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Using Econometic Models to Estimate the Relationship between Nanotechnology and the Added Value of Manufacturing

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Summary

This study aims to use the panel models to estimate the impact of nanotechnology on economic growth represented in this study by the added value of manufacturing, by clarifying between the three models represented by the pooled regression model, the fixed effects model, and the random effects model. The Haussmann criterion was based on choosing the best model by studying two independent variables that affect technology. The study included two economic sectors, namely, the manufacturing sector and the scientific research sector related to nanotechnology, for the period from 2000 to 2022. The study concluded that the fixed effects model is better than the pooled regression model and the random effects in estimating the relationship between research variables related to nanotechnology and industrial development. The study concluded that there is a strong positive statistically significant relationship between nanotechnology and the added value of manufacturing.

First: The concept of Panel data and Its importance

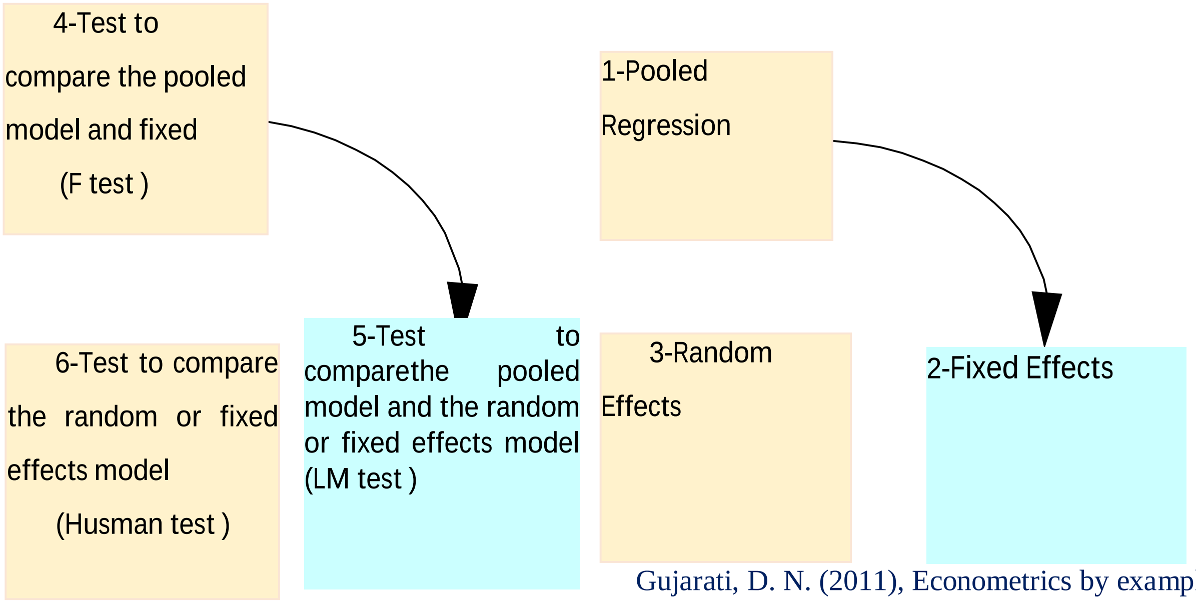
Panel data means the cross-sectional views (countries or companies) observed during a certain period of time.

[1]This means that this data has two dimensions, the first: for the time series, and the second:

[2]for cross sections. With regard to the time series, it describes the behavior of a single individual during a certain period of time. Whereas the cross-sectional data describe the behavior of a number of items at one time period, and the longitudinal data are either balanced or unbalanced.[3]

If all observations are equal for the study sample, the longitudinal data are balanced (Balanced Panel data); While it is unbalanced (Unbalanced Panel data) if there are missing observations for some of the study sample, and it should be noted that panel data has a synonymous term, it may also be called Longitudinal data.[4] Longitudinal data models have gained increasing interest, particularly in economic studies; It takes into account the effect of the difference between the cross-sections and the effect of the change of time.[5]

The methods for estimating the panel models are the following graph



Gujarati, D. N. (2011), Econometrics by example

Figure1 Steps for estimating panel data models

Practical framework for longitudinal data model

First hypothesis: There is a positive significant relationship with statistical significance between the added value of manufacturing and nanotechnology.

Study variables: The variables used in estimating the model can be defined as follows:

Table 1.Study variables

variable name	Definition	measruing unit	Variable type
Add value	Manufacturing, value added	(current US$)	dependent variable
Nanotechnology	Nanotechnology publications (Article)	Numerical numbers	independent variable
High-tech	Medium and high-tech Industry	(% manufacturing value added)	independent variable

Study population and sample

Value added was chosen as an indicator of industrialization for the sample of foreign countries and as a response variable (dependent);While The proportion of medium and high-tech industry and Number of nanotechnology-related articles indexed in Web of Science (WoS) were included as an independent and explanatory variable, the study covers foreign countries with available data representing 72countries during the period 2000 to 2022, thus the number of observations used in the total sample is 1563.

Table 2.the study countries

Country	Country	Country
1- China	27- Czech Republic	49- Kazakhstan
2- USA	28- Thailand	50- Belarus
3- India	29- Belgium	51- Kuwait
4- Iran	30- Portugal	52- Croatia
5- South Korea	31- Austria	53- Lithuania
6- Germany	32- Finland	54- Estonia
7- Japan	33- Denmark	55- Lebanon
8- Saudi Arabia	34- Romania	56- Luxembourg
9- UK	35- Ukraine	57- Peru
10- France	36- Greece	58- Latvia
11- Russia	37- Ireland	59- Sri lanka
12- Spain	38- Argentina	60- Azerbaijan
13- Australia	39- Norway	61- Cyprus
14- Italy	40- Chile	62- Uruguay
15- Canada	41- Hungary	63- Bahrain
16- Pakistan	42- Nigeria	64- Moldova
17- Turkey	43- Bangladesh	65- Cuba
18- Brazil	44- Slovakia	66- Georgia
19- Poland	45- Slovenia	67- Nepal
20- Malaysia	46- New Zealand	68- Uzbekistan
21- Singapore	47- Serbia	69- Iceland
22- Sweden	48- Jordan	70- North Korea
23- Netherlands		71- Venezuela
24- Switzerland		72- Costa rica
25- Vietnam		
26- Mexico		

Description of model variables

Through this econometric model, we try to find out whether there is a relationship between the study variables and nanotechnology, by using panel models to reach the nature of this relationship (moral or insignificant), The estimation of the model depends on entering the variables in logarithmic form, using the EViews program.

