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Structural Change and Economic Growth in Schengen Region

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ABSTRACT

The structural change of economy entails that in the long run how the dynamics of three main sectors (i.e., agriculture, industry and services) are related to economic growth. We conduct Granger non-causality tests with data from 15 Schengen countries in period 1970-2012. The results confirmed that industry sector is still the “engine” of economy and the larger service sector retards the gross domestic product per capita (GDPc) growth rate in Schengen region. The results support Baumol’s argument concerning the productivity differences and their growth effects across the sectors.

Keywords: Sector Shares, Economic Growth, Panel Data, Co-integration, Error Correction
JEL Classifications: E1, E2, J, O1, O4

1. INTRODUCTION

A debate exists why structural changes occur in the industrial countries. The neoclassical growth approach is based on the view that structural change is an unimportant side effect of the economic development (Echevarria, 1997). On the other hand economist associated with the World Bank, including Kuznets (1971), Rostow (1971), Chenery and Syrquin (1975), and Baumol et al. (1989) posit that growth is brought by the changes in economy’s sectoral composition. Thus there exist two main schools in the economic literature on how sectoral composition and growth interrelate. Some progress has lately taken place to combine these strains of literature.

A minimum condition for a positive effect of sector changes on economic growth is that there is a net shift of resources out of sectors with relatively low productivity level to sectors with high productivity levels. Thus a sector with high productivity level and productivity growth should be positively related with economic growth. Typically we can still divide an economy into three main sectors: Agricultural or primal, industrial, and services sectors. Theoretically there exist conflicting arguments how these sectors are related to economic growth and development, i.e., how the shares of three major sectors develop in time. Thus, shifts of resources, output and employment between different sectors accompanying the process of economic growth are recognized as a possible challenge for adjustment in industrial economics. The mainstream hypothesis in economics tends to classify this as a short-term problem of adjustment. The challenge of combining a model of stable growth along a steady path with structural change between sectors with different productivity paths was formulated by Baumol (1967). In this model the service sector as the stagnant sector with low productivity growth attracts labour and thereby lowers the overall growth rate of the economy (Kratena, 2005). It has been shown (Echevarria, 1997; Kongsamut et al. 2001; Bonatti and Felice, 2008) that whether Baumol’s pessimistic outcome is reproduced or not depends on the functional forms of the utility function of consumers, and on the differences in technological progress between the sectors. However, typically the structural changes ceases when the stable path is reached. Baumol’s result changes also considerably by taking into account intermediate demand for services. In the case the small productivity increases in the services sector are not a threat for an overall stable rate of growth (Oulton, 2001).

Balanced growth models (BGM) are based on the Kaldorian facts. These “great ratios” imply that in the long run growth rate of output, the capital-labour ratio, and the labour and capital income shares are roughly constant over time. However so-called “Kuznets facts” refer to reallocation process taking place in the economy’s sectoral shares during its development. This structural change entails that income share of agriculture declines and share of services increases in the economy. These sectoral dynamics are associated with the rise in per capita income. BGM generally disregards the observed reallocation experienced by all expanding economics partly because the Kuznets facts apply for longer time period than Kaldorian facts. After all one property of BGM is that the fraction of capital and labour allocated to different industries (sectors) remain constant over time. In response to this, Kongsamut et al. (2001) proposed a generalized growth path model wherein balanced growth is consistent with the dynamics of structural change. However the result is an outcome of quite demanding restrictions on sector endowments.

With respect to arguments above we argue that the main empirical question is how the sectoral shares are related to gross domestic product per capita (GDPc) growth across the Schengen region. This question is analyzed with data from 15 Schengen countries in period 1970-2012. We conduct Granger non-causality (GC) tests over the sample countries. We observe that industry sector is still the "engine" of economy and the larger service sector retards the GDPc growth rate.

The paper is organized as follows. Section 2 reviews in more details the structural change in the sample countries. Section 3 presents models and estimation procedure. The results are presented in Sections 4. Conclusions with some discussion are given in Section 5.

2. STRUCTURAL CHANGES AND ECONOMIC GROWTH

2.1. Economic Growth and Sector Shares in European Countries

In order to get the first impression how sector shares relate with long run growth rate of output we must first determine the appropriate variables to measure expansion of each sector. In this case GDP shares of each sector and the growth rate of output can be used as variables. We use real GDPc growth rate as variable to capture economic growth. We report the results without time averaging of the data in order to capture all dynamics between economic growth and sector shares. Annual percentage growth rate of GDPc (Δln GDPc) is based on constant 1995 US$ prices. Appendix 1 for more details on data.

Figures 1-3 report the economic growth and structural change history in sample countries over the period 1970-2012. Casual observation supports the Baumol stagnancy result. The rate of growth for per capita income has fallen almost for all countries and share of industrial sector is decreasing while the share of services sector is increasing. Note also that there has been some economic growth convergence between the most advanced Schengen countries during the period (Linden, 2002). All countries enjoyed higher growth rates in period from 1950 to 1990. However during period of 1970-2012 convergence took place also in sector shares across the countries. The variation of sector shares in 1971-1980 was higher than in 1991-2000 (Appendix 2).

Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing as well as cultivation of crops and livestock production (Appendix 1). Graphs in Figure 1 show a long decreasing trend for whole panel of countries except Netherlands and Iceland.

Industry corresponds to ISIC divisions 10-45. It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas (Appendix 1). Graphs in Figure 2 show clear declining trends for all countries except for Norway.

