The Role of Agriculture in Economic Growth in Greece

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Abstract This paper aims at analyzing the contribution of agriculture to economic growth in postwar Greece, especially after 1970 by exploring the relationship of agriculture with the main non-agricultural economic sectors. The development model proclaimed and followed in postwar Greece neglected agriculture and emphasized industrialization. However, the implementation of the model did not lead to a strong industrial sector, but it destroyed agriculture and over inflated services. In the paper, the use of proper econometric and statistical techniques utilizing time series data collected for the period 1970 up to date establishes that agriculture followed a path not affecting the other economic sectors and at the same time not being affected by them.

Keywords Agriculture • Economic growth

JEL Classification Codes Q1 • Q10 • R1

1 Introduction

Early economic development theory advocated industrialization as the prime development strategy through a massive investment flow stream either inter-sectorally balanced or focused on some leading sectors characterized by strong

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A. Karasavvoglou and P. Polychronidou (eds.), *Economic Crisis in Europe and the Balkans*, Contributions to Economics, DOI 10.1007/978-3-319-00494-5_13,

inter-sectoral linkages.[1] Agriculture should either be neglected or, as it was suggested by the dual economy argument, assist industrialization providing surplus capital and labor to industry.[2] Agricultural labor productivity is low in underdeveloped economies, and labor could easily be transferred to industry without lowering agricultural output. On the contrary, the migration of surplus labor would increase productivity in the sector managing to maintain production of food at sufficient levels and at low cost, and hence at low prices. Transfer of labor and capital from agriculture to the industrial sector of the economy could be realized by taxing agriculture much heavier than industry and by influencing the terms of trade between industry and agriculture in favor of the former. Both policies would maintain agriculture income at low levels relatively to the income generated in the industrial sector. Rural workers would be forced to internally migrate to the non-agriculture sectors, and the extracted agricultural surplus to industrial investments. The dual economy argument suggests that the economy consists of two sectors, i.e. an advanced capital intensive industrial sector that is able to achieve fast productivity increases and economies of scale, and to enlarge the domestic market size; and a backward agriculture sector that, although it has a role to play in assisting industrial development,[3] its only chance for growth is through spillovers from industry. In fact, it is an industry led economic growth policy.

Many developing countries in the 60s and 70s adopted strategies conforming to the dual economy development strategy[4] but with poor results.[5] Inter-sectoral linkages between agricultural and non- agricultural sectors have been underestimated. Agriculture supplies inputs to a number of manufacturing sectors such as food and beverages, textiles – clothing – footwear, wood products, etc. which are important at the initial development stages because they require standardized technologies and relatively low capital. At the same time, agriculture requires industrial and services inputs. Increased agriculture production, therefore, benefits industry through both forward and backward inter-sectoral linkages. In addition, agricultural income is spent on manufacturing goods and services, therefore, income increases in agriculture may benefit non-agricultural industries providing consumption goods.[6] Also, the role of agriculture in both reducing poverty[7] and avoiding a Malthusian type poverty trap has been underestimated.

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[1] See, Rosenstein – Rodan (1943); Hirschman (1958); Nurkse (1953).

[2] See, initially Lewis (1954); Jorgenson (1961); Fei and Ranis (1964); and later Gardner (2000); Hwa (1988).

[3] In addition to the provision of surplus labour and capital agriculture it may also provide markets for industrial products, substitute for food imports saving that way foreign exchange, and generate export revenues both contributing to the financing of both industrial investment and intermediate input imports. See Johnston and Mellor (1961).

[4] India is a very good case in point. See Kanwar (2000).

[5] See World Bank (1982) and Kanwar (2000).

[6] See Thirtle et al. (2003).

[7] See Timmer (1995).