Estimating the model and verifying the hypothesis of the search

Estimating the relationship between the added value of industrial development and scientific production of nanotechnology ,By estimating the following function:

LADD_VALUE = f (LNANOTECHNOLOGY, LHIGH_TECH)

First, estimate the cumulative regression model, fixed effects, and random effects

In order to make the vision clear that to measure the impact of the scientific production of nanotechnology on industrial development, the longitudinal data model was used by applying three models, the aggregate regression model, the fixed effects model and the random effects model, and the results of these three models were reached as shown in the following table:

Table 3.Estimation of the pooled regression model and fixed and random effect

Dependent Variable: LADD_VALUE **Sample: 2000 – 2022** **Cross-sections included: 72** **Total panel (balanced) observations: 1563**												
Variable	**Pooled Regression Model**				**Fixed Effects Model**				**Random Effects Model**			
	Coefficient	**Std. Error**	**t-Statistic**	**Prob**	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**
C	**17.907**	**0.1645**	**108.807**	**0.0000**	**22.18767**	**0.118806**	**186.7549**	**0.0000**	**22.02747**	**0.1592**	**138.326**	**0.0000**
LNANOTECHNOLOGY	**0.5145**	**0.0144**	**35.6475**	**0.0000**	**0.274375**	**0.006727**	**40.78767**	**0.0000**	**0.279149**	**0.0066**	**41.70706**	**0.0000**
LHIGH_TECH	**0.9717**	**0.0580**	**16.7317**	**0.0000**	**0.097909**	**0.035642**	**2.747007**	**0.0061**	**0.138922**	**0.0352**	**3.943864**	**0.0001**
R-square	0.695488				0.977658				0.540060			
Adjusted R-squared	0.695098				0.976562				0.539471			
F-statistic	1781.479				892.5523				915.8741			
Prob (F-statistic)	0.000000				0.000000				0.000000			
AIC	2.876022				0.354639							
BIC	2.886299				0.608140							
HQC	2.879842				0.448883							

Source: Prepared by the researcher based on the statistical program EViews, 10th edition. **(See the appendices, tables No. 7, 8, 9)**

The above table shows the results of testing the three panel models (Pooled , fixed and random), which were reached based on the available data that show the countries of the research sample. After the model has been estimated, a comparison is now made between these methods in order to rely on the best method. In order to reach this goal, the F-test is used to compare between the pooled regression model and between the fixed effects model and the random effects model. In order to choose the appropriate model to be used, the table (4) shows the F-test.

Secondly, the F test and the Haussmann test for differentiation between the three models

The first method: Choosing between a cumulative regression model and a fixed effects model When choosing between a pooled regression model (PM) and a fixed effects model (FEM), the constrained F-test is used as follows:

$$F(n-1, nT-n-K) = \frac{\left(R^2_{FEM} - R^2_{PM}\right)/(n-1)}{(1-R^2_{FEM})/(nT-n-K)} \quad (1)$$

Since:

K: the number of estimated parameters.

R_{FEM}: coefficient of determination when using a fixed effects model (FEM).

R_{PM}: coefficient of determination when using a pooled regression model (PM).

After obtaining the calculated F value, it is compared with its tabular counterpart ((F(α, N− 1, Nt− N− k), if it is greater than it, or the value of the cross-section Chi-square is significant, the null hypothesis (H0) is rejected, And accept the alternative hypothesis (H1), that is, the fixed or random effects model is suitable for the study, but if the calculated F value is less than the tabular value, or the cross-section chi-square value is not significant, then the null hypothesis (H0) is accepted, and the hypothesis is rejected Alternative (H1), meaning that the pooled regression model (PM) is suitable for the study.

Table 4.F. test

Test Summary	**Prob**
Cross-section F	0.00

Source: Prepared by the researcher based on the statistical program EViews, 10th edition.

The results of the F-test as shown in Table (26) showed that the probability of the F-test was significant at a level less than (0.01); Therefore, we reject the null hypothesis (H0), and accept the alternative hypothesis (H1), that is, the fixed or random effects model is the appropriate model for estimating the impact of nanotechnology on industrial development, and accordingly we move to the Hausman Test.

Second, the Hausman test for choosing between a fixed-effects model and a random-effects model

To make sure the most appropriate model is consistent with the data used in this study after the fixed effects and random effects model have been tested, the final judgment will be made based on the Hausman test

Hausman test hypotheses:

A random effects model is appropriate...........................H_0
Fixed effects model is appropriate..................................H_1

The test results are shown in the following table:

Table 5.Hausman Test

Correlated Random Effects- Hausman Test			
Test cross-section Random Effects			
Test Summary	Chi-Stat	Chi-sq. df	Prob
Cross-section	81.244657	2	0.0000

Source: Prepared by the researcher based on the statistical program EViews 10th Edition. (See Appendices Table No. 17)

The statistical value $\chi2$= 81.244657and the critical tabular value of this test reached at a significant level of 5% the tabular value in the chi-squared table (Prop = 5.99), and therefore we reject the null hypothesis and accept the alternative hypothesis that says that the fixed effects model is the appropriate model for this study.

By noting the table (5), the results of the Haussmann test showed that the statistical value was significant at a level less than (0.05); Therefore, we reject the null hypothesis (H0) and accept the alternative hypothesis (H1), that is, the fixed effects model is the appropriate model for estimating the impact of nanotechnology on industrial development, as shown in Table (5).

Third, Analysis of the results of estimating the fixed effects model .