Services correspond to ISIC divisions 50-99 (Appendix 1). Graphs in Figure 3 show upward trends for all countries except Norway.

In general the increase of service sector share of GDP across the countries during period 1970-2012 is evident. This has happened with cost of agricultural and industry shares. However the GDPc effects of these trends are not self-evident since the level of GDPc and growth of GDPc may have feedback effects on sector dynamics that are not uniform across the sectors.

2.2. Relationship between Sector Shares of Production and GDPc

The relationship between the level GDPc and sectoral shares are represented in Figure 4. Figure shows a quite clear pattern. Services sector is clearly positively related with GDPc level. This is due to the fact that GDPc for all the sample countries has increased over the last three decades and share of services sector has also been increasing. In response to this industrial and agricultural shares are showing negative patterns with the level of GDPc.

The relationship between sector shares and growth rate of GDPc (Δln GDPc) is given in Figure 5. The outcome is quite different compared to preceding figure with the level of GDPc. We detect a negative pattern between the share of services sector and GDPc growth but industrial shares show non-negative pattern. Agriculture sector shows small positive pattern. The opposite patterns in Figures 4 and 5 suggest the importance of dynamics of sector shares to growth rate of output per capita.

The expansion of the service sector relative to the rest of the economy leads to a reduction in the long run rate of growth of output per capita because production of services needs less physical capital compared to other sectors (Baumol et al., 1985; Bjork, 1999; Wolff, 1985b)[1]. The dramatic rise in the share of the services in total economic activity during the post war periods is often cited as a major factor in the apparent productivity slowdown in the U.S. and in other advanced economies during the late 1960s and early 1970s. Note that IT-revolution that started in early 1990s' may alter the role of service sector in the post-industrial economics. However the empirical results are still quite mixed (Colecchia and Schreyer, 2002; Nordhaus, 2006, Jorgenson et al., 2003).

There is no direct theory that explains how share of agricultural sector is related to economic growth in post-industrial economy. We can explain this phenomenon indirectly by the fact that when an

1 Note that services sector also includes the services provided by the government, i.e., education, health and defense.

Figure 1: Agriculture shares of gross domestic product (% of gross domestic product) for 15 European Countries in 1970-2012

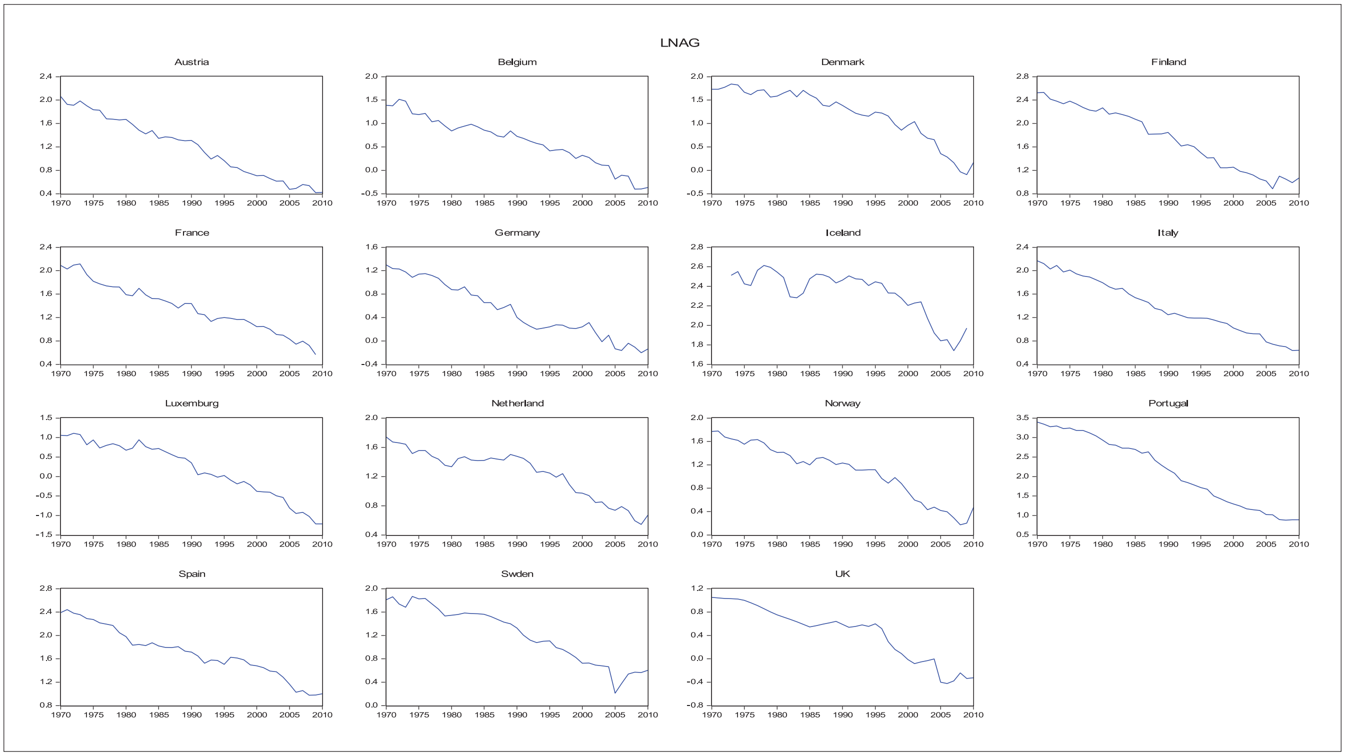


Figure 2: Industry shares of gross domestic product (% of gross domestic product) for 15 European countries in 1970-2012