Income and productivity increases in agriculture are necessary in order to balance population growth, and to achieve an increase in the living standards,[8] thus creating externalities and raising consumption capabilities. In this context agriculture influences domestic market size, the enlargement of which is crucial in allowing industry to realize economies of scale, which in turn permits production cost to become lower and, consequently, it guarantees the industrial sector's viability, hence growth. Therefore, productivity increases in agriculture could lead to increasing production, in turn to rising import substitution and exporting of agricultural products, thus, to foreign exchange revenues and higher incomes and savings, all together creating domestic markets and financing investments for industrial expansion. However, increasing productivity in agriculture requires investments in both infrastructure and technological improvements undermining both the agriculture neglect hypothesis and the industry-led growth. In fact, the argument may be reversed to agriculture-led growth.

Empirical research, although extensive, has not resolved the theoretical issue of the causality between agriculture and industry growth. Econometric models have been tested either through cross-country data sets or through one country time series data sets. The relationship between agriculture, industry, and economic growth is dynamic in nature, and econometric studies using the OLS technique on cross-country data samples face technical limitations pertained to misspecifications of the correlations between industrial and agricultural growth, and they fail to capture structural changes occurring through time. Economic growth leads to changes at the composition of GDP increasing the share of industry at the expense of agriculture, due to the fact that productivity in industry rises faster than that in agriculture, thanks to differential rates of technological change.[9]

Tiffin and Irz (2006) used an 85 country panel data set on which they applied bivariate Granger causality tests. They established that in developing countries there is a definite causal relationship running from agriculture to economic growth, but in the developed countries evidence were inconclusive. In five developed countries, i.e. Australia, Canada, the Netherlands, the UK, and the US, the causality run from agriculture value added to GDP growth, while in the remaining developed countries the opposite occurred. The authors attributed the results for the five countries to their highly competitive agriculture considering them as exceptions, and they interpreted the developed country case as one where agriculture does not cause economic growth. Awokuse (2009) estimated an autoregressive distributed lag econometric model for 15 developing countries in Africa, Asia, and Latin America, and concluded that agriculture causes economic growth. Matahir (2012) employed Granger and Toda-Yamamoto causality tests on co-integrated annual value added time series data of both agriculture and industry in Malaysia for the period 1970–2009, and established a one-way causal relationship running from industrial growth to agriculture both in the short and long run. This result is

[8] For a short but thorough presentation see Tiffin and Irz (2006).

[9] See Awokuse (2009) and Tsakok and Gardner (2007).

consistent with the findings of Gemmell et al. (2000) who concluded that although manufacturing growth reduces agriculture's output in the short run, it stimulates the latter's expansion in the long run, while services' growth have adverse effects on agriculture both in the short and long run periods. Hye (2009) in an econometric study employing an autoregressive distributed lag model for Pakistan for the 1971–2007 period established that agriculture and industry have a bidirectional causality in the short run, while there is a one way causal relationship from industry to agriculture in the long run. Subramanian and Reed (2009) studied the relationship between agriculture and non-agricultural sectors in Romania and Poland. They concluded that, in the long run, sectors outside agriculture have positive effects on the latter, but in the short run industry harms agriculture. Agriculture seems to affect positively the industrial sector in the West African States according to Seka (2009), who has run Granger type causality tests. Kanwar (2000) using a Vector Autoregressive Regression Model and running Granger type causality tests in a multi sector time series framework for India concluded that agriculture along infrastructure and services cause growth in both industry and construction as opposed to industry that does not cause growth in agriculture. On the contrary, Paul (2010) found that industry and services cause growth in agriculture for India, while Chaudhuri and Rao (2004) concluded that there is a bidirectional causality between agriculture and industry in the same country.