Table No.8 in the appendices. Fixed Effects Model test: Depending on the results of Table (6) and in light of the results of estimating the fixed effects model, the researcher notes through the following equation:

Estimation Command:

LS(CX=F) LADD_VALUE C LNANOTECHNOLOGY LHIGH_TECH

Estimation Equation:

LADD_VALUE = C(1) + C(2)*LNANOTECHNOLOGY + C(3)*LHIGH_TECH + [CX=F]

Table 6.fixed test

Dependent Variable: LADD_VALUE				
Method: Panel Least Squares				
Date: 10/24/21 Time: 10:01				
Sample: 2000 2022				
Periods included: 23				
Cross-sections included: 72				
Total panel (unbalanced) observations: 1563				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.18767	0.118806	186.7549	0.0000
LNANOTECHNOLOGY	0.274375	0.006727	40.78767	0.0000
LHIGH_TECH	0.097909	0.035642	2.747007	0.0061
	Effects Specification			

Cross-section fixed (dummy variables)				
R-squared	0.977658	Mean dependent var		24.01758
Adjusted R-squared	0.976562	S.D. dependent var		1.844109
S.E. of regression	0.282320	Akaike info criterion		0.354639
Sum squared resid	118.6804	Schwarz criterion		0.608140
Log likelihood	-203.1502	Hannan-Quinn criter.		0.448883
F-statistic	892.5523	Durbin-Watson stat		0.375851
Prob (F-statistic)	0.000000			

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Substituted Coefficients

LADD_VALUE = 22.1876727936 + 0.274374917648*LNANOTECHNOLOGY + 0.0979094342961*LHIGH_TECH + [CX=F]

1. **Significance of parameters:** The model coefficients with statistical significance are represented in the scientific production of nanotechnology and Medium and high-tech industry, where we find the probability of the fixed coefficient for each of them (0.0000), (0.0061), respectively, because they are less than the level of significance (0.05).) .
2. **Overall Significance:** Through the model, we find that the value of the F-statistic (0.000) is less than (0.05) indicating the overall Significance of the model, which is significant at the level of significance of 5%, meaning that the model is totally significant.
3. **Goodness of fit:** The value of R2 is 0.977658, meaning that the independent variables explain changes in industrial development by 97%, and the rest is due to factors of variables outside the model, that is, explained by other variables that are not included in the model.
4. **The positive sign of** the scientific production coefficient for nanotechnology (0.274375) indicates the direct relationship between the added value and the scientific development in nanotechnology; When the production of nanoparticles increases by one unit, the addvalue increases by0.274375; That is, increasing scientific research on nanotechnology increases economic growth rates.
5. **Using econometric models** and analyzing the relationship between value-added and nanotechnology, it was found that there is a significant positive impact of nanotechnology on industrial growth. This agrees with the hypothesis that there is a positive influence relationship between industrial growth and scientific outputs of nano-research, and therefore, through the results of estimating the fixed effects model, the model can be accepted from an economic point of view considering that the economic theory corresponds to the obtained results.
6. **The integration of nanotechnology** in manufacturing is one of the basic components of economic development to establish the bases of industrial production and to regulate the local and external competitive capabilities of the national economy, so that countries can achieve sustainable development that brings prosperity to its citizens, and enables it to occupy a distinguished competitive position among the countries of the world.

7. **Industrialization requires** relying on the data of science and knowledge in industrial production, which drives the development of income and the application of modern technological methods, and raising the ability to absorb the available resources.

