The causal relationship between patent growth and growth of GDP with quarterly data in the G7 countries: cointegration, ARDL and error correction models

Dushko Josheski (e-mail address: dushkojosheski@gmail.com)
Cane Koteski(e-mail address: cane.koteski@ugd.edu.mk)

Abstract

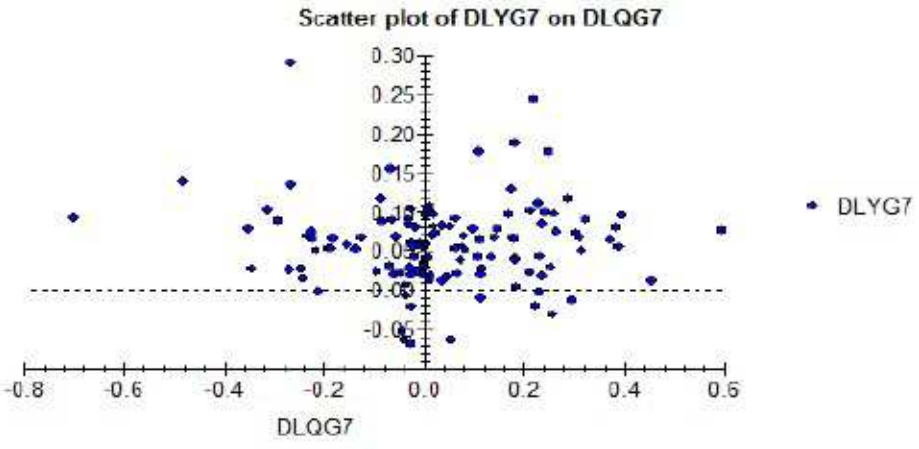
This empirical study investigates the dynamic link between patent growth and GDP growth in G7 economies. ARDL model showed that there exist positive relationship in long run between quarterly growth of patents and quarterly GDP growth. The error correction term suggests that 20,6 percent of the adjustment back to long run equilibrium of industrial production in G7 countries is corrected by 20,6% a year, following a shock like the one in 1974 , which in our study is controlled by a dummy variable D74. In the short run however at one or two lags there exist negative relationship between quarterly patents growth and quarterly growth of GDP. Johansen's procedure for cointegration showed that long run multipliers are positive between the patent growth and GDP growth in G7 economies. Granger causality test showed that patent growth Granger cause GDP growth in G7 countries. Unrestricted VAR showed that there exists positive relationship between patent growth and GDP growth at two or three lags.

Key words: Cointegration, ARDL, Error correction models, Johasens's procedure, Patent growth, GDP growth

Introduction

In 1975 French president Valéry Giscard d'Estaing invited leaders of Germany, Italy, USA, the Unite Kingdom, Japan. The group was discussing oil crisis, stock market crash .So the event was to become annual and that is how the group was formed, later Canada was invited to join and the G7 was created. We use quarterly data on growth of patents and quarterly data of GDP growth (1963Q1 to 1993Q4) from G7 countries, and our purpose here is to estimate the causal relationship between this two variables.

Technological revolution in the twentieth century has happened and more innovations than all the earlier centuries happened. Technology and innovation are seen as engines of economic growth (Usmani, Ahmad, Junoh). Technological change has been regarded as a major source of long-run productivity growth (Romer, 1990, Grossman and Helpman, 1991), with innovation no longer being treated as an exogenous process. Patents have become increasingly important, especially over the past two decades. As patent office procedures have adapted to remain abreast of changing economic and scientific circumstances, it has also become increasingly important to define and analyse innovation more precisely(Mcalleer, Slotje, 2005). In the next graph it is presented the relationship between quarterly growth of patents and quarterly growth of GDP.



Scatter plot of GDP growth quarterly data in G7 countries and growth of quarterly patents in G7 countries data from 1963 Q1 to 1993Q4.