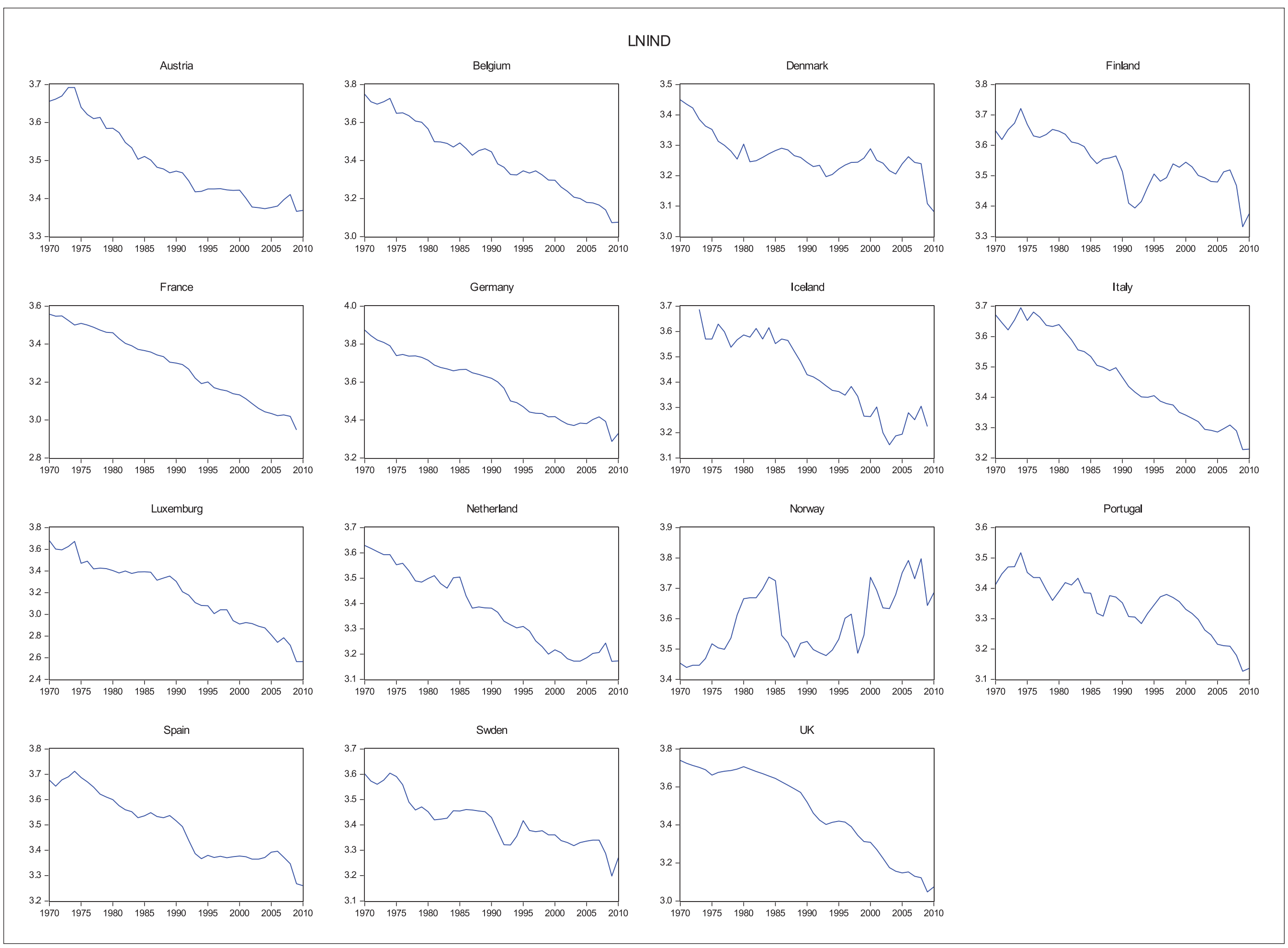
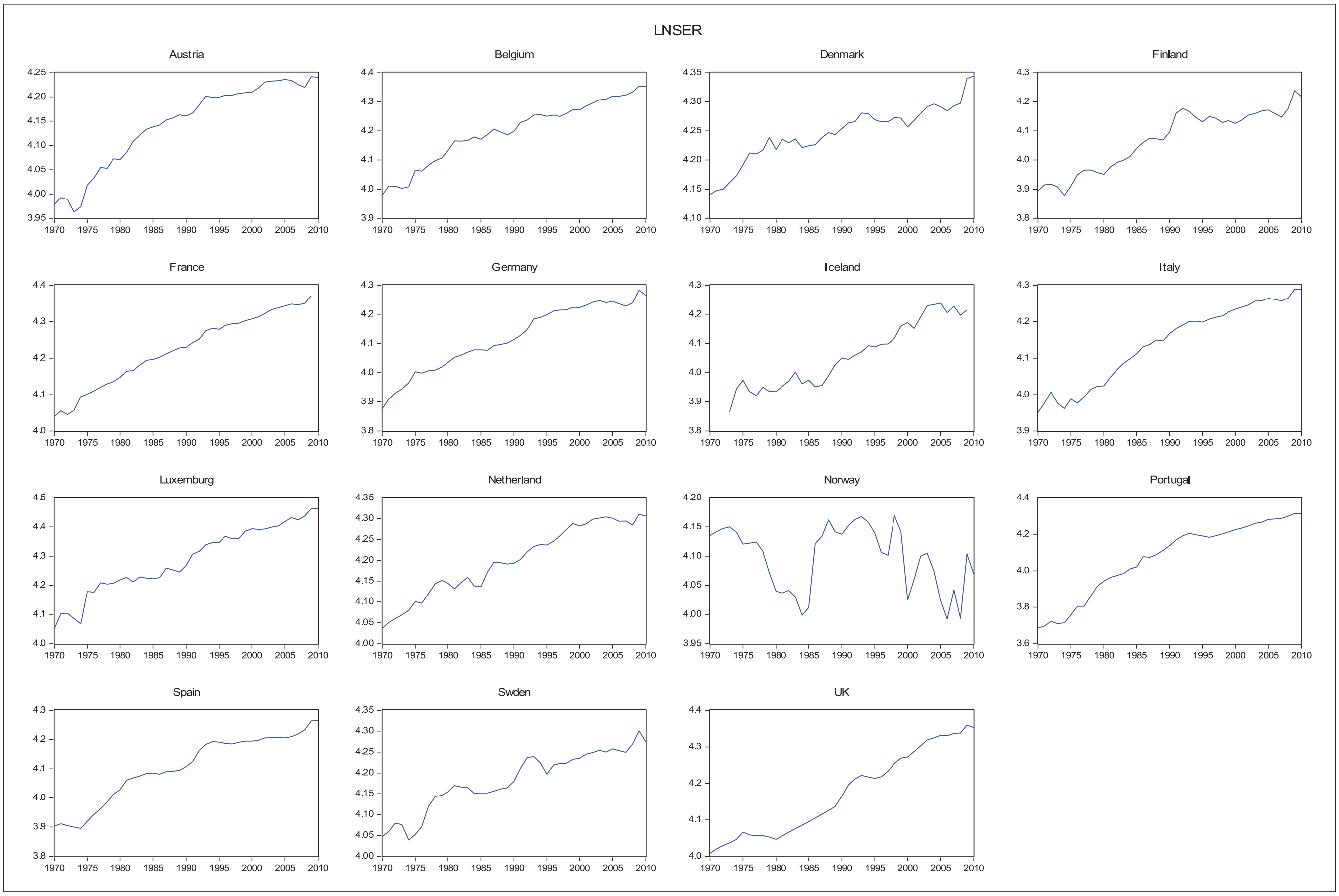


