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IS THE KALDOR'S GROWTH LAW VALID FOR HIGH INCOME ECONOMIES: A PANEL STUDY

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ABSTRACT

In the 1960s Nicholas Kaldor stated three propositions emphasizing the causes of the economic growth. So, Kaldor's laws of growth have been focus point for many researchers and the researchers have tried to prove empirically the laws. We have dealt with the first law of Kaldor. The first law asserts that the faster growth in manufacturing will trigger economic growth. The purpose of this article is to investigate whether Kaldor's first law hold for 23 OECD countries that have high income economies during the period 1980-2008, using panel estimation techniques. The findings from empirical analysis indicate that Kaldor's first law is compatible with the economic growth of selected countries during period 1980-2008.

JEL CLASSIFICATION & KEYWORDS

C23 | O14 | N60 | Kaldor's Law | Panel Co-integration | Manufacturing Sector | Increasing Return to Scale

INTRODUCTION

After the World War II, there has been important difference between countries' growth of productivity and output. Economists widely have focused on research related with the sources of economic growth. Many growth models have been derived by economist. These models have differed with used some assumptions.

Nicholas Kaldor was one of the first to regard the role of increasing returns in economic growth. On the contrary endogenous growth theory regarding on supply-side issues, Kaldor emphasized the importance of the exogenous components (export especially as component) of demand in explaining economic growth in the long run. Nicholas Kaldor proves three different prepositions related with the source of economic growth, referred to as Kaldor's law. Briefly, the first law of Kaldor postulates that manufacturing industry is the engine of economic growth; the second law is that manufacturing productivity growth triggers output growth in manufacturing through the returns to scale, known as Verdoorn's law and finally the third law is that manufacturing growth induces productivity growth (Thirlwall, 1991: 34).

The empirical testing of Kaldor's law has been implemented at both country level and regional level by researchers in the literature. For example, Parikii (1978), McCombie (1983), Thirwall (1983), Whiteman (1987), Stoneman (1979) are some of the researchers testing the law at country level. Mccombie and De ridder (1983) Bernat (1996), Casetti and Tanaka (1992) and Fingleton (2004) are some of the researchers conducting the law at regional level as well.

The rest of the paper is structured as follows. Section 2 reviews of Kaldor's law and the literature related to the law. Section 3 details the econometric method used in this paper and Section 4 and 5 reports the results and concludes the paper, respectively.

KALDOR'S LAW

The fundamental aim of the growth models is to produce response the question of why some countries growth bigger than others.

Neoclassical economics is entirely based on supply side. However, Kaldor's law is focused on both supply and demand side. According to Kaldor, the income elasticity of demand for manufacturing good is much higher than that for agricultural good. This is demand side of Kaldor's law. On the supply side, Kaldor asserted that manufacturing was regarded to have greater potential for productivity growth (Dasgupta and Singh, 2006). Kaldor features the phenomenon of increasing returns to scale as distinct from neoclassical economists.

Kaldor (1966) originally examined the three laws using data for twelve OECD countries during the period 1953-54 and 1963-1964 period with dynamic cross-country econometric analysis. Kaldor's first law states that there is a close relation between the growth of manufacturing and economic growth. The first law is called as the manufacturing industry is the engine of economic growth. The first law can be represented by following regression (1):

$$Q_i = \alpha_1 + \beta_1 . M_i + u_{1i}, \ \beta_1 > 0 \quad (1)$$

where Q_i refers to the growth rate of total output and M_i refers to the growth rate of manufacturing output.

The second law of Kaldor is called as Verdoorn's law. Verdoorn (1949) proved the presence of the positive relationship between labour productivity growth and output growth in a number of countries. The Verdoorn's equation can be expressed the following linear relationship:

$$e = -\frac{\mu}{p} + \frac{1}{p} . \rho$$

where μ and p are constant. ρ is growth rate of industrial productivity. e is growth rate of industrial employment. Hence output growth q equals ρ + e . This can be expressed as

$$\rho = \frac{\mu}{1+p} + \frac{p}{1+p} . q$$

As can be seen from the equation, there is a linear relationship between ρ and q . He regressed ρ on q , using data from a number of coefficient of q equal to 0.573 (Rowthorn, 1979).