The general trend of variables

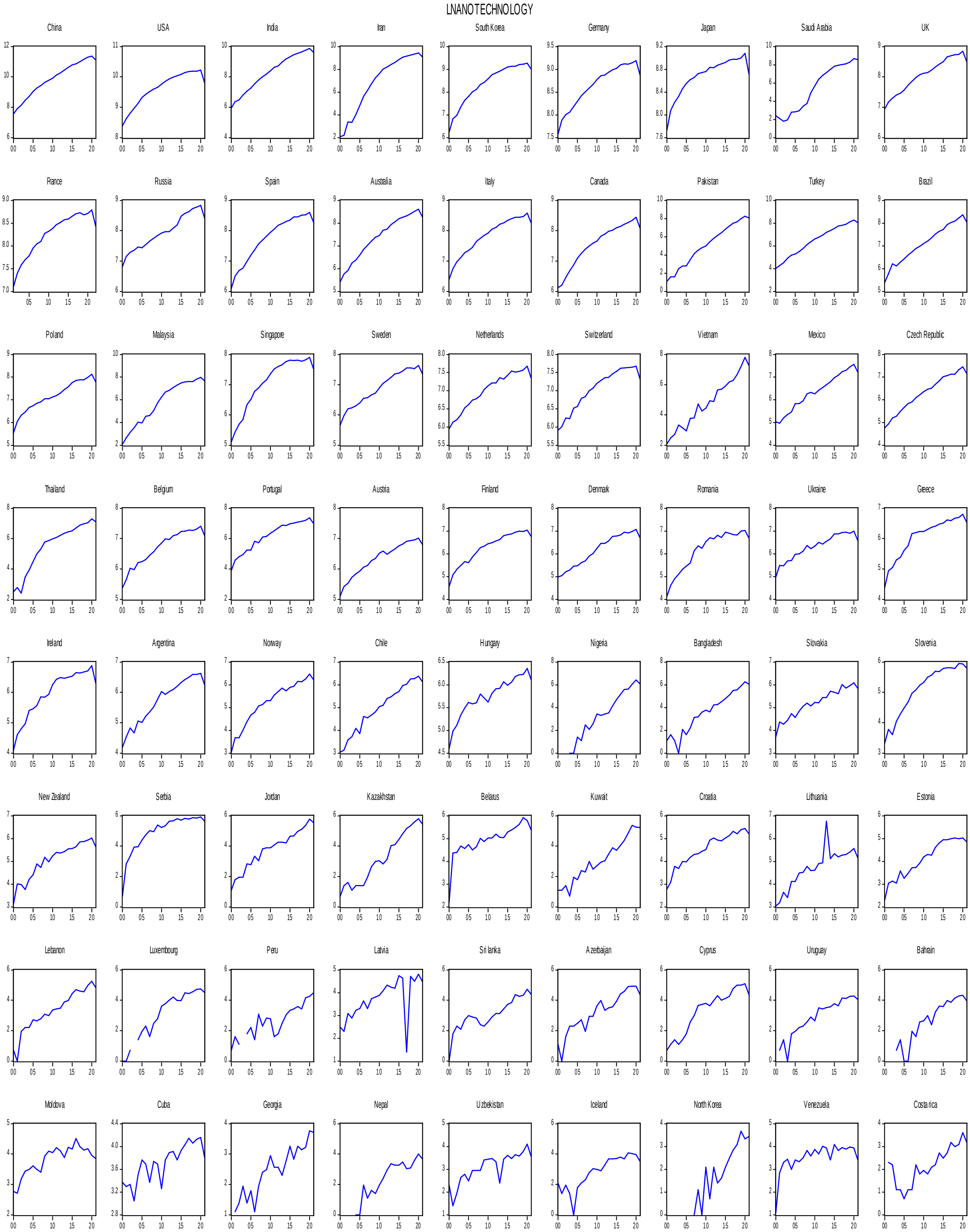
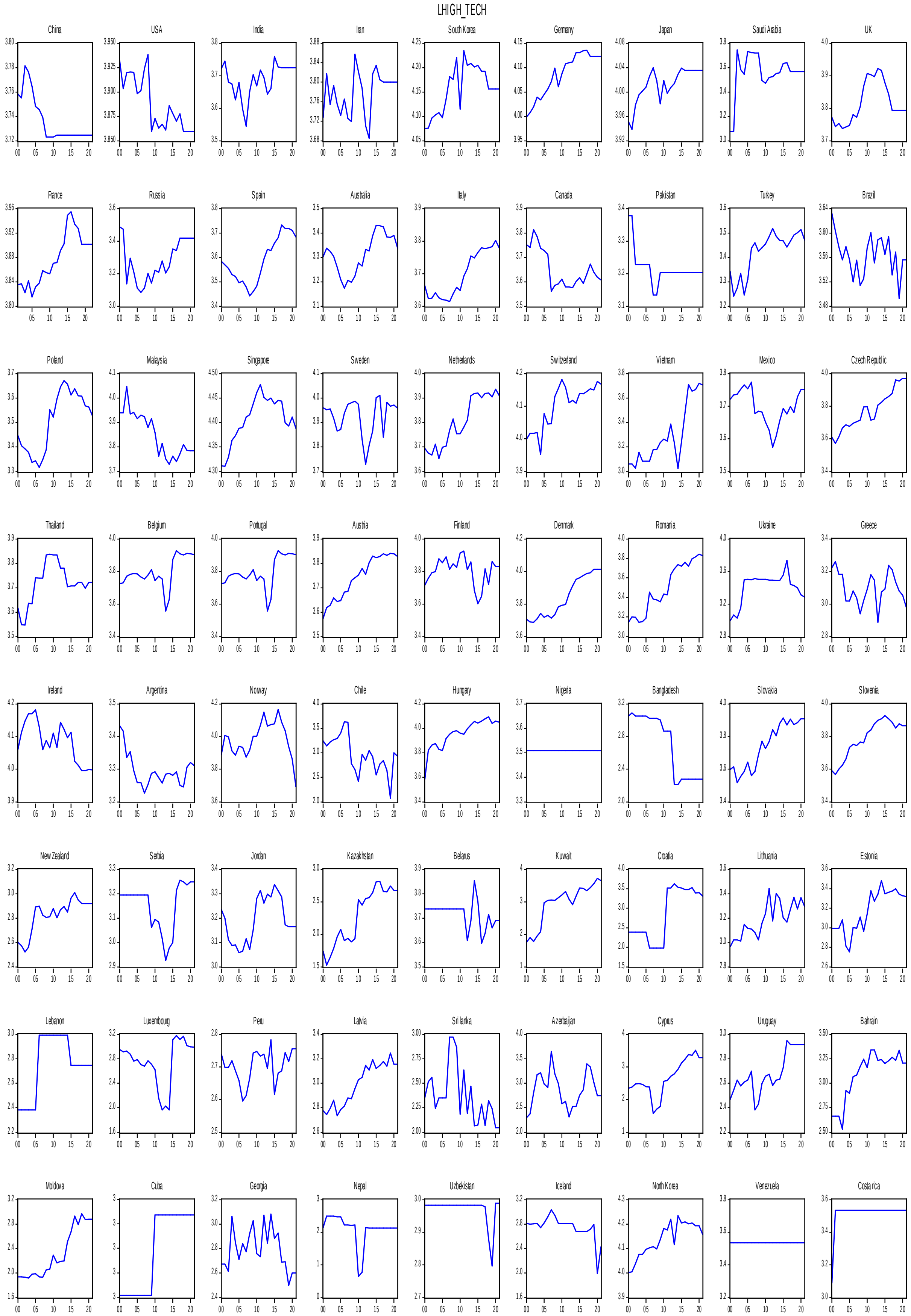
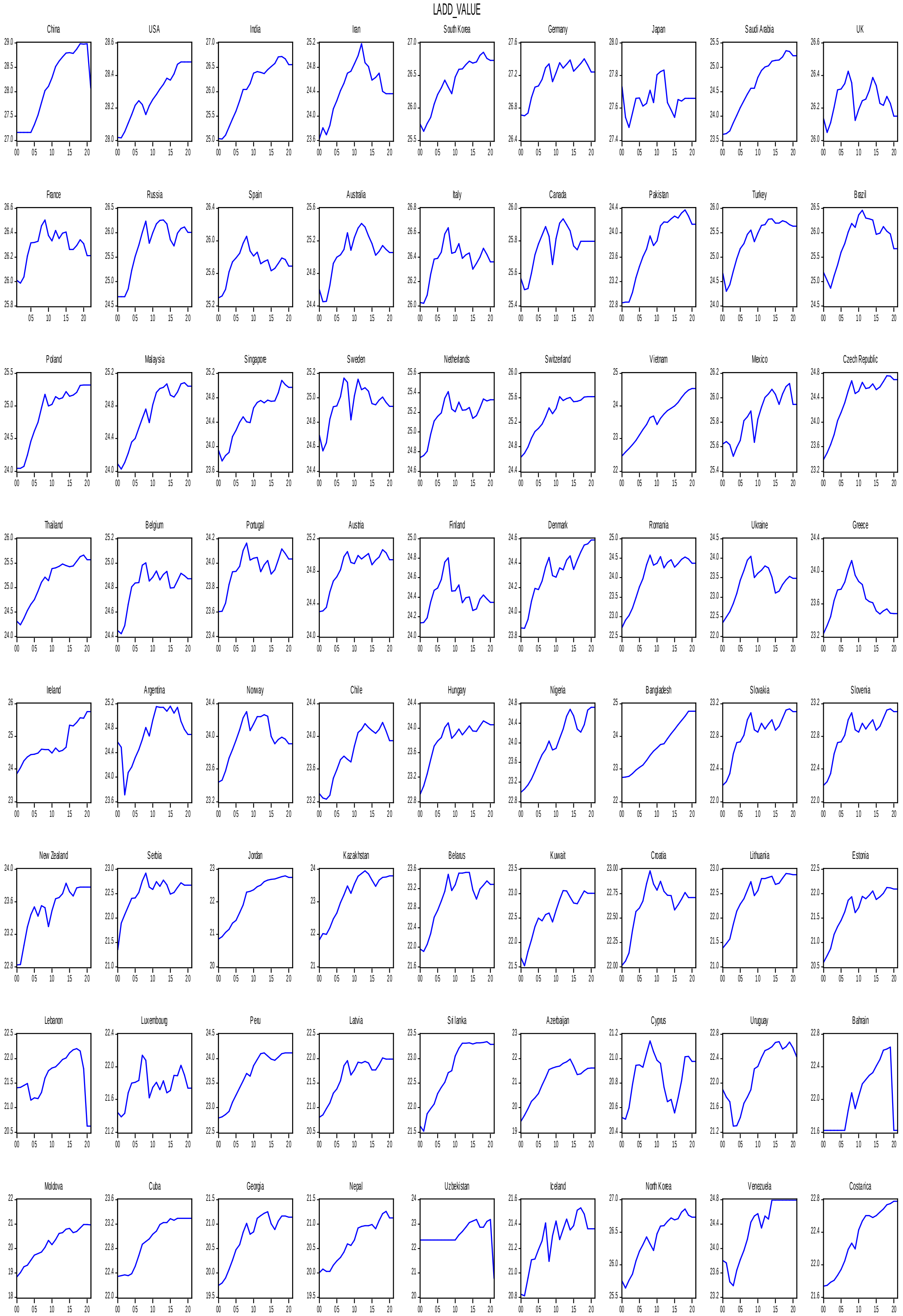