It is evident from the above cited, though non exhaustive list of more recent empirical research employing the state of the art econometric techniques that there is no firm conclusion on the causal relationship between industrial and agricultural growth. The aim of the current paper is to contribute to the empirical discussion of the issue by investigating the case of Greece. Greece adopted a development strategy focused on industrialization in the early 1950s, and it managed to transform its economy from an agrarian to industrialized one by the 1970s creating new industries, changing the composition of industrial output in favor of intermediate and capital goods sectors, and shifting the gravity of its exports away from agriculture and in favor of manufacturing. However, the dynamics of industrialization reached a stalemate in the 1970s under the presence of the first and the second oil shocks and the emergence of new sources of international competition on the part of the then called newly industrialized economies of South-East Asia, which triggered a course of de-industrialization and returned the emphasis to traditional consumer goods industries, such as textiles, food, etc., forming the main share of industrial output and coupled with a considerable rise of services in terms of both GDP contribution and employment.[10] Greek agriculture reduced its GDP share from 29 % in 1951 to just above 12 % in 1970 and to 3.4 % in 2007, but rural employment maintained a considerable 15 % share of total employment in 2007 compared with 55.7 % in 1970, and almost 60 % in 1951. Greece recorded structural transformations becoming a developed country, member of the European Union since 1981, and member of the Euro zone since 2002. These structural transformations in addition to the development course followed by Greece in the

[10] See Kyrkilis (2005).

post war period may constitute Greece as an interesting case different from other recently investigated cases, which are developing economies. The paper aspires to investigate the contribution of agriculture to Greek economic growth using a VAR econometric model for running an Error Correction Model aiming at establishing causal relationships within a multi-sectoral framework, i.e. agriculture, industry, construction, wholesale and retail, financial intermediation, and other services for the period 1970–2007.

2 Data and Hypothesis

The data set consists of 38 annual observations, which represent the Gross Value Added (GVA) of six aggregate sectors of the economy; i.e. agriculture, industry, construction, wholesale, financial intermediation, and other services for the period 1970–2007. The data are adopted from OECD database (http://stats.oecd.org). Figure 1 shows the intertemporal evolution of sectoral GVAs. It is obvious that all the non-agricultural sectors show similar evolution (i.e. increasing), whereas agriculture shows a severe decline after the year 2000.

Agriculture's value added in 2007 was €5,526 millions at constant 2000 prices (3.5 % of the total value added), lower than its level in 1970, i.e. €6,164 millions at constant 2000 prices or 12.1 % of the total value added of the economy. In the same period, all other economic sectors increased their value added at constant prices, but only trade achieved a substantial increase from almost 20 % to almost 35 % of total value added with both construction and other services reducing their shares from 12.5 % to 8.0 % and from 23.7 % to 21.6 % respectively, while financial intermediation managed a moderate increase from 14.4 % to 17.3 %, and industry maintained a share of approximately 13.5 %. Industry reached its highest share at the end of the 70's, i.e. just about 16 % in 1979 and stagnated thereafter.[11]

The application of the European Common Agricultural Policy restructured agricultural production in favor of subsidized crops such as cotton, cereals and few others reducing production of high value added products such as vegetables, olive and olive oil; aromatic and pharmaceutical herbs, etc. The reduction of agriculture production became more potent after the disconnection of subsidies from output levels during 2005. Agriculture gross value added declined to levels below their equivalent in 1970. There are indications that agriculture may have some significant forward linkages with manufacturing. According to Nikolaidis (2010), the majority of its output, i.e. 72.6 % supplies intermediate domestic demand while only 19.1 % supplies the domestic final demand, 7.1 % is directed to exports and only 1.2 % to gross fixed capital formation. These figures show that agriculture is a main material supplier of other domestic economic sectors. At the same time, according to 2003 data, the intermediate consumption of agriculture as percentage of final output is low, i.e. 24.1 % compared with 48.3 % average for the EU-15.

[11] Data are adopted by OECD, www.stats.oecd.org.