Figure 3: Service shares of gross domestic product (% of gross domestic product) for 15 European countries in 1970-2012



economy develops then the labour still moves from the traditional sector to the modern sector where labour productivity and wages are higher. Thus in European countries the share of agriculture sector declines still but slower than earlier. In this case we expect no relationship between share of agriculture sector and growth rate. However Gopinath et al. (1996) find that in U.S. productivity gains in agricultural feed back into the food processing industry, i.e., two sectors correlate positively.

3. MODELS AND ESTIMATION PROCEDURE

3.1. Model

Considered following production function type relationship between GDP volume and its main sector sources.

$$Q_t=F(I_t,S_t,A_t) \tag{1}$$

Where I_t is industrial output, S_t is service output, and A_t is the output in primary sector (agriculture etc.) all measured with some physical units.

Total differentiation linearizes the equation.

$$dQ_t=F_I dI_t+F_s dS_t+F_A dA_t \tag{2}$$

Where F_i with i = I, S, and A are the partial derivates of different sectors. Dividing equation with Q_t and augmenting it with sector outputs gives.

$$\frac{dQ_t}{Q_t}=\frac{F_I}{Q_t}dI_t\frac{I_t}{I_t}+\frac{F_S}{Q_t}dS_t\frac{S_t}{S_t}+\frac{F_A}{Q_t}dA_t\frac{A_t}{A_t}$$

A closer inspection of this is

$$\frac{dQ_t}{Q_t}=\frac{\partial F_I}{\partial I_t}\frac{I_t}{Q_t}\frac{dI_t}{I_t}+\frac{\partial F_S}{\partial S_t}\frac{S_t}{Q_t}\frac{dS_t}{S_t}+\frac{\partial F_A}{\partial A_t}\frac{A_t}{Q_t}\frac{dA_t}{A_t}$$