Kaldor's second law posits that there is a positive relation between the growth rate of labour productivity in manufacturing and manufacturing output growth. The second law is following as:

$$PM_i = \alpha_2 + \beta_2 . M_i + u_{2i}, \ \beta_2 > 0 \qquad (2)$$

where PM_i indicates manufacturing productivity growth.

Verdoorn's law provides evidence of the existence of increasing returns to scale within industry. The fundamental argument is that an industrial growth in output causes growth in productivity that allow for fall in production cost and in prices, increasing the competition power of a country or region. Therefore, there is a positive relation between labour factor productivity and manufacturing production as a result of the increasing return to scale in industry (Novell and Marsal, 1998:5 guo).

Verdoorn's model assumes that wage rates are positively related to productivity. Increased productivity would imply higher wages which results in decreased labor use. Unlike, according to Kaldor's third law posits the surplus labor in nonmanufacturing sector keeps the wages from rising in the manufacturing sector increases in productivity. Increased labor demand in the manufacturing sector would decrease surplus labor in the nonmanufacturing sector, so productivity would increase (Mamgain, 1999). However, as Kaldor noticed there is a problem in estimating Verdoorn's law. A strong correlation has emerged between dependent and independent variables as can be seen from equation (3). This can gives biased results in an econometric sence. Let e_i be the rate of growth of labour employment in manufacturing sector.

$$e_i = M_i - PM_i \qquad (3)$$

This problem is handled by substituting in (2) and rearranging yields (4):

$$e_i = -\alpha_2 + (1 - \beta_2) M_i \qquad (4)$$

Kaldor's third law asserts that growth in manufacturing output induces growth in overall productivity growth in economy. In short Kaldor's third low postulates that there is a positive relation between overall productivity growth and manufacturing output, although overall productivity growth is related negatively employment in non-manufacturing sectors in the third law. As can be seen from equation 5, it is expected to be the positive relation between labor productivity growth rate of all productive sectors and manufacturing output growth rate. Kaldor's third law could be explained by equation 5:

$$P_i = \alpha_3 + \beta_3 M_i + u_{3i}, \ \beta_3 > 0 \qquad (5)$$

where P_i is the productivity growth for all productive sector.

An alternative way to express the law is:

$$Q_i = \alpha_4 + \beta_4 EM_i + u_{4i}, \beta_4 > 0 \qquad (6)$$

where EM_i is the growth rate of manufacturing employment. The third law can be explained by the existence of dual economies. If there are wage differentials between the high productivity sectors and the low productivity sectors, then an economy has a dual economy structure. The transferring of labor from the low-productivity (agricultural sector) sector to higher-productivity sector (manufacturing sector) will not decrease the output of low-productivity sector, but will increase the productivity of manufacturing due to the much increase output of manufacturing (Cripps and Tarling 1973, Kaldor 1968, Thirlwall 1983).

Rowthorn (1975) concluded that there is no empirical evidence that Kaldor's law has operated during the post-war period in manufacturing. According to Rowthorn (1975), Kaldor's study is based on a small sample of countries chosen in such a way that the extreme observations of one special case-Japan- account for the bulk of observed correlation between productivity growth and employment growth.

Pons-Novell and Viladecans-Marsal (1998) tested the Kaldor laws using cross-section data for the period 1984-1992 in European regions. They found the findings that are in favour of other laws instead of the first law.

Libanio (2006) investigated the importance of manufacturing industry for the growth with Kaldorian perspective for a sample of seven largest economies in Latin America during the period 1985-2001. Gilberto found results supporting Kaldor's views on the importance of manufacturing sector for economic growth.

Pieper (2003) showed strong positive relationship between the rate of growth of employment and the rate of growth of output for all nine sectors selected in the study with his linear and non-linear estimations. His findings were in supportive for the Verdoorn's Law in developing countries.

