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSION TRADUITE: FRANÇAIS

Voici une traduction approximative des idées présentées ci-dessus. Cela a été fait pour donner une compréhension générale des idées présentées dans le document. Veuillez excuser toutes les erreurs grammaticales et ne pas tenir les auteurs originaux responsables de ces erreurs.

INTRODUCTION

> Pourquoi certaines régions se développent-elles continuellement pendant de nombreuses années alors que d'autres stagnent? Pourquoi certaines régions croissent-elles plus vite que d'autres? La percée théorique dans la réponse à ces questions commencée par Solow (1956) et Romer (1990) a perdu de son élan, laissant certaines questions importantes sans réponse. Suivant les théories néoclassiques de croissance et de croissance endogène, le progrès technologique est considéré comme le principal moteur de la croissance économique, mais comment exactement de nouvelles connaissances se traduit par des performances économiques supérieures par les régions n'a été décrit ni par les théories de la croissance ni trouvé une explication empirique sans équivoque. Les études empiriques, dépourvues de fondements théoriques, se sont penchées sur les réseaux (Wal et Boschma, 2009), sur la mobilité de la main-d'œuvre (Almeida et Kogut, 1999) et sur d'autres facilitateurs potentiels de débordements (Tsvetkova, 2015).

Au cours des dernières années, les chercheurs et les décideurs politiques ont de plus en plus prêté attention à étudier le lien entre l'innovation, l'entrepreneuriat et les résultats régionaux (Galindo et Mendez-Picazo 2014; Grossman 2009; Howells, 2005; Malerba et Brusoni 2007; Tsvetkova 2015; Wang et coll. 2005). Toutefois, dans ce document, nous nous sommes spécifiquement intéressés à examiner le lien entre innovationnote2 et croissance économique dans les pays européens sélectionnés. L'innovation est considérée comme l'un des principaux moteurs de l'économie (Andergassen et coll., 2009; Bae et Yoo 2015; Mansfield en 1972; Nadiri, 1993; Romer 1986; Santacreu 2015; Solow en 1956), surtout depuis l'œuvre séminale schumpeterfootnote3 (1911). Elle affecte l'économie dans de multiples canaux, tels que la croissance économique, la compétitivité mondiale, les systèmes financiers, la qualité de vie, le développement des infrastructures, l'emploi, l'ouverture commerciale, et donc, engendre une forte croissance économique. Note de bas de page4 Toutes ces études ci-dessus portent principalement sur l'impact de l'innovation sur la croissance économique, ce qui indique l'approche axée sur l'offre du lien innovation-croissance. Mais en réalité, c'est la croissance économique qui peut aussi accroître le niveau d'innovation dans le processus de développement. Cela signifie qu'il existe une faisabilité de causalité bidirectionnelle entre l'innovation et la croissance économique (Pradhan et coll., 2016). Par conséquent, l'objectif principal du présent document est d'examiner le lien bidirectionnel entre l'innovation et la croissance économique. En résumé, nous voudrions évaluer l'importance du lien innovation-croissance

économique, en examinant si le niveau de l'innovation a contribué à la croissance économique, ou si l'extension de l'innovation n'est qu'une conséquence d'une croissance économique rapide.

Dans cet article, nous utilisons l'approche de causalité granger pour examiner la dynamique entre l'innovation et la croissance économique pour un échantillon de 19 pays européens. La principale contribution de l'étude est double. Premièrement, nous évaluons spécifiquement l'importance des activités d'innovation sur la croissance économique, en examinant si les activités d'innovation ont contribué à la croissance économique ou si l'expansion des activités d'innovation n'est qu'une conséquence d'une croissance économique rapide. L'approche de causalité de Granger a été déployée pour mener à bien cette enquête. Note de bas de page5 Deuxièmement, notre ensemble de données est plus récent et plus complet (c.-à-d. 1989–2014) contrairement aux études existantes.