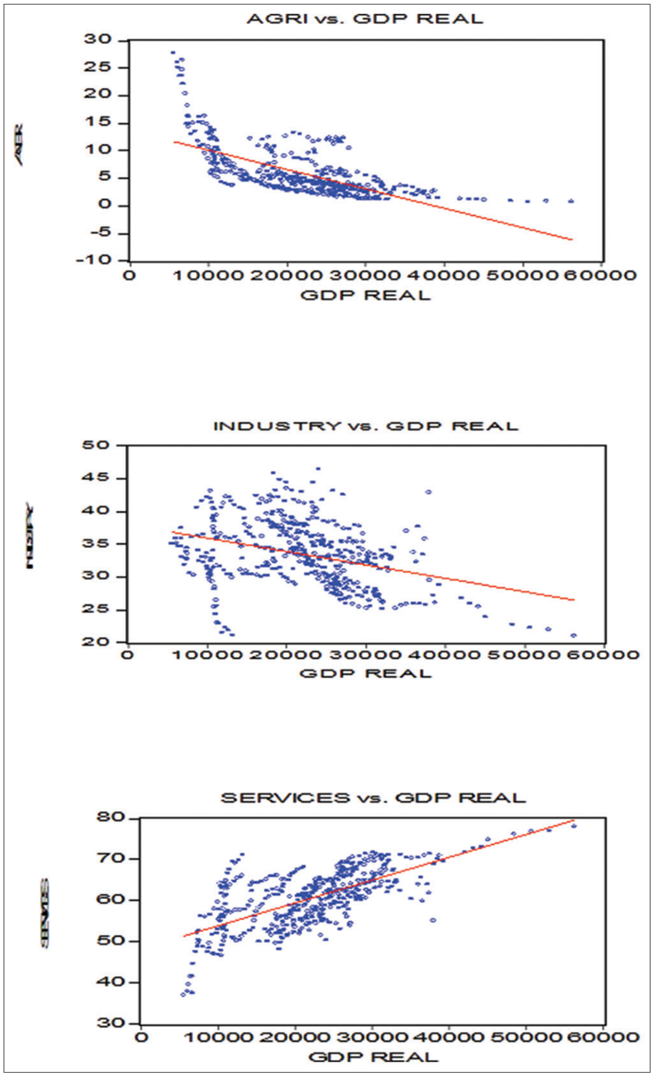
$$\frac{dQ_t}{Q_t}=\alpha_I\frac{dI_t}{I_t}+\alpha_S\frac{dS_t}{S_t}+\alpha_A\frac{dA_t}{A_t} \tag{3}$$

Under assumption of constant sectoral output GDP elasticities (α_I, α_S, α_A) this specification leads to a) model with variables $\frac{dQ_t}{Q_t}$, $\frac{dI_t}{I_t}$, $\frac{dS_t}{S_t}$, and $\frac{dA_t}{A_t}$ since any exogeniety assumptions cannot be used in this context without prior information. Alternative, if we assume that competitive conditions prevail between the sectors then the marginal product pricing rule can be used, e.g. $F_{It}=w_{It}$ where w_{It} is the real marginal cost of industry sector output. Now we have

$$\frac{dQ_t}{Q_t}=\frac{w_{It}I_t}{Q_t}\frac{dI_t}{I_t}+\frac{w_{St}S_t}{Q_t}\frac{dS_t}{S_t}+\frac{w_{At}A_t}{Q_t}\frac{dA_t}{A_t}$$

$$\frac{dQ_t}{Q_t}=W_{It}\frac{dI_t}{I_t}+W_{St}\frac{dS_t}{S_t}+W_{At}\frac{dA_t}{A_t} \tag{4}$$

Figure 4: Relationship between real gross domestic product per capita and sector shares in 15 European Countries 1970-2012



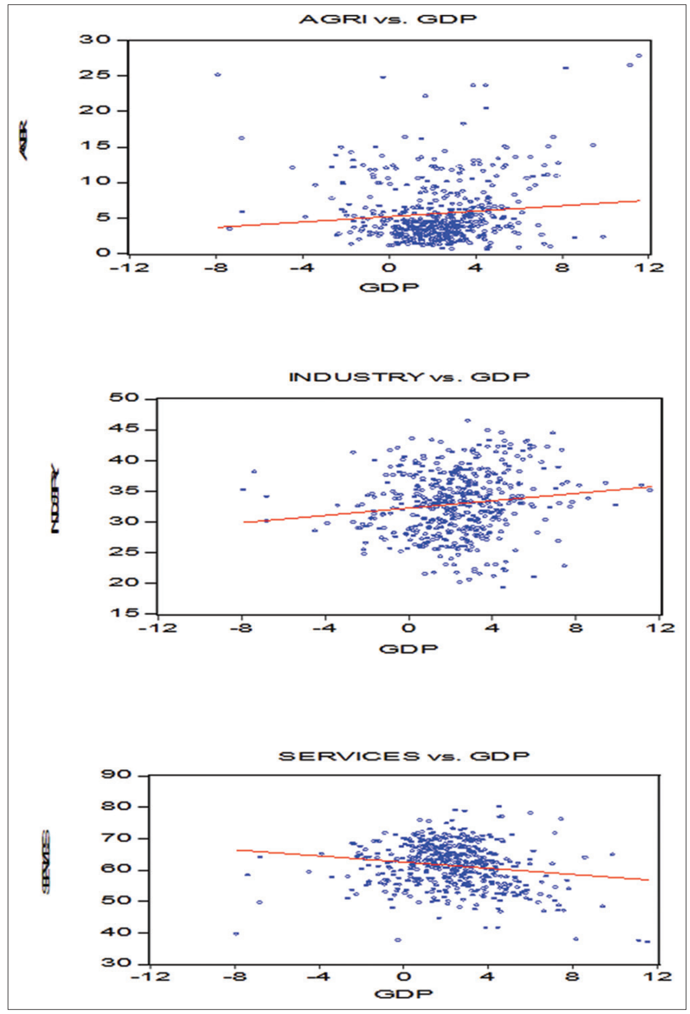
Where $W_{I,t}$ W_{St}, and W_{At} are the sector shares of output measured by production costs in these sectors. Next, if we assume that long run growth rates of sector outputs, i.e., $\frac{dI_t}{I_t}, \frac{dS_t}{S_t}$ and $\frac{dA_t}{A_t}$ have stationary presentations, then

$$\left.\begin{aligned} \frac{dI_t}{I_t} &= g_I + \varepsilon_{It}, \varepsilon_{It} \sim I(0) \\ \frac{dI_t}{S_t} &= g_S + \varepsilon_{St}, \varepsilon_{St} \sim I(0) \\ \frac{dI_t}{A_t} &= g_A + \varepsilon_{At}, \varepsilon_{At} \sim I(0) \end{aligned}\right\} \quad (5)$$