Wells and Thirlwall (2003) found that the growth of manufacturing sector leads to the economic growth than of the agricultural or service sectors.

Hansen and Zhang (1996) employed pooled regional data of 28 regions of China over the period of 1985 to 1991. They have accepted the presence of the Kaldor's law in China with their empirical analysis.

Çetin (2009) tested the validity of the law in Turkey and 14 European countries, using annual data for the period 1981-2007. The findings indicate that industrial growth has a positive and significant effect on economic growth in 11 out of 15 countries.

DATA AND EMPIRICAL ANALYSIS

Data

This paper investigates the relationship between the growth of GDP (RGDP) and the growth of industrial production (RIND). The nominal values of all the variables used in the analysis are deflated in order to obtain real values, and all the growth rates calculated in this study are logarithmic values. The data are gathered on yearly basis from 1980 to 2008 of 23 OECD countries that have high economies. The data are taken from International Financial Statistics released by the International Monetary Fund, as well as National Accounts Estimates of Main Aggregates released by the United Nations Statistics Division. We rely on data for the 23 OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

The relationship is estimated from a logarithmic regression of the form

$$\ln RGDP = \alpha + \beta . \ln RIND + u \qquad (7)$$

where *ln* stands for natural logarithm of the variable, *u* is the stochastic term, α denotes the regression constant, and β is the elasticity of GDP with respect to industrial production.

Empirical Analysis

Analysis of unit root

It has to be controlled whether there is dependency across cross-sections in regression. Thus, we test Breusch and Pagan (1980)'s cross-section LM testing in order to control the presence of the dependency across cross-sections. it is take into accounted CDLM1 test of Pesaran (2004) Since number of cross-section observation is smaller number of time series observation in our model. CDLM1 test statistic is following as:

$$\text{CDLM1} = T.\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \sim \chi^{2}_{N.(N-1)/2}$$

where $\hat{\rho}_{ij}$ is correlation of coefficient across residuals obtained from each regression estimated by OLS estimator. One of second generation tests is Cross-Sectionally Augmented Dickey Fuller (thereafter CADF) testing. Pesaran (2003) presents a new procedure for testing unit root in dynamic panels subject to possibly cross sectionally dependent in addition to serially correlated errors. Pesaran (2003) proposes a test based on standard unit root statistics in a CADF regression. CADF process can be reduced with estimated to this equation:

$$\Delta Y_{it} = \alpha_i + \beta_i.Y_{i,t-1} + \sum_{j=1}^{p_i}\delta_{ij}\Delta Y_{i,t-j} + d_i.\tau + c_i.\bar{Y}_{t-1} + \sum_{j=0}^{p_i}\varphi_{ij}.\Delta\bar{Y}_{i,t-j} + \varepsilon_{it} \quad (8)$$

where $\bar{Y}_t = N^{-1}.\sum_{j=1}^{N}Y_{jt}$, $\Delta\bar{Y}_{i,t} = N^{-1}\sum_{j=1}^{N}\Delta Y_{jt}$ and ε_{it} represents regression errors. Let $CADF_i$ be the ADF statistics for the i-th cross-sectional unit given by the t-ratio of the OLS estimate $\hat{\beta}_i$ of β_i in the CADF regression (8). Individual CADF statistics are used to develop a modified version of IPS t-bar test (denoted CIPS for Cross-sectionally Augmented IPS) that simultaneously take account of cross-section dependence and residual serial correlation:

$$CIPS = N^{-1}\sum_{i=1}^{n}CADF_i$$

Hypotheses for both CADF and CIPS are same. The null hypothesis is formulated as:

$H_o : \beta_i = 0$ This hypothesis implies that all the time series are nonstationary

$H_A : \beta_i \prec 0$ This hypothesis implies that all the time series are stationary.