The scatter plot result is ambiguous, meaning that between growth of quarterly patents and quarterly growth of GDP in G7 countries exist positive as well negative relationship. We will

test this result empirically in the latter of the paper. The application of the conventional Granger (1969) causality tests is a common practice in empirical research. In the standard Granger-causality test, a variable X_t Granger-causes Y_t if the lagged values of X_t help improve the forecast of Y_t. One of the problems of the conventional Granger-causality tests which Miller and Russek (1990), and Miller (1991) pointed out is that it is possible to find no causal relationship between two variables that share a common trend. This is the case because a variable that exhibits non-stationarity will show no tendency to return to its long-run equilibrium level in the event of a random disturbance; hence the conventional Granger causality tests may lead to misleading results. One of the important features of the cointegration analysis over the standard Granger causality test is that if two variables are integrated of order one, that is *I(1),* and cointegrated, there must be Granger-causality in at least one direction because one variable can help predict the other(OWOYE,1995).

Data and the methodology

First, in the paper we will use ARDL model to see the long run relationship between this variables. Afterwards we set error correction model to capture short run and long run coefficients as well as the coefficient on the error correction model. Descriptive statistics of the variables and correlation matrix is given as follows:

Descriptive statistics		
	LYG7	LQG7
Maximum	0.37752	51.7423
Mean	-2.4425	47.3223
Minimum	-6.9122	39.8834
Correlation matrix		
	LYG7	LQG7
LYG7	1.00	-
LQG7	.87495	1.00

Autoregressive distributed lag model (ARDL)[1]

In economics we know that rarely Y variable responds instantaneously on X variable let say. Y responds with laps of time. Such a laps of time is called lag (Gujaraty,2003).

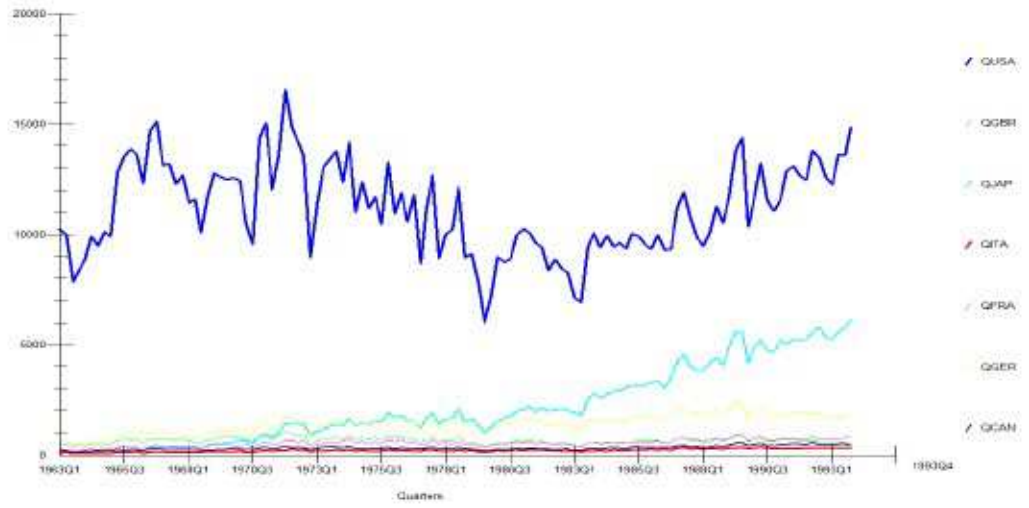
General model with lags is as follows:

$$Y_t = \langle + ® _0 X_t + ® _1 X_{t\ 1} + ... + ® _k X_{t\ k} + u_t$$

Here β_0 is short run coefficient while, $\sum_{i=0}^{k} ® _i = ® _0 + ® _1 + ... + ® _k = ®$, is long run coefficient , or total lag distributed multiplier.

Our ARDL is up to four lags, also here we add dummy variable in the model D74 , this variable is used to control for 1973-1974 stock market crash. This was what followed after great oil crash 1973, and after Bretton Woods fall 1972.

This time series is plotted as follows:



On average highest quarterly patents from 1963 to 1993 has USA, followed by quarterly patents of Japan. The third one in G7 countries is Germany, while other 4, France, Canada, Great Britain, and Italy has similar number of quarterly patents in the period.

Firstly there are lags between growth of quarterly patents and quarterly growth of GDP is because the lag between the invention of an idea or device and its development up to a

[1] See Appendices variables definitions.