Where g_I, g_S and g_A are long run (constant) growth rates, and I(0) refers to stationary error process. Inserting these into growth decomposition in equation 4, we get following:

$$\frac{dQ_t}{Q_t} = (g_I + \varepsilon_{It})W_{It} + (g_S + \varepsilon_{St})W_{St} + (g_A + \varepsilon_{At})W_{At}$$

Figure 5: Relationship between real gross domestic product per capita growth and sector shares in 15 European Countries 1970-2012



$$\frac{dQ_t}{Q_t} = g_I W_{It} + g_S W_{St} + g_A W_{At} + \varepsilon_{Qt} \quad (6)$$

Where

ε_{Qt}-I(0)

As we know from equation 5 that g_I, g_S and g_A are constant. Therefore equation 6 can be written as following:

$$\frac{dQ_t}{Q_t} = \alpha W_{It} + \beta W_{St} + \gamma_A W_{At} + \varepsilon_t \quad (7)$$

Here in equation 7 W_{It}, W_{St}, and W_{At} are the shares of industrial, services and agriculture sector respectively and $\frac{dQ_t}{Q_t}$ is growth arte of GDP. In our analysis we use growth rate of GDPc as proxiy for economic growth, therefore we have following pannel data econometric model.

$$\ln\Delta GDPc_{it} = \alpha_0 + \alpha \ln W_{Iit} + \beta \ln W_{Sit} + \gamma_3 \ln W_{Ait} + \varepsilon_{it} \quad (8)$$

Where $\Delta \ln GDPc_{it}$ is growth rate of GDPc, W_{Iit} is shares of industrial sector, W_{Sit} is shares of services sector W_{Ait} is shares of services sector in country i. Subscript is used for cross section t is used for time period. Ln is natural log. We analyze 15 cross sections from 1970-2012.

3.2. Estimation Procedure

3.2.1. Panel unit root tests

The data depicted above show a clear trending behavior for the share of agriculture, industry and share of services sector (Figures 1-3). A question rises that are the series trend or difference stationary. In last few years we have witnessed a growing interest in non-stationary (or difference stationary) panels (Baltagi, 2008). However non-stationary panels include some unique issue such as cross-sectional heterogeneity and correlation. As with non-stationary time series the interest in the panel unit root test has extended to the panel co-integration tests. Next we use five different panel unit root tests to panel of series across the countries, i.e., we analyze growth rate of GDPc ($\Delta \ln GDPc_{it}$), industrial share, (W_{It}) services share (W_{St}), and agriculture share (W_{At}), for 15 cross sections with 40 time periods (1970-2012). Tests by Levin, Lin, and Chu (LLC, 2002), and Breitung (2000), Im et al. (IPS, 2003), and Fisher- augmented Dickey-Fuller and PP-tests by Maddala et al. (1999) are used. Table 1 gives a summary of different panel unit root tests.

Tables 2 and 3 present the panel unit root test results for the level of analyzed series and their first difference, respectively. Table 2 indicates that ($\Delta \ln GDPc_{it}$) is a stationary with all tests. Agriculture share shows stationary only in LLC-test and PP-test but failed to show stationary in all other three tests. Results in Table 3 indicate that all panel first-difference series ($\Delta \ln GDPc_{it}$), ($\Delta \ln W_{It}$), ($\Delta \ln W_{St}$), and ($\Delta \ln W_{At}$) are all stationary at 1% level of significance.

The unit root panel testing indicates that the growth rate of GDPc series ($\Delta \ln GDPc_{it}$), ($\Delta \ln W_{It}$), ($\Delta \ln W_{St}$), and ($\Delta \ln W_{At}$) are stationary. Hence we will write equation 8 as following:

$$\Delta \ln GDPc_{it} = \alpha \Delta \ln W_{Iit} + \beta \Delta \ln W_{Sit} + \gamma \Delta \ln W_{Ait} + \varepsilon_{it} \quad (9)$$

Where $\Delta \ln GDPc_{it}$ is growth rate of GDPc, $\Delta \ln W_{Iit}$, $\Delta \ln W_{Sit}$ and $\Delta \ln W_{Ait}$ are growth rate of the shares of industrial, services and agriculture sector. Where, $\alpha+\beta+\gamma=1$.

3.2.2. Fixed effects approach

The granger non causality analysis is conducted on the growth rates of sector share series, i.e., on $\Delta \ln Z_{it} = \Delta \ln W_{Iit}$, $\Delta \ln W_{Sit}$, or $\Delta \ln W_{Ait}$. The GC-testing is conducted in panel setting. Fixed effects[2] GC-test models can be written as follows:

$$\Delta \ln GDPc_{i,t} = c_i + \sum_{j=1}^{n} \rho_j \Delta \ln Z_{it-j} + \sum_{j=1}^{n} \delta_j \Delta \ln GDPc_{i,t-j} + \varepsilon_{i,t} \quad (4a)$$

2 Note that fixed effects OLS estimation method is used despite of the fact that in dynamic panel models parameter estimate are biased (Nickell 1981) because the lagged explanatory variables and residuals are correlated. However the bias is order of (1/T). This is not considered important in this context where T>30.