We have employed Im, Pesaran and Shin (2003) (hereafter IPS)'s test, Fisher-type test proposed first by Maddala and Wu (1999) (hereafter MW) then developed Choi (2001), and Levin, Lin and Chu (2002) (hereafter LLC) as first generation tests in this study. A first generation of models has analyzed the properties of panel-based unit root tests under the assumption that the data is independent and identically distributed (i.i.d) across individuals.

In general, this type of panel unit root tests is based on the following regression:

$$\Delta Y_{i,t} = \beta_i.Y_{i,t-1} + Z_{i,t}.\gamma + u_{i,t} \quad (9)$$

where i = 1,2,…,N is individual, for each individual t=1,2,…,T time series observations are available, $Z_{i,t}$ is deterministic component and $u_{i,t}$ is error term. The null hypothesis of this type is

ρ_i = 0 for $\forall_i$.

The first of first generation panel unit root tests is LLC that allow for heterogeneity of individual deterministic effects and heterogeneous serial correlation structure of the error terms assuming homogeneous first order autoregressive parameters. They assume that both N and T tend to infinity but T increase at a faster rate, so N/T $\rightarrow$ 0. They assume that each individual time series contains a unit root against the alternative hypothesis that each time series stationary. Thus, referring to the model (9), LLC assume homogeneous autoregressive coefficients between individual, i.e. $\beta_i = \beta$ for all *i*, and test the null hypothesis $H_o : \beta_i = \beta = 0$ against the alternative $H_A : \beta_i = \beta \prec 0$ for all i. The structure of the LLC analysis may be specified as follows:

$$\Delta Y_{i,t} = \alpha_i + \beta_i.Y_{i,t-1} + \delta_i.\tau + \sum_{j=1}^{p_j}\phi_{ij}.\Delta Y_{i,t-j} + u_{it} \quad (10)$$

For *i = 1,…, N* and *t = 1,…,T* where τ is trend, α_i is individual effects, u_{it} is assumed to be independently distributed across individuals. LLC estimate to this regression using pooled OLS. In this regression deterministic components are an important source of heterogeneity since the coefficient of the lagged dependent variable is restricted to be homogeneous across all members in the panel (Barbieri, 2006). Other test, Im, Pesaran and Shin (2003) test allows for residual serial correlation and heterogeneity of the dynamics and error variances across units. Hypothesis of IPS may be specified as follows:

$H_0 : \beta_i = \beta = 0$; $H_A : \beta_i \prec 0$ for all *i*

The alternative hypothesis allows that for some (but not all) of individuals series to have unit roots. IPS compute separate unit root tests for the N cross-section units. IPS define their t-bar statistics as a simple average of the individual ADF statistics, t_i, for the null as:

$$\bar{t} = \sum_{i=1}^{N}t_i / N$$

It is assumed that t_i are i.i.d and have finite mean and variance and E(t_i), Var(t_i) is computed using Monte-Carlo simulation technique. Other test Maddala and Wu (1999) consider deficiency of both the LLC and IPS frameworks and offer an alternative testing strategy (Barbieri, 2006). MW is based on a combination of the *p*-values of the test statistics for a unit root in each cross-sectional unit.

The-Two Way Fixed Effects Model

Fixed effects model can be formulated as

$$y_{it} = x'_{it}.\beta + \alpha_i + \varepsilon_{it} \quad (11)$$

where α_i denotes all the observable effects and it is group-specific constant term in the regression model. α_i equals $z'_i.\alpha$ in the (11) regression. If z_i is unobserved, but correlated with x_{it}, then the coefficient of β is biased and inconsistent under assumptions of

$$y_{it} = \alpha_0 + X_{it}.\beta + \alpha_i + \gamma_t + \varepsilon_{it} \quad (12)$$

Equation (12) can be formulated as a two-way fixed effects model controlling for unmeasured time-invariant differences between units and unit-invariant differences between time periods. α_i denotes individual-specific effects and γ_t denotes period-specific effects (Worrall and Pratt, 2004).