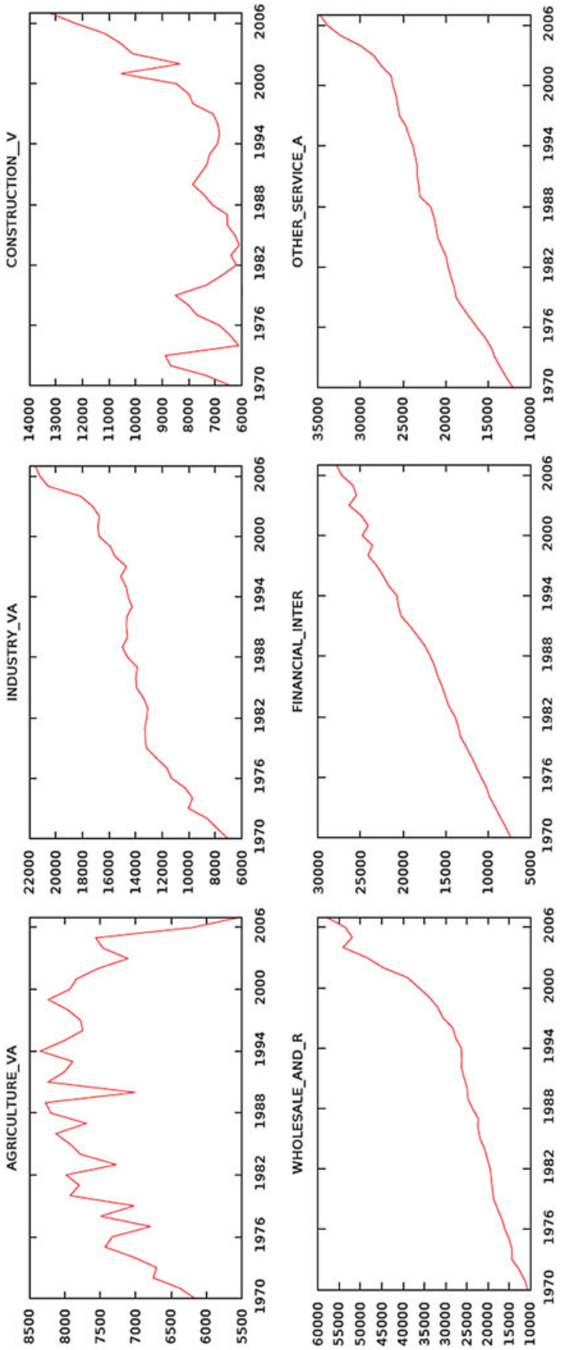

Fig. 1 GVA evolution of aggregate sectors in Greek economy from 1970 to 2007

This is true for almost all categories of intermediate consumption such as fertilizers, pesticides, feed, equipment, building, maintenance, expenditure on services, with the exception of energy. Although low share of inputs to output means higher value added, it also indicates low backward linkages with non-agricultural sectors; low yields, low quality of products, and finally low competitiveness. Agriculture fails to incorporate technological advances remaining a labor intensive activity.

The emerging picture gives rise to the hypothesis that agriculture cannot be an engine of growth due to low backward linkages. At the same time, the probability that agriculture growth is driven by the growth of other sectors, especially manufacturing is low given its diminishing value added and its increasing focus on a limited number of products. Despite that, some forward linkages with other economic sectors do exist.

3 Methodology

Following the main strand of relevant research, the paper adopts the methodology developed by Johansen and Juselius (1992); i.e., a multivariate co-integration analysis is conducted using a vector auto regression (VAR) model. This analysis is based on the estimation of a VAR model by maximum likelihood. The reason for the selection of this methodology is that it is characterized by independency of the choices of the endogenous variables. Furthermore, the existence of more than one co-integrating vectors in the multivariate system can be scanned through the application of the Johansen and Juselius's methodology.

For the co-integration analysis, the aggregate division of sectors of the economy is adopted. These sectors are agriculture, industry, construction, wholesale trade, financial intermediation, and other services. In order to estimate the contribution of each sector to the economy, sectoral gross value added data is utilized. The analysis of the correlation matrix provides some indication on the relationship of these sectors. These hinds are further analyzed through the co-integration analysis. Detailed descriptions of this method are found for example in Engle and Granger (1987), Hamilton (1994), Johansen (1995), or Banerjee et al. (1993).

In time series regressions the data need to be stationary. This requires that the means, variances and co-variances of the data series cannot depend on the time period in which they are observed. For the specific test, the methodologies of Perron (1989) and Zivot and Andrews (1992) were utilized. It was ascertained that the existence of a possible structural break did not alter the statistical characteristics of the series under examination; therefore, they should be used in the econometric analysis as non stationary.