Le reste du document est esquissé comme suit. La section « Base théorique et revue de littérature » présente la base théorique et l'examen de la littérature. La section « n aperçu de l'innovation dans les pays européen » résume le statut de l'innovation dans les pays européens. La section « Hypothèses, variables, structure de données et modèle » proposée décrit l'hypothèse, les variables, les données et le modèle proposés. La section « Résultats et discussion » présente les résultats et la discussion. Enfin, nous résumons et concluons dans la section « conclusion ».

CONCLUSION

Le niveau et la structure de l'innovation ne doivent pas être ignorés parce qu'il joue un rôle impératif dans la stimulation de la croissance économique (Pradhan et al., 2016; Hassan et Tucci 2010). Cette étude a exploré le lien de causalité de Granger entre l'innovation et la croissance économique par habitant pour les 19 pays européens à l'aide de données de séries temporelles de 1989 à 2014. Le message central de notre étude pour les décideurs et les académiciens est que les implications tirées de la recherche sur la croissance économique par habitant qui ne tiennent pas compte de l'interrelation dynamique des deux variables seront imparfaites. C'est la relation de va-et-vient entre l'innovation et la croissance économique par habitant qui construit notre étude et guide la recherche future sur ce sujet.

Notre étude reconnaît des données mitigées sur la relation entre l'innovation et la croissance économique par habitant dans les 19 pays européens, tant dans chaque pays que dans le cadre du panel. Dans certains cas, la croissance économique par habitant conduit à l'innovation, en apportant un soutien à l'hypothèse qui suit la demande d'un lien innovation-croissance. Dans d'autres cas, c'est l'innovation qui régule le niveau de croissance économique par habitant, en apportant un soutien à l'hypothèse de pointe de l'innovation et de la croissance. Il y a aussi des circonstances où l'innovation et la croissance économique par habitant sont mutuellement interdépendantes. C'est la situation où les deux se renforcent et offrent un soutien à l'hypothèse de rétroaction du lien innovation-croissance. En outre, il y a aussi des cas où l'innovation et la croissance économique par habitant sont indépendantes les unes des autres. C'est la situation où les deux sont neutres et offrent un soutien à l'hypothèse de neutralité du lien innovation-croissance.

L'étude suggère donc que, pour promouvoir la croissance économique par habitant, il faut accorder une attention particulière aux stratégies politiques qui favorisent l'innovation. Compte tenu de la possibilité d'une causalité inversée ou d'une causalité bidirectionnelle dans certains cas, des politiques qui augmentent la croissance économique par habitant (comme des mesures visant à accroître l'investissement) seraient souhaitables pour apporter plus d'innovation dans l'économie. Par conséquent, il est suggéré que le gouvernement joue un rôle plus positif afin de favoriser l'innovation et de l'intégrer ensuite à la croissance économique par habitant. Il ne fait aucun doute que ces derniers temps, de nombreux pays, y compris les pays européens, ont reconnu l'importance de l'innovation pour une forte croissance économique et, par conséquent, ils ont intensifié leurs efforts pour avoir plus d'innovation dans leurs pays. Néanmoins, ce qu'il faut, c'est que le gouvernement des pays respectifs accorde une plus grande attention à l'environnement stable afin de promouvoir le lien entre l'innovation et la croissance économique par habitant. Cela nécessite ce qui suit. Tout d'abord, le gouvernement partout dans le monde peut reconnaître l'importance de l'innovation pour la croissance à long terme. Cela est plus évident dans les pays où les options faciles ont