Figure 1.Trend of nanotechnology development in African countries



Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 2.Trend of Medium and high-tech Industry development in African countries



Source: Prepared by the researcher based on the statistical program E Views 10th Edition

Figure 3.Trend of Medium and Add value Industry development in African countries

The graphic shows that African countries have witnessed a boom in the nanotechnology industry, and it has increased at an accelerated pace by seizing opportunities to support environmentally friendly technological systems.

The share of the advanced technology category has increased in Africa, and the participation in global production of global value chains and integration in supply chains has increased. It has also increased in the share of added value resulting from intermediate exports and the stimulation of other sectors through forward and backward links.

Reaching advanced levels of comprehensive and sustainable industrial development requires moving towards a structural transformation of modern technologies such as nanotechnology and establishing resilient infrastructure, and then achieving sustainable growth in the long term.

Assumptions of Multiple Linear Regression

Multiple linear regression is based on the following assumptions:

Multiple Linear Regression Formula

The multiple linear regression equation is as follows:

$$\hat{Y} = b_0 + b_1 X_1 + b_2 X_2 + \dots + b_p X_p,$$

Where:

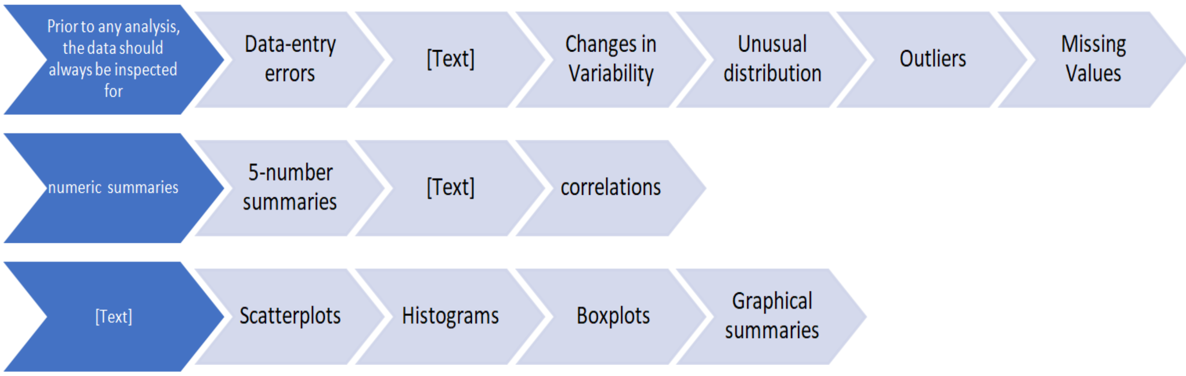
- **yi** is the dependent or predicted variable
- **β0** is the y-intercept, i.e., the value of y when both xi and x2 are 0.
- **β1** and **β2** are the regression coefficients representing the change in y relative to a one-unit change in **xi1** and **xi2**, respectively.
- **βp** is the slope coefficient for each independent variable
- **ϵ** is the model's random error (residual) term.