The relevant terms for stationarity of a stochastic process, as well as the test methods for the level of integration can be found in Tambakis (1999), Johansen et al. (2000), Juselius (2006). To test for stationarity, the Augmented Dickey-Fuller (ADF) test via Ordinary Least Square (OLS) was applied. The ADF test estimates the following equation:

$$y_t - y_{t-1} = \Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \varepsilon_t,$$

The null hypothesis of the ADF test is that the time series has a unit root and is not stationary, which means that $\alpha_1 = 0$. Rejecting this hypothesis concludes that the series is stationary. Accepting the null means that the level is not stationary.

A Vector Error Correction Model (VECM) is a form of vector auto regression or VAR, applicable where the variables of the model are individually integrated of order 1 (that is, are random walks, with or without drift), but exhibit co-integration.

The Johansen and Juselious estimation method presupposes the estimation of the following relationship:

$$\Delta \mathrm{Y_t} = \mu + \gamma_1 \Delta \mathrm{Y_{t-1}} + \gamma_2 \Delta \mathrm{Y_{t-2}} + \ldots\ldots. + \gamma_{\mathrm{p-1}} \Delta \mathrm{Y_{t-p+1}} + \Pi \mathrm{Y_{t-p}} + \mathrm{ut},$$

The model above was used in order to examine the Granger causal relationships between the variables under examination. As a testing criterion the F statistic was used. With the F statistic the hypothesis of statistical significance of specific groups of explanatory variables was tested for each separate function.

4 Empirical Application and Results

The time series plot (Fig. 1) reveals potential problems with the gross value added data related to non-stationarity. Since the actual values indicate some level of non-stationarity, the logarithmic transformation is used for reducing variability of the variables. The graphical representation of the logarithms of the variables (Fig. 2) suggests stationarity. The first step is to test the series stationarity and to determine the order of integration of the examined variables.

With the exception of agriculture, all other variables appear to be slightly quadratic in time. Hence, we choose an ADF test that includes a constant and a time trend. The results of the test, using the Gretl software, are shown in Table 1.

In this respect none of the data series is non-stationary when the test refers to the logarithms of variables, (i.e. fail to reject the unit root hypothesis). According to these results, the logarithms of the variables, when transformed to first differences, become stationary and, consequently, the relevant variables could be described as integrated of order one I(1). Table 2 presents the summary statistics of the data, i.e. time series.

The correlation matrix of the variables (logarithms and first differences of logarithms of GVA) is presented in Table 3 and it provides some interesting insights, even before conducting the co-integration analysis. According to the correlation indices, agriculture shows minimum correlation with the rest of the sectors, whereas industry, wholesale trade, and financial intermediation exhibits quite high correlation indices. These findings suggest that there is a weak relation of agriculture with the rest economic sectors, which is translated to a differentiated growth path.