été épuisées et où la croissance future dépend de moyens plus efficaces de combiner les intrants ou de produire des extrants nouveaux ou améliorés. Deuxièmement, le gouvernement peut favoriser l'innovation indirectement en offrant un environnement approprié aux entreprises qui sont prêtes à investir davantage et à innover. Ils peuvent également soutenir directement l'innovation, soit en finançant la recherche publique, soit en encourageant les investissements privés dans la recherche et l'innovation. Les exemples cités sont le biais d'incitations fiscales et de subventions liées à l'innovation. Troisièmement, il existe une exigence d'options politiques pour une importance sectorielle, en fonction de l'exigence particulière du développement du pays. Cela exige des gouvernements qu'ils fassent des choix difficiles, en trouvant un équilibre entre l'amélioration de l'environnement général pour l'innovation et le soutien direct à l'innovation, ciblé ou non à des (groupes) d'acteurs spécifiques. La combinaison d'objectifs et d'instruments politiques devrait être adaptée au niveau de développement d'un pays et aux forces et faiblesses de son système d'innovation, de sorte qu'il devrait varier à la fois d'un pays à l'autre et au fil du temps (voir, par exemple, Veugelers et Schweiger 2016).

Au-delà, notre étude est strictement limitée pour examiner le lien de causalité entre les activités d'innovation et la croissance économique. Nous n'avons donc pas inclus d'autres facteurs pertinents, tels que le capital, la main-d'œuvre, l'infrastructure, l'entrepreneuriat et le capital-risque (voir, par exemple, Galindo et Mendez-Picazo (2014), Navas (2015), Samila et Sorenson (2011), Santacreu (2015)), dans notre processus d'enquête empirique. L'inclusion de ces facteurs peut influer sur nos principales conclusions et cela pourrait faire l'objet de recherches futures. En outre, les autres limitations existent dans cette étude. Premièrement, aucun effet indirect ou complémentaire sur le lien entre les activités d'innovation et la croissance économique; deuxièmement, l'exclusion de l'impact sectoriel des activités d'innovation sur la croissance économique; troisièmement, la petite dimension temporelle des données, c'est-à-dire de 1989 à 2014; quatrièmement, les résultats ne sont réglementés qu'aux pays européens. Par conséquent, une étude plus approfondie dans ces zones mutables peut produire des résultats plus inspirants et spontanés au lien entre l'innovation et la croissance économique.

TRANSLATED VERSION: GERMAN

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

ÜBERSETZTE VERSION: DEUTSCH

Hier ist eine ungefähre Übersetzung der oben vorgestellten Ideen. Dies wurde getan, um ein allgemeines Verständnis der in dem Dokument vorgestellten Ideen zu vermitteln. Bitte entschuldigen Sie alle grammatikalischen Fehler und machen Sie die ursprünglichen Autoren nicht für diese Fehler verantwortlich.

EINLEITUNG

> Warum wachsen einige Regionen seit vielen Jahren kontinuierlich, während andere stagnieren? Warum wachsen einige Regionen schneller als andere? Der theoretische Durchbruch bei der Beantwortung dieser Fragen, der von Solow (1956) und Romer (1990) ins Leben gerufen wurde, hat an Schwung verloren und einige wichtige Fragen unbeantwortet gelassen. Nach den neoklassischen Wachstumstheorien und den endogenen Wachstumstheorien wird angenommen, dass der technologische Fortschritt der Hauptmotor des Wirtschaftswachstums ist, doch wie genau neues Wissen in überlegene Wirtschaftsleistung der Regionen übersetzt wird, wurde weder von den Wachstumstheorien beschrieben noch eine eindeutige empirische Erklärung gefunden. Empirische Studien ohne theoretische Grundlagen untersuchten Netzwerke (Wal und

Boschma 2009), Die Arbeitskräftemobilität (Almeida und Kogut 1999) und andere potenzielle Förderer von Spillovern (Tsvetkova 2015).