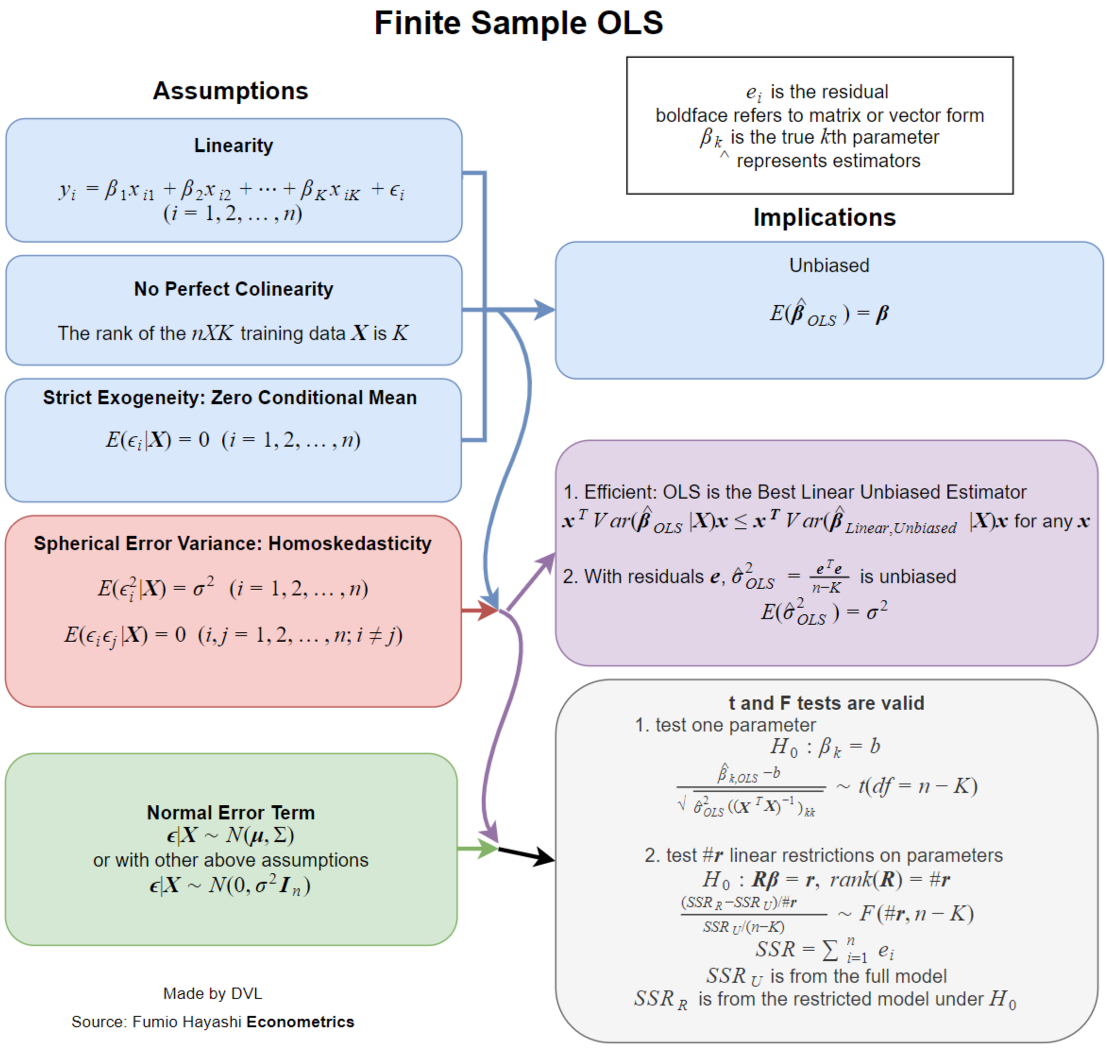
Prior to any analysis, the data should always be inspected for Data-entry errors Missing Values Outliers Unusual distribution Changes in Variability

Numerical summaries 5-number summaries correlations

Graphical summaries Boxplots Histograms Scatterplots

Data cleaning and preprocessing

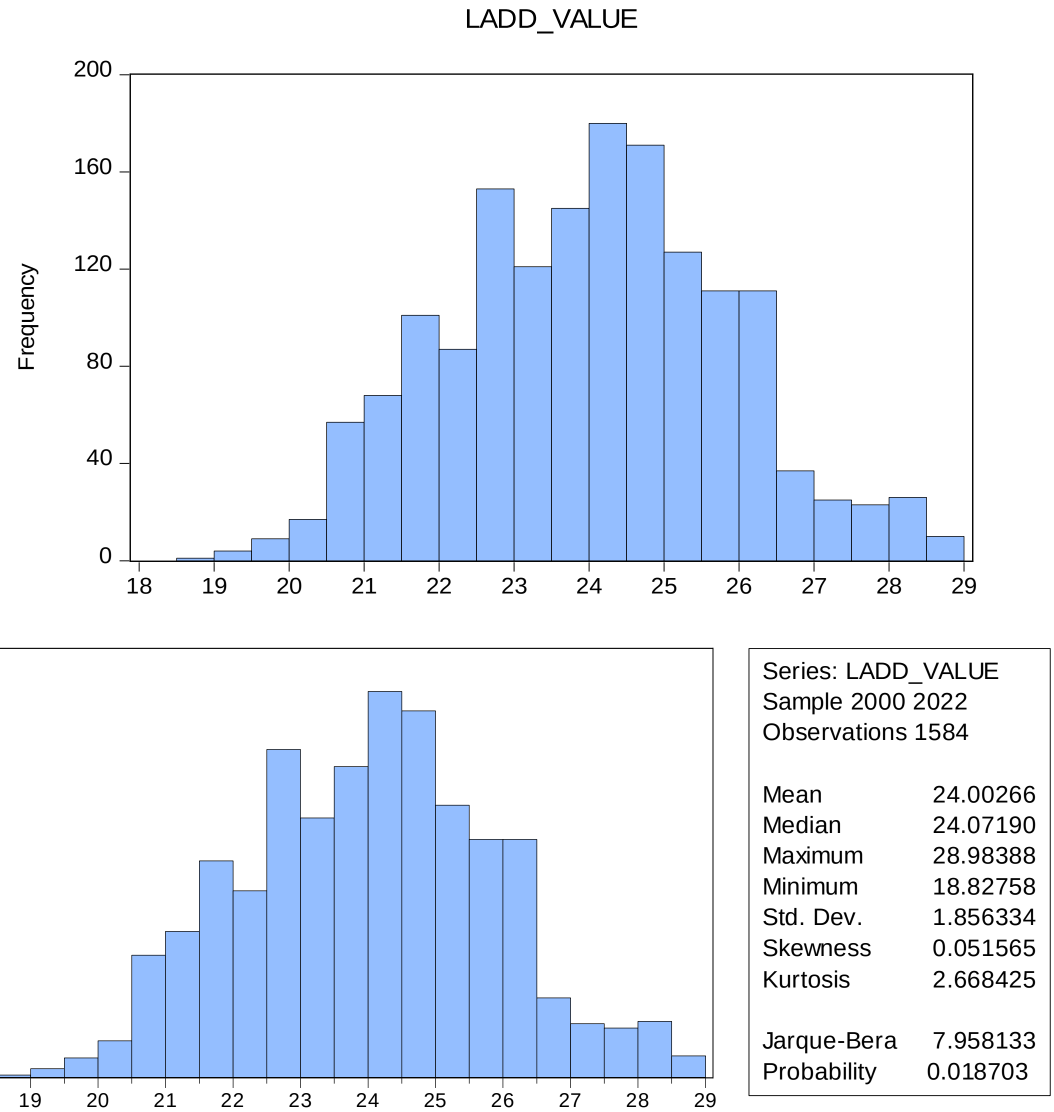




Diagnostic tests

Normality Test for the dependent variable

Normality tests are used to determine if a data set is well-modeled by a normal distribution and measures a goodness of fit of a normal model to the data.



Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 4.Normality Test

From figure in Figure 5, data of Add Value are given. Normality of the above data was assessed. Result showed that data were not normally distributed as skewness (0.0515) and kurtosis (2.668) individually were within ±1. Jarque-Bera test (*P* = 0. 0187) were statistically significant, that is, data were considered unnormal distributed.

Although both methods indicated that data were not normally distributed. As SD of the Add Value was less than half mean value (1.85 <24.006), data were considered unnormally distributed.

Correlation matrix

A correlation matrix is a table showing correlation coefficients between sets of variables. Each random variable (Xi) in the table is correlated with each of the other values in the table (Xj). This allows you to see which pairs have the highest correlation.

Figure 5.correlation matrix

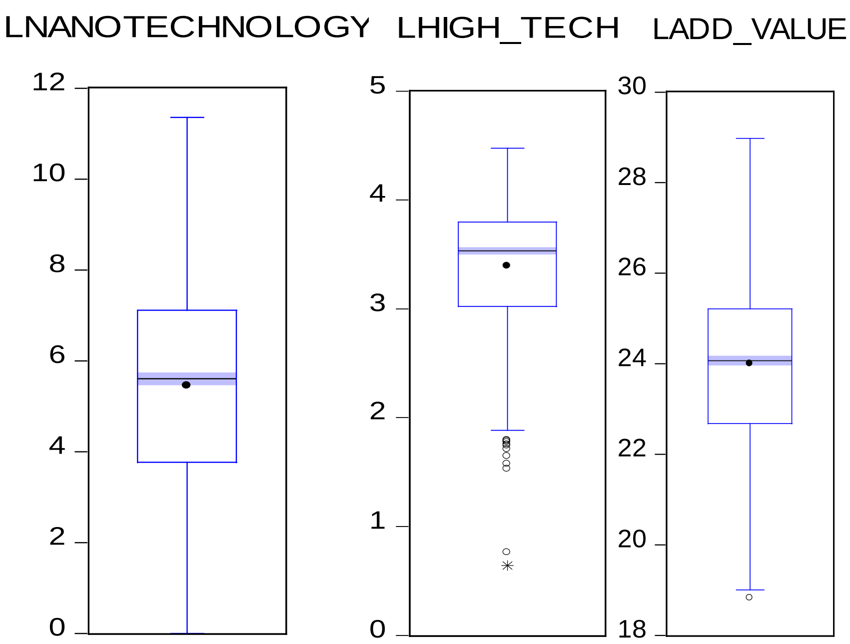
Covariance Analysis: Ordinary			
Date: 10/25/21 Time: 14:13			
Sample: 2000 2021			
Included observations: 1563			
Balanced sample (listwise missing value deletion)			
Covariance			
Correlation	LHIGH_TECH	LADD_VALUE	LNANOTECHNOLOGY
LHIGH_TECH	0.308772		
	1.000000		
LADD_VALUE	0.685226	3.398561	
	0.668909	1.000000	
LNANOTECHNOLOGY	0.748596	3.299685	4.999181
	0.602531	0.800526	1.000000

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

The figure shows the relationship between the independent variables and shows the correlation between the variable LNANOTECHNOLOGY and LHIGH_TECH (0.602531). This means that there is a strong positive relationship and it is called Multicollinearity problem.

Boxplot Test for the variables

Boxplot using the inter-quartile range (IQR) to judge outliers in a dataset. Outliers are elements that exist outside of a pattern



Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 6.Boxplot Test

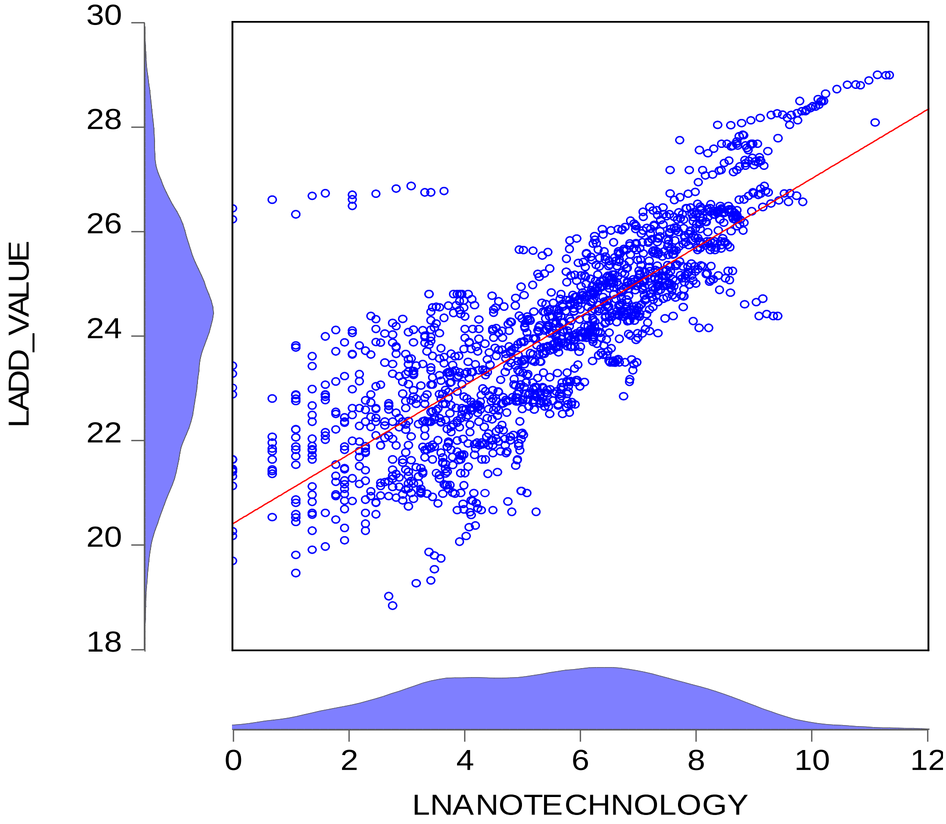
Form figure LHIGH_TECH, The boxplot shows that the median in the sample data is approximately 3.7, The minimum value is about 1.9, and the maximum value is about 4.8,in graph a dot plot to represent the outliers .An outlier is an observation that lies an abnormal distance from other values in a random sample from a population.

Form figure LNANOTECHNOLOGY, The boxplot shows that the median in the sample data is approximately 5.8, The minimum value is about 0.00, and the maximum value is about 11.9.