THE RESULTS OF ECONOMETRIC ANALYSIS

Firstly, we have employed Breusch and Pagan's (1980) cross-section LM testing in order to investigate the presence of the cross-section dependency. Table 1 shows results of the LM tests. According to Table 1, we accept to presence of cross-sectional independence since the probability values of all the statistics of the test are bigger than significance level (0.05). So, we must rely on first generation unit root tests depending crucially upon the independence assumption across individuals.

Table 1 Results of Cross-Section Dependence Tests

Table 1	Without Trend		With Trend	
	T stat.	Prob.	T stat.	Prob.
CDLM1	254.66	0.458	271.61	0.201
CDLM2	0.073	0.470	0.827	0.203
CDLM	0.555	289	0.231	0.408

Table 2 and Table 3 show the results of first generation unit root tests for RGDP and RIND, respectively. The results obtained from the tests show that the presence of a unit roots for RGDP and RIND in both with trend and without trend models. So, we can say that both RGDP and RIND are stationary series in terms of all the first generation unit root tests.

Table 2 1st Generation Unit Root Tests results for RGDP in Level

1st Gen. Tests	Without Trend		With Trend	
	Test stat.	Prob.	Test stat.	Prob.
Levin, Lin & Chu t stat.	-5.20	0.00	-20.11	0.00
Im, Pesaran and Shin W stat.	-6.20	0.00	-10.86	0.00
ADF – Fisher Chi-square stat.	113.46	0.00	608.98	0.00
PP – Fisher Chi-square stat.	251.09	0.00	670.75	0.00

Number of lag for LLC, IPS, ADF- Fisher and PP-Fisher test statistics was selected by Schwarz criterion

Table 3 1st Generation Unit Root Tests results for RIND in Level

Table 3 1st Gen.Tests	Without Trend		With Trend	
	Test stat.	Prob.	Test stat.	Prob.
Levin, Lin & Chu t stat.	-31.67	0.00	-20.80	0.00
Im, Pesaran and Shin W stat.	-14.50	0.00	-9.82	0.00
ADF – Fisher Chi-square stat.	194.84	0.00	440.18	0.00
PP – Fisher Chi-square stat.	212.74	0.00	464.92	0.00

Number of lag for LLC, IPS, ADF- Fisher and PP-Fisher test statistics was selected by Schwarz criterion

Table 4 shows the results of tests of cross section and period fixed effects. We have used two-way Panel least square estimator in estimating the relationship between RGDP and RIND since the probability values of both cross section F and period F statistic are smaller than significance level (0.05).

Table 4 Test of Cross-Section and Period Fixed Effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	6957.474608	-22.615	0.0000
Cross-section Chi-square	3682.508264	22	0.0000
Period F	2.137609	-28.615	0.0007
Period Chi-square	61.946084	28	0.0002
Cross-Section/Period F	3062.239981	-50.615	0.0000
Cross-Section/Period Chi-square	3682.714642	50	0.0000

Table 5 The Results for Two-way Fixed Effects Model

Dependent Variable: RGDP

Panel OLS			**(Table 5)**
β	t-ratio	std.error	prob.
0.715	54.544	0.013	0.000

The results obtained from the two-way Panel fixed effects model for Kaldor's law are shown in table 5. The first law testing is based on equation (1). The coefficient of 0.725 can be interpreted as 10 percentage of growth in manufacturing will induce more than 7.2 percent growth in GDP. The result is supportive to the first law of Kaldor that manufacturing sector is the engine of the economy. That is, manufacturing is the important driving force of the OECD countries selected.

CONCLUSION

This paper investigated the relationship between industrial growth and economic growth by estimating Kaldor's first law for a sample of 23 OECD countries that have high economies over the period 1980-2008.

For this purpose, firstly we tested whether there exists of unit root among the panel series. We find that all variables are I(0), i.e. they are stationary variables in level. We employed two-way fixed effects in order to estimate the Kaldor's first law. After the empirical analysis, the obtained finding confirms the Kaldor's first law suggesting the manufacturing is the engine of growth hypothesis in selected countries.

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