In den letzten Jahren haben sowohl Forscher als auch politische Entscheidungsträger zunehmend darauf geachtet, den Zusammenhang zwischen Innovation, Unternehmertum und regionalen Ergebnissen zu untersuchen (Galindo und Mendez-Picazo 2014; Grossman 2009; Howells 2005; Malerba und Brusoni 2007; Zwetkowa 2015; Wang et al. 2005). In diesem Papier befassen wir uns jedoch speziell mit dem Zusammenhang zwischen Innovationund Footnote2 und Wirtschaftswachstum in den ausgewählten europäischen Ländern. Innovation gilt als einer der wichtigsten Treiber der Wirtschaft (Andergassen et al. 2009; Bae und Yoo 2015; Mansfield 1972; Nadiri 1993; Romer 1986; Santacreu 2015; Solow 1956), vor allem seit dem wegweisenden Werk von schumpeterfootnote3 (1911). Sie wirkt sich auf die Wirtschaft in verschiedenen Kanälen aus, wie Wirtschaftswachstum, globale Wettbewerbsfähigkeit, Finanzsysteme, Lebensqualität, Infrastrukturentwicklung, Beschäftigung, Handelsoffenheit und führt damit zu einem hohen Wirtschaftswachstum. Fußnote 4 Alle oben genannten Studien konzentrieren sich hauptsächlich auf die Auswirkungen von Innovation auf das Wirtschaftswachstum, was auf den angebotsorientierten Ansatz des Innovations-Wachstums-Nexus hindeutet. Aber in Wirklichkeit ist es das Wirtschaftswachstum, das auch das Innovationsniveau im Entwicklungsprozess erhöhen kann. Das bedeutet, dass eine bidirektionale Kausalität zwischen Innovation und Wirtschaftswachstum durchführbar ist (Pradhan et al. 2016). Daher besteht das Hauptziel dieses Papiers darin, die bidirektionale Verbindung zwischen Innovation und Wirtschaftswachstum zu untersuchen. Zusammenfassend möchten wir die Bedeutung der Verbindung zwischen Innovation und Wirtschaftswachstum bewerten, indem wir untersuchen, ob das Innovationsniveau zum Wirtschaftswachstum beigetragen hat oder ob die Ausweitung der Innovation einfach eine Folge eines raschen Wirtschaftswachstums ist.

In diesem Beitrag nutzen wir den Granger-Kausalitätsansatz, um die Dynamik zwischen Innovation und Wirtschaftswachstum für eine Stichprobe von 19 europäischen Ländern zu untersuchen. Der Hauptbeitrag der Studie ist zweifach. Erstens bewerten wir insbesondere die Bedeutung von Innovationsaktivitäten für das Wirtschaftswachstum, indem wir untersuchen, ob die Innovationsaktivitäten zum Wirtschaftswachstum beigetragen haben oder ob die Ausweitung der Innovationsaktivitäten einfach eine Folge des raschen Wirtschaftswachstums ist. Für diese Untersuchung wurde der Granger-Kausalitätsansatz eingesetzt. Fußnote 5 Zweitens ist unser Datensatz im Gegensatz zu bestehenden Studien aktueller und umfassender (d. H. 1989–2014).

Der Rest des Papiers ist wie folgt skizziert. Der Abschnitt "Theoretische Grundlagen und Literaturrezension" stellt die theoretische Grundlage und Literaturrezension vor. Der Abschnitt "Ein Überblick über die Innovation in den europäischen Ländern" fasst den Stand der Innovation in den europäischen Ländern zusammen. Der Abschnitt "Vorgeschlagene Hypothesen, Variablen, Datenstruktur und Modell" beschreibt die vorgeschlagene Hypothese, Variablen, Daten und Modell. Im Abschnitt "Ergebnisse und Diskussion" werden die Ergebnisse und Diskussionen präsentiert. Schließlich fassen wir im Abschnitt "Schlussfolgerung" zusammen und schließen ihn ab.