Form figure LADD_VALUE, The boxplot shows that the median in the sample data is approximately 24.00, The minimum value is about 19.00, and the maximum value is about 29.00

Draw the estimated equation

LADD_VALUE = 22.1876727936 + 0.274374917648*LNANOTECHNOLOGY + 0.0979094342961*LHIGH_TECH

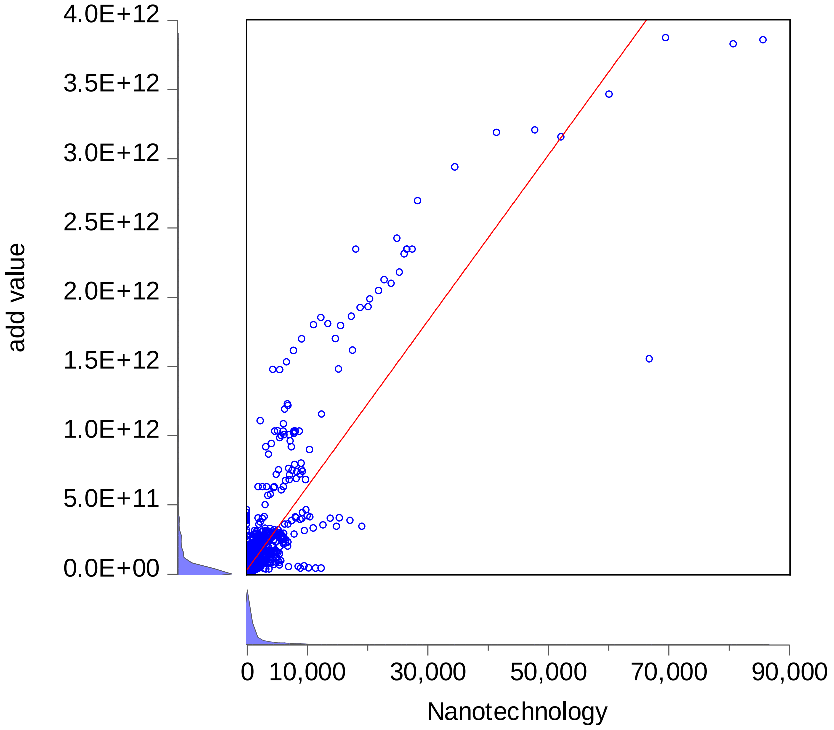


Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 7.Simple regression

As appears Scatter diagram between independent variable and and it is placed at the point corresponding to the measurement of the LNANOTECHNOLOGY (horizontal axis) and the LADD_VALUE (vertical axis). shows increasing positive of relation amongvariables.

LADD_VALUE = C(1) + C(2)* NANOTECHNOLOGY + C(3)* HIGH_TECH

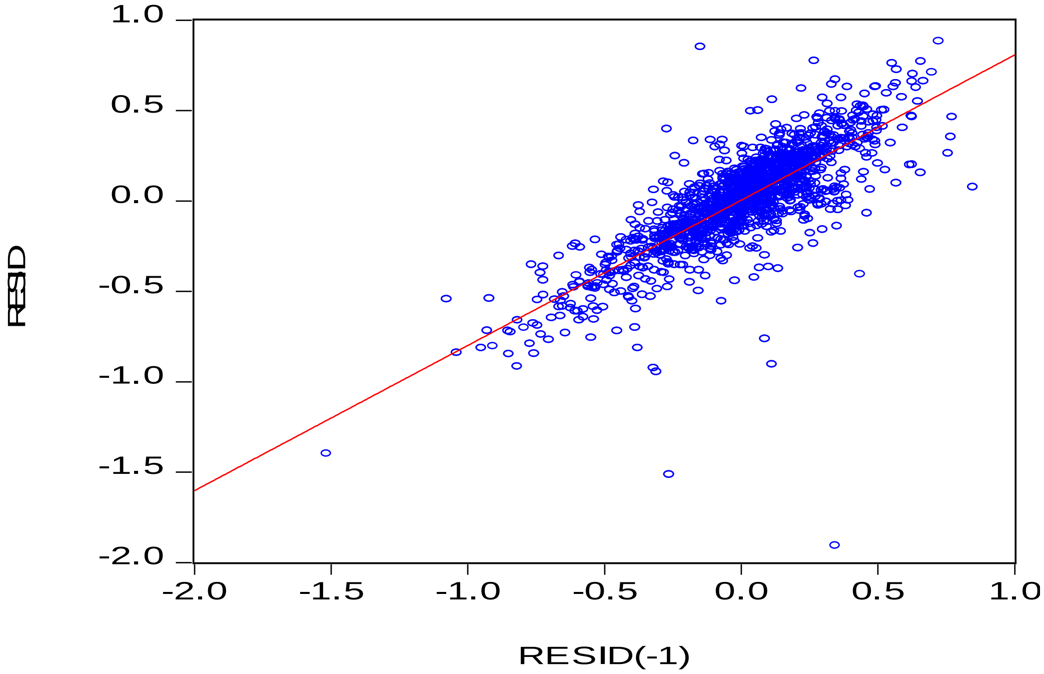


Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 8.Simple regression

As appears of observations collected is linear positively related, The pattern shows the covered area by the dots center's on a straight line. In this case the type of a straight line can adequately describe the general trend of the dots.

Autocorrelation test



Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Figure 9.Autocorrelation test

The diagram shows that there is a positive relationship in the form of a straight line.This means that there is an autocorrelation of the term of the random error, meaning that the term of the random error in any time period is related with the term of the random error in another time period.As it shown in equation :

$$\nu_t \sim N(0,\sigma_u^2)\ u_t = \rho u_{t-1} + \nu_t$$

$$u_t \sim N(0,\sigma_u^2) \quad \text{for all } t$$
$$E(u_t, u_s) = 0 \quad \text{for all } t$$

Heteroscedasticitytest

- The error term of our regression model is homoskedastic if the variance of the conditional distribution of uigiven Xi,

Var(ui|Xi=x), is constant for all observations in our sample:

Var(ui|Xi=x)=σ2 ∀ i=1,…,n.

- If instead there is dependence of the conditional variance of uion Xi, the error term is said to be heteroskedastic. We then write

Var(ui|Xi=x)=σ2i ∀ i=1,…,n.

- Homoskedasticity is a special case of heteroskedasticity.