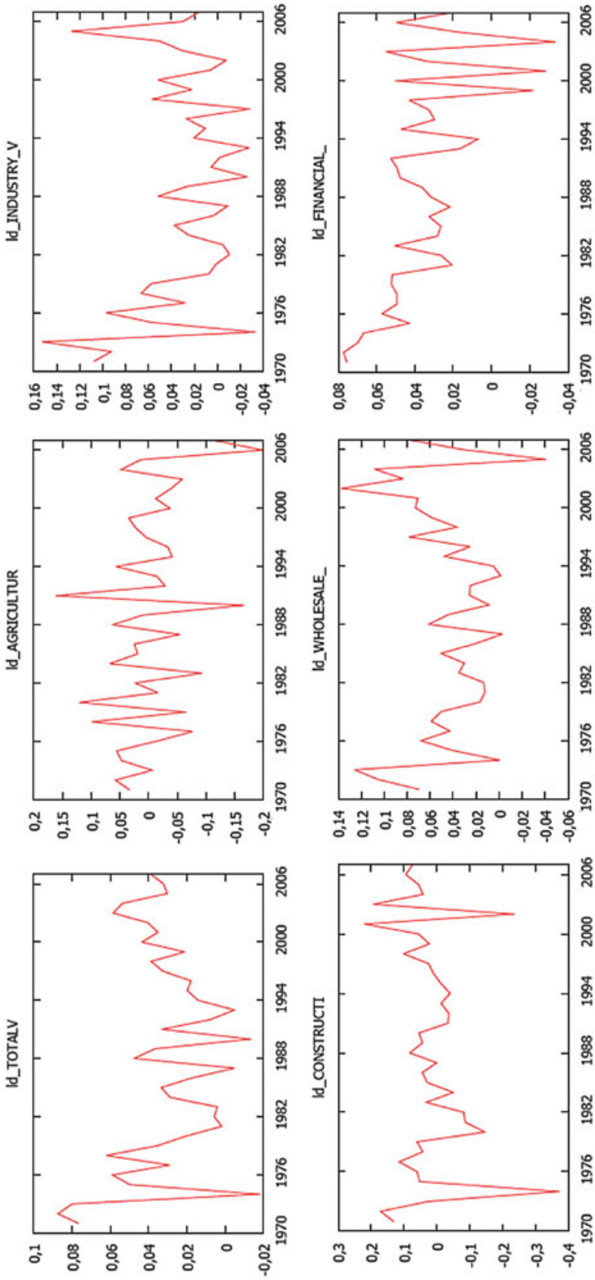

Fig. 2 Logarithmic depiction of the GVA of the aggregate sectors of the Greek economy

Table 1 Augmented Dickey – Fuller (ADF) test for unit roots (lag 1)

Variables	Test values
Logarithms	
Agriculture	−1.97151
Industry	−2.79543
Construction	−0.745465
Wholesale	−0.0354297
Financial intermediation	−3.42533
Other services	−0.647655
First differences	
Agriculture	−7.29704
Industry	−4.97359
Construction	−6.45665
Wholesale	−4.50284
Financial intermediation	−5.28263
Other services	−4.19505

Critical value at 1 %: −4.431, at 5 %: −3.5348, at 10 %: −3.322

Table 2 Summary statistics

	Average	St.D.
l_AGRICULTURE	8.91656	0.0948415
l_INDUSTRY_VA	9.52981	0.246541
l_CONSTRUCTION	8.95336	0.196156
l_WHOLESALE_A	10.1072	0.444743
l_FINANCIAL_I	9.71322	0.384561
l_OTHER_SERVICES	9.97302	0.264011
d_l_AGRICULTURE	−0.00295155	0.0726899
d_l_INDUSTRY_	0.0301827	0.0436051
d_l_CONSTRUCTION	0.0195159	0.109494
d_l_WHOLESALE	0.0457949	0.0378858
d_l_FINANCIAL	0.0360502	0.0254476
d_l_OTHER_SERVICES	0.0286326	0.0200336

In order to assess these suggestions and to test for causality, a VAR econometric model is applied. Since it has been determined that the variables under examination are integrated order I(1), we then proceed by defining the number of co-integrating vectors between the variables, using the Johansen (1988) maximum likelihood procedure. Results are shown in Table 4.

In this respect, we proceed with the Vector Error Correction Model (VECM), in order to estimate relationships both in the short and long-run and determine their direction. The vector error correction model contains the co-integration relation built into the specification, so that it restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics.