SCHLUSSFOLGERUNG

Das Niveau und die Struktur der Innovation sollten nicht ignoriert werden, da sie eine zwingende Rolle bei der Stimulierung des Wirtschaftswachstums spielt (Pradhan et al. 2016; Hassan und Tucci 2010). Diese Studie untersuchte anhand von Zeitreihendaten von 1989 bis 2014 den Kausalzusammenhang von Granger zwischen Innovation und Pro-Kopf-Wirtschaftswachstum für die 19 europäischen Länder. Die zentrale Botschaft unserer Studie für politische Entscheidungsträger und Akademiker gleichermaßen ist, dass die Auswirkungen, die aus der Forschung auf das Pro-Kopf-Wirtschaftswachstum gezogen werden, die die dynamische Wechselbeziehung der beiden Variablen außer Acht lassen, unvollkommen sein werden. Es ist die miteinander verbundene Hin und Her-Beziehung zwischen Innovation und Pro-Kopf-Wirtschaftswachstum, die unsere Studie aufbaut und die zukünftige Forschung zu diesem Thema leitet.

Unsere Studie würdigt gemischte Belege für den Zusammenhang zwischen Innovation und Pro-Kopf-Wirtschaftswachstum in den 19 europäischen Ländern, sowohl in den einzelnen Ländern als auch auf der

Podiumsdiskussion. In einigen Fällen führt das Pro-Kopf-Wirtschaftswachstum zu Innovationen, die eine Nachfrage-Folgehypothese des Innovationswachstums-Nexus unterstützen. In einigen anderen Fällen ist es die Innovation, die das Niveau des Pro-Kopf-Wirtschaftswachstums reguliert und angebotsführende Hypothesen über Innovationswachstums-Nexus unterstützt. Es gibt auch Umstände, in denen Innovation und Pro-Kopf-Wirtschaftswachstum voneinander abhängig sind. Das ist die Situation, in der beide sich selbst verstärken und die Feedbackhypothese des Innovations-Wachstums-Nexus unterstützen. Darüber hinaus gibt es auch Fälle, in denen Innovation und Wirtschaftswachstum pro Kopf voneinander unabhängig sind. Das ist die Situation, in der beide neutral sind und die Neutralitätshypothese des Innovations-Wachstums-Nexus unterstützen.

Die Studie legt daher nahe, dass bei der Förderung des Wirtschaftswachstums pro Kopf politische Strategien zur Förderung von Innovation beachtet werden müssen. Angesichts der Möglichkeit umgekehrter Kausalität oder bidirektionaler Kausalität in einigen Fällen wäre es wünschenswert, dass Maßnahmen, die das Wirtschaftswachstum pro Kopf steigern (wie Maßnahmen zur Steigerung der Investitionen), mehr Innovation in die Wirtschaft bringen. Daher wird vorgeschlagen, dass die Regierung eine positivere Rolle spielen sollte, um Innovation zu fördern und sie dann in das Pro-Kopf-Wirtschaftswachstum zu integrieren. Zweifellos haben viele Länder, einschließlich der europäischen Länder, in jüngster Zeit die Bedeutung von Innovation für ein hohes Wirtschaftswachstum erkannt, und folglich haben sie ihre Anstrengungen verstärkt, um mehr Innovation in ihren Ländern zu haben. Dennoch ist es notwendig, dass die Regierung der jeweiligen Länder der Stabilität der Umwelt größere Aufmerksamkeit widmet, um die Verbindung zwischen Innovation und Wirtschaftswachstum pro Kopf zu fördern. Dies erfordert folgendes. Erstens kann die Regierung überall die Bedeutung von Innovation für langfristiges Wachstum anerkennen. Am deutlichsten wird dies in den Ländern, in denen die einfachen Optionen ausgeschöpft sind und das künftige Wachstum von effizienteren Möglichkeiten abhängt, Inputs zu kombinieren oder neue oder verbesserte Produktionen zu produzieren. Zweitens kann die Regierung Innovation indirekt fördern, indem sie ein angemessenes Umfeld für Unternehmen bietet, die bereit sind, mehr zu investieren und Innovationen zu entwickeln. Sie können Innovation auch direkt unterstützen, indem sie entweder öffentliche Forschung finanzieren oder private Investitionen in Forschung und Innovation fördern. Die angeführten Beispiele sind innovationsbezogene Steueranreize und Zuschüsse. Drittens sind politische Optionen für die Bedeutung auf sektorweiser Ebene erforderlich, abhängig von den besonderen Erfordernissen der Entwicklung des Landes. Dies erfordert, dass die Regierungen schwierige Entscheidungen treffen und ein Gleichgewicht zwischen Verbesserungen im allgemeinen Innovationsumfeld und direkter Unterstützung für Innovationen finden, die gezielt oder nicht für bestimmte (Gruppen von) Akteuren ausgerichtet sind. Die Kombination von politischen Zielen und Instrumenten sollte auf das Entwicklungsniveau eines Landes und die Stärken und Schwächen seines Innovationssystems zugeschnitten sein, so dass es sowohl von Land zu Land als auch im Laufe der Zeit variieren sollte (siehe z. B. Veugelers und Schweiger 2016).