$$\Delta \ln Z_{it} = h_i + \sum_{j=1}^{n} \sigma_j \Delta \ln Z_{i,t-j} + \sum_{j=1}^{n} \tau_j \Delta \ln GDPc_{i,t-j} + \mu_{it} \quad (4b)$$

Where $\Delta \ln Z_{it} = \Delta \ln W_{Iit}$, or $\Delta \ln W_{Sit}$, ΔW_{Ait} j represents the lag length used for the analysis. We included up till five lags (n=5) to secure non-correlated errors. The null hypotheses in regression 4a), $\rho_j = 0$ for all j, imply that growth rates in sector shares do not Granger because economy wide growth rate. Similarly the hypothesis that GDPc growth rate does not Granger cause growth rates of sector shares is based on the regression 4b), i.e., $\tau_j = 0$ for all j. We use Wald test for testing the coefficient restrictions. The long run impact parameters can be solved with the following formulas:

$$A_{LR} = \sum_{j=1}^{n} \rho_j / (1 - \sum_{j=1}^{n} \delta_j) \text{ and } B_{LR} = \sum_{j=1}^{n} \tau_j / (1 - \sum_{j=1}^{n} \sigma_j)$$

4. RESULTS FROM GC TEST

Unidirectional causality runs from growth rate of GDPc to growth of agriculture share (Table 4). Agriculture share growth has no impact on economic growth but changes in agriculture shares are predicted by the past growth of GDPc. In post-industrialized Schengen countries the impact of growth of GDPc on growth of agricultural share is negative with value of −0.50. The agriculture products are relatively less expensive, which diminishes their share in GDP. Therefore, Granger cause suggests here that the sector has a low productivity and resources devoted to it are unproductive.

The GC-test values imply that bi-directional causality is valid between growth rates of GDPc and industry sector. For the Schengen countries the higher growth rate of GDPc means decreasing growth rate of industrial sector share (estimate for B_{LR} is −0.12). However, the long run net effect between growth rates of GDPc and industry share is 0.10 since industry share growth affects GDPc growth with value of 0.22.

The GC-test values and long run solutions of impact parameters imply quite complex relation between GDPc growth rate and sector share growth rates. Higher service share growth rates predict negative GDPc growth rates (−0.23). Causality runs also in opposite direction with positive economy wide growth effects on services share growth (0.15). However the net effect between these variables is negative. This is the Baumol effect. Labor productivity in services does not grow as fast as in agriculture and in industry because most services jobs are based on human capital, not on physical capital. This makes services more expensive relative to agriculture and industrial goods, further increasing service share of GDP. Therefore, this can be one reason that GDPc growth rate predicts positive growth effects on services sector.

In general GC-analysis implies that industry (share) growth rate is still the engine of growth rate of economy. Agriculture share does not have growth effects and service share effects are negative. Recent empirical literature shows that services sector has a low productivity growth as compare to other sectors. Oulton (2001) analyzed the contribution of services to overall productivity growth in the United States and United Kingdom since the 1970's. Wolff (2000, 2005, and

Table 1: Unit root tests

Test	Null hypothesis	Alternative	Possible deterministic components*	Autocorrelation correction method
LLC	Unit root	Number unit root	None, F, T	Lags
Breitung	Unit root	Number unit root	None, F, T	Lags
IPS	Unit root	Some cross-sections without unit root	F, T	Lags
Fisher-ADF	Unit root	Some cross-sections without unit root	None, F, T	Lags
Fisher PP-test	unit root	Some cross-sections without unit root	None, F, T	Kernel

*No deterministic components. F: Fixed cross section effects. T: Individual trend effects, ADF: Augmented Dickey-Fuller, LLC: Levin, Lin and Chu

Table 2: Panel unit root test results

Test	Growth rate of GDPc		Agriculture share		Industrial share		Services share	
	Test value	P	Test value	P	Test value	P	Test value	P
LC	−9.03	0.00***	−5.01	00***	−0.82	0.21	−1.27	0.09
Breitung	−4.72	0.00***	1.83	0.96	0.38	0.65	0.91	0.82
IPS	10.15	0.00***	−0.26	0.39	2.64	0.99	2.67	0.99
Fisher-ADF	157.7	0.00***	37.65	0.15	15.12	0.98	11.89	0.99
PP-test	189.5	0.00***	48.37	0.02**	13.24	0.99	11.16	0.99

Automatic selection of lags based on minimum AIC: 0-3, ***,**, and * denote rejection of null hypothesis at 1%. 5% and 10% level of significance, Deterministic components. LLC, PP, Breitung, and Fisher-ADF tests: Fixed cross section effects and individual trends. IPS: Fixed cross section effects, GDPc: Gross domestic product per capita, ADF: Augmented Dickey-Fuller

Table 3: Panel unit root test results on first differences

Test	Growth rate of GDPc		Agricultures share		Industrial share		Services share	
	Test-value	P-value	Test-value	P-value	Test-value	P-value	Test-value	P-value
LLC	−14.78	0.00***	−12.22	0.00***	−8.85	0.00***	−10.14	0.00***
Breiuing	−11.33	0.00***	−6.65	0.00***	−6.20	0.00***	−5.75	0.00***
IPS	−19.50	0.00***	−13.72	0.00***	−12.46	0.00***	−12.91	0.00***
Fisher-ADF	327.19	0.00***	223.92	0.00***	197.37	0.00***	206.91	0.00***
PP-test	42.67	0.00***	402.44	0.00***	303.76	0.00***	269.40	0.00***