Table 3 Correlation matrix

l_Agriculture	l_Industry_VA	l_Construction	l_Wholesale_A	l_Financial_I	l_Other_Services	
1.0000	0.2341	−0.4513	0.0954	0.2983	0.2070	l_AGRICULTURE
	1.0000	0.5732	0.9457	0.9429	0.9805	l_INDUSTRY_VA
		1.0000	0.6847	0.4987	0.5751	l_CONSTRUCTION
			1.0000	0.9552	0.9746	l_WHOLESALE_A
				1.0000	0.9811	l_FINANCIAL_I
					1.0000	l_OTHER_SERVICES
d_l_Agriculture	**d_l_Industry_VA**	**d_l_Construction**	**d_l_Wholesale**	**d_l_Financial_I**	**d_l_Other_Services**	
1.0000	0.1746	−0.2412	−0.0174	−0.0692	0.0232	d_l_AGRICULTURE
	1.0000	0.4434	0.3304	0.2569	0.6656	d_l_INDUSTRY_
		1.0000	0.2521	−0.0662	0.1839	d_l_CONSTRUCTION
			1.0000	0.0733	0.3019	d_l_WHOLESALE
				1.0000	0.2331	d_l_FINANCIAL
					1.0000	d_l_OTHER_SERVICES

Table 4 Co-integration tests, ignoring exogenous variables

Rank	Eigenvlaue	Trace test p-value	Lmax test p-value
0	0.96194	139.43 [0.0000]	120.94 [0.0000]
1	0.39330	18.490 [0.0000]	18.490 [0.0000]

Table 5 Results of the VECM model (1 lag)

	Beta
l_AGRICULTURE	1.0000
	(0.00000)
l_INDUSTRY_VA	5.5934
	(0.42141)
l_CONSTRUCTION	1.7224
	(0.17709)
l_WHOLESALE_A	10.149
	(0.47110)
l_FINANCIAL_I	2.1645
	(0.31352)
l_OTHER_SERVICES	7.3518
	(0.88417)
Const	76.050
	(4.1492)

Results are shown in Table 5. The number of significant co-integration vectors is equal to four. The presence of those vectors indicates that there is a differentiation in the long-run and short-run growth mechanism in the Greek economy (Table 6).

The results show clearly that industry, construction, and wholesale trade are the sectors that drive the economic growth. On the contrary, agriculture, and financial intermediation show moderate impact on economic growth (in the short run). Furthermore, and in line with the insights gained by the correlation analysis, according to the Granger test, agriculture shows no impact on any other sector. The short run Granger causality test indicates that there are no causal relationships between agriculture and the rest economic sectors.

5 Conclusions

The present paper attempts to contribute to the empirical investigation of the causal relationship between agriculture and economic growth. In doing so it employs an error correction model using time series data of the value added of five broadly defined economic sectors, i.e. agriculture, industry, construction, wholesale and retail trade, financial intermediation, and other services. These time series sets are proven to be co-integrated at the first level. The model is applied in Greece for the period 1970–2007. Results show that the agricultural output neither causes nor it is caused by the evolution of the non-agricultural sector output. Our results suggest that although the other sectors have moved together through time, agriculture in

Table 6 Error correction model estimations

	Coef.	StD	t-value	p-value
d_l_AGRICULTURE				
l_TOTALV	0.562984	0.479089	1.1751	0.24811
EC1	−0.0184424	0.0156855	−1.1758	0.24786
d_l_INDUSTRY_VA				
l_TOTALV	1.38586	0.174293	7.9513	<0.00001***
EC1	−0.045288	0.00570641	−7.9363	<0.00001
d_l_CONSTRUCTION				
l_TOTALV	2.1932	0.632787	3.4659	0.00145***
EC1	−0.0717493	0.0207176	−3.4632	0.00146***
d_l_WHOLESALE_				
l_TOTALV	1.14456	0.163194	7.0135	<0.00001***
EC1	−0.0373426	0.00534303	−6.9890	<0.00001***
d_l_FINANCIAL				
l_TOTALV	0.274316	0.168113	1.6317	0.11196
EC1	−0.00887926	0.00550407	−1.6132	0.11594
d_l_OTHER_SERVICES				
l_TOTALV	0.497971	0.105666	4.7127	0.00004***
EC1	−0.0162222	0.00345953	−4.6891	0.00004***

***means statistical significance at 1%

Greece seems to have followed its own course quite independently from the rest of the economy without utilizing or building intersectoral linkages. Future research on exploring relationships between sectors will assist in explaining the overall growth path of the Greek economy.

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