Darüber hinaus ist unsere Studie streng darauf beschränkt, den kausalen Zusammenhang zwischen Innovationstätigkeit und Wirtschaftswachstum zu untersuchen. Andere relevante Faktoren wie Kapital, Arbeit, Infrastruktur, Unternehmertum und Risikokapital (siehe z. B. Galindo und Mendez-Picazo (2014), Navas (2015), Samila und Sorenson (2011), Santacreu (2015)) haben wir daher nicht in unseren empirischen Untersuchungsprozess einbezogen. Die Einbeziehung dieser Faktoren kann sich auf unsere wichtigsten Erkenntnisse auswirken, und dies könnte Gegenstand künftiger Forschung sein. Darüber hinaus gibt es in dieser Studie weitere Einschränkungen. Erstens keine indirekten oder sich ergänzenden Auswirkungen auf den Zusammenhang zwischen Innovationstätigkeiten und Wirtschaftswachstum; zweitens die Ausschluß sektormäßiger Auswirkungen von Innovationstätigkeiten auf das Wirtschaftswachstum; drittens kleine Zeitdimension der Daten, d. H. Von 1989 bis 2014; und viertens sind die Ergebnisse nur für europäische Länder reguliert. Folglich können weitere Studien in diesen veränderlichen Bereichen zu inspirierenderen und spontaneren Erkenntnissen über den Zusammenhang zwischen Innovation und Wirtschaftswachstum führen.

TRANSLATED VERSION: PORTUGUESE

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSÃO TRADUZIDA: PORTUGUÊS

Aqui está uma tradução aproximada das ideias acima apresentadas. Isto foi feito para dar uma compreensão geral das ideias apresentadas no documento. Por favor, desculpe todos os erros gramaticais e não responsacule os autores originais responsáveis por estes erros.

INTRODUÇÃO

> Por que algumas regiões crescem continuamente por muitos anos enquanto outras estagnam? Por que algumas regiões crescem mais rápido que outras? O avanço teórico na resposta a essas perguntas iniciada por Solow (1956) e Romer (1990) perdeu seu ímpeto, deixando algumas questões importantes sem resposta. Após o crescimento neoclássico e as teorias endógenas de crescimento, acredita-se que o avanço tecnológico seja o principal motor do crescimento econômico, mas como exatamente novos conhecimentos se traduzem em desempenho econômico superior por regiões não foi descrito pelas teorias do crescimento nem encontrou explicação empírica inequívoca. Estudos empíricos, sem fundamentos teóricos, analisaram redes (Wal e Boschma 2009), mobilidade laboral (Almeida e Kogut 1999) e outros potenciais facilitadores de transbordamentos (Tsvetkova 2015).