(1) Automatic selection of lags based on minimum AIC: 0-3 (2) ***.** and *denote rejection of null hypothesis. 1%. 5% and 10% level of significance, (3) Deterministic components. LLC, PP, Breitung, and Fisher-ADF tests: Fixed cross section effects and individual trends. IPS: Fixed cross section effects, GDPc: Gross domestic product per capita, ADF: Augmented Dickey-Fuller, LLC: Levin, Lin, and Chu

Table 4: Panel granger non-causality tests between growth rates of sector shares and GDPc

	Agriculture share	Industrial share	Services share
H_0: Growth rate of sector share does not Granger cause growth rate of GDPc			
P-value	0.60	0.02**	0.003***
Number of observation	537	537	537
Fixed effects (P-value)	0.00***	0.00***	0.00***
A_{LR}	0.02	0.22**	−0.25**
χ^2 (1) residual normality test (P-value)	0.59	0.10	0.10
P-value	0.001***	0.04**	0.08*
Number of observation	537	537	537
Fixed effects (P-value)	0.00***	0.00***	0.00***
B_{LR}	−0.50**	−0.12**	0.15**
χ^2 (1) residual normality test (P-value)	0.12	0.09	0.10

***Significant at 1% level, **significant at 5% level, *significant at 10% level of significance, AR (1) and AR (2): Residual AR (1) and AR (2) LM-tests, H_0: No residual autocorrelation, Normality test on residual of each regression, where H_0: Residuals are normal distributed, GDPc: Gross domestic product per capita

2006) used a sample of OECD countries and related the weight of services in economic activity and productivity growth rate. Marolo and Rubalaba (2008) have constructed the contribution of services to overall economic growth in European Union. These all studies show negative relationship between aggregate productivity growth and the activities of services sector.

5. CONCLUSIONS

The objective of study has been in analyzing how the sector shares are related to economic growth in 15 Schengen countries in period 1970-2012. For this purpose we conducted GC tests in panel. The result from GC-analysis is that for the analyzed countries the higher growth rate of GDPc means decreasing growth rate of industrial sector share but the industry share growth effects are positive on GDPc growth rate. The dynamic impacts between growth rates of GDPc and service share are opposite. Larger service sector share growth rate predicts smaller GDPc growth rate but the effects from GDPc growth rate on service share growth are positive. By stressing the sector share growth effect results we observe that industry sector is still the "engine" of economy and the larger service sector retards the GDPc growth rate.

We conclude that the relationships existed between economy's main sector shares among Schengen countries in period 1970-2012. The links between GDPc growth and service and agriculture shares are complex but e.g. EU policy bolstering the agriculture sector is not growth retarding. More likely it is the increasing service sector and large public sector that retard the economic growth in Europe.

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APPENDIX

Appendix 1

Data

Data source: World Bank national accounts data and OECD National Accounts data files. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Value added is determined by the International Standard Industrial Classification (ISIC, revision 3).

GDPc is GDP divided by midyear population: GDPc is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Agriculture: Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources.

Industry (i.e., Industry corresponds to good producing industry). Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources.

Services: Value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling.

Appendix 2: Average structural change (as %GDP) in the Schengen countries 1970-2012

Country	Agriculture share			Industrial share			Services share			Over all (1971-2012)		
	1971-80	81-90	1991-2012	1971-80	1981-90	1991-2012	1971-80	1981-90	1991-2012	Agriculture	Industry	Service
Austria	5.81	4.10	2.69	40.13	35.49	32.81	54.06	60.41	64.50	3.94	35.56	60.48
Belgium	3.71	2.59	1.75	40.33	33.40	28.97	55.96	64.01	69.27	3.24	34.42	62.33
Denmark	6.17	5.27	3.40	29.14	27.21	25.99	64.70	67.53	70.61	4.65	27.24	68.10
Finland	10.18	7.60	4.66	38.85	35.85	32.00	50.97	56.55	63.33	7.00	35.11	57.88
France	6.20	4.32	3.23	37.30	32.21	27.00	56.51	63.47	69.77	4.35	31.05	64.59
Germany	2.86	1.97	1.32	42.96	38.44	33.59	54.40	59.60	65.07	4.45	37.23	60.83
Greece	14.57	12.7	9.57	34.28	30.26	23.52	51.15	56.95	66.91	11.8	28.79	59.38
Iceland	12.25	11.3	11.36	33.07	32.49	28.05	54.66	56.12	60.28	11.6	31.18	57.15
Italy	7.35	4.72	3.31	41.02	35.91	30.85	51.63	59.37	65.83	4.84	35.01	60.13
Luxem	3.28	2.61	1.12	39.90	34.30	24.92	56.82	63.09	73.96	2.18	31.85	65.95
Netherland	4.73	4.41	3.48	36.42	32.60	28.22	58.85	62.98	68.30	4.05	31.80	64.13
Norway	5.08	3.76	2.64	34.21	38.45	35.68	60.71	57.79	61.68	3.62	36.32	60.04
Portugal	23.86	13.2	5.31	34.72	32.53	30.80	41.42	54.21	63.90	12.9	32.14	54.93
Spain	9.67	6.24	4.63	40.87	36.40	31.19	49.46	57.36	64.17	6.47	35.36	58.16
Sweden	5.29	4.16	2.35	35.90	32.81	29.44	58.82	63.03	68.21	3.68	32.17	64.14
Standard deviation	5.51.	3.65	2.88	3.75	2.99	3.35	5.4	3.2	3.66	3.42	2.85	3.61