Nos últimos anos, tanto pesquisadores quanto formuladores de políticas têm prestado cada vez mais atenção para investigar a ligação entre inovação, empreendedorismo e resultados regionais (Galindo e Mendez-Picazo 2014; Grossman 2009; Howells 2005; Malerba e Brusoni 2007; Tsvetkova 2015; Wang et al. 2005). No entanto, neste artigo, analisamos especificamente ofootnote1 sobre a ligação entre a inovaçãofootnote2 e o crescimento econômico nos países europeus selecionados. A inovação é considerada um dos principais impulsionadores da economia (Andergassen et al. 2009; Bae e Yoo 2015; Mansfield 1972; Nadiri 1993; Romer 1986; Santacreu 2015; Solow 1956), particularmente desde o trabalho seminal de schumpeterfootnote3 (1911). Afeta a economia em múltiplos canais, como crescimento econômico, competitividade global, sistemas financeiros, qualidade de vida, desenvolvimento de infraestrutura, emprego, abertura comercial e, portanto, gera alto crescimento econômico. Nota de rodapé4 Todos esses estudos acima se concentram principalmente no impacto da inovação para o crescimento econômico, indicando a abordagem orientada pela oferta do nexo inovação-crescimento. Mas, na realidade, é o crescimento econômico que também pode aumentar o nível de inovação no processo de desenvolvimento. Isso significa que há uma viabilidade de causalidade bidirecional entre inovação e crescimento econômico (Pradhan et al. 2016). Por isso, o principal objetivo deste artigo é examinar a ligação bidirecional entre inovação e crescimento econômico. Em suma, gostaríamos de avaliar a importância da articulação inovação-crescimento econômico, investigando se o nível de inovação contribuiu para o crescimento econômico, ou se a extensão da inovação é simplesmente uma consequência do rápido crescimento econômico.

Neste artigo, utilizamos a abordagem de causalidade granger para examinar a dinâmica entre inovação e crescimento econômico para uma amostra de 19 países europeus. A principal contribuição do estudo é dupla. Em primeiro lugar, avaliamos especificamente a importância das atividades de inovação no crescimento econômico, investigando se as atividades de inovação contribuíram para o crescimento econômico, ou se a expansão das atividades de inovação é simplesmente uma consequência do rápido crescimento econômico. A abordagem de causalidade de Granger foi implantada para realizar esta

investigação. Nota de rodapé5 Segundo, nosso conjunto de dados é mais recente e abrangente (ou seja, 1989-2014) em contraste com os estudos existentes.

O resto do papel é esboçado da seguinte forma. A seção "Base teórica e revisão da literatura" apresenta a base teórica e a revisão da literatura. A seção "Um esboço de inovação nos países europeus" resume o status da inovação nos países europeus. A seção "Hipóteses propostas, variáveis, estrutura de dados e modelo" descreve a hipótese, variáveis, dados e modelo propostos. A seção "Resultados e discussão" apresenta os resultados e a discussão. Finalmente, resumimos e concluímos na seção "Conclusão".

CONCLUSÃO

O nível e a estrutura da inovação não devem ser ignorados porque desempenha um papel imperativo no estímulo ao crescimento econômico (Pradhan et al. 2016; Hassan e Tucci 2010). Este estudo explorou o nexo causal granger entre inovação e crescimento econômico per capita para os 19 países europeus usando dados de séries temporânicos de 1989 a 2014. A mensagem crucial do nosso estudo para os formuladores de políticas e acadêmicos é que as implicações extraídas de pesquisas sobre o crescimento econômico per capita que desconsideram a inter-relação dinâmica das duas variáveis serão imperfeitas. É a relação de ida e volta entre inovação e crescimento econômico per capita que constrói nosso estudo e orienta as futuras pesquisas sobre o tema.

Nosso estudo reconhece evidências mistas sobre a relação entre a inovação e o crescimento econômico per capita nos 19 países europeus, tanto no país individual quanto no cenário do painel. Em alguns casos, o crescimento econômico per capita leva à inovação, emprestando apoio à hipótese de crescimento da inovação. Em alguns outros casos, é a inovação que regula o nível de crescimento econômico per capita, dando suporte à hipótese líder de fornecimento de nexo de inovação-crescimento. Há também circunstâncias em que a inovação e o crescimento econômico per capita são mutuamente interdependentes. Essa é a situação em que ambos se auto-reforçam e oferecem suporte à hipótese de feedback do nexo de crescimento da inovação. Além disso, há também casos em que a inovação e o crescimento econômico per capita são independentes uns dos outros. Essa é a situação em que ambos são neutros e oferecem suporte à hipótese de neutralidade do nexo de crescimento da inovação.

Nesse ponto, o estudo sugere que, para promover o crescimento econômico per capita, é preciso prestar atenção às estratégias políticas que promovam a inovação. Dada a possibilidade de causalidade reversa ou causalidade bidirecional para alguns casos, políticas que aumentem o crescimento econômico per capita (como ações para aumentar o investimento) seriam desejáveis para trazer mais inovação na economia. Consequentemente, sugere-se que o governo tenha um papel mais positivo para fomentar a inovação e depois integrá-la ao crescimento econômico per capita. Sem dúvida, nos últimos tempos, muitos países, incluindo os países europeus, reconheceram a importância da inovação para o alto crescimento econômico e, consequentemente, aumentaram seus esforços para ter mais inovação em seus países. No entanto, o que é necessário é que o governo dos respectivos países preste mais atenção para trazer o ambiente estável, a fim de promover a ligação entre inovação e crescimento econômico per capita. Isso requer os seguintes. Em primeiro lugar, o governo em todos os lugares pode reconhecer a importância da inovação para o crescimento a longo prazo. Isso é mais evidente nos países onde as opções fáceis foram esgotadas e o crescimento futuro depende de formas mais eficientes de combinar insumos ou produzir novas ou melhores saídas. Em segundo lugar, o governo pode nutrir a inovação indiretamente, proporcionando um ambiente adequado para empresas que estão dispostas a investir mais e inovar. Eles também podem apoiar a inovação diretamente, financiando pesquisas públicas ou incentivando o investimento privado em pesquisa e inovação. Os exemplos citados são por meio de incentivos fiscais e subvenções relacionados à inovação. Em terceiro lugar, há a exigência de opções políticas para a importância do nível setorial, dependendo da exigência particular do desenvolvimento do país. Isso exige que os governos façam escolhas difíceis, atingindo um equilíbrio entre melhorias no ambiente geral para a inovação e apoio direto à inovação, direcionados ou não a atores específicos (grupos de) atores. A combinação de objetivos e instrumentos políticos deve ser adaptada ao nível de desenvolvimento de um país e aos pontos fortes e fracos de seu

sistema de inovação, por isso deve variar tanto entre os países quanto ao longo do tempo (veja, por exemplo, Veugelers e Schweiger 2016).

Além disso, nosso estudo é estritamente constrangido para examinar o nexo causal entre as atividades de inovação e o crescimento econômico. Assim, não incluímos outros fatores relevantes, como capital, trabalho, infraestrutura, empreendedorismo e venture capital (ver, por exemplo, Galindo e Mendez-Picazo (2014), Navas (2015), Samila e Sorenson (2011), Santacreu (2015)), em nosso processo de investigação empírica. A inclusão desses fatores pode afetar nossos principais achados e isso pode ser objeto de futuras pesquisas. Além disso, existem outras limitações neste estudo. Em primeiro lugar, não há efeitos indiretos ou complementares sobre o nexo entre as atividades de inovação e o crescimento econômico; segundo, a exclusão do impacto setorial das atividades de inovação no crescimento econômico; terceiro, pequena dimensão temporal dos dados, ou seja, de 1989 a 2014; e em quarto lugar, os resultados são regulados apenas para os países europeus. Consequentemente, um estudo mais aprofundado nessas áreas mutáveis pode produzir achados mais inspiradores e espontâneos para o nexo entre inovação e crescimento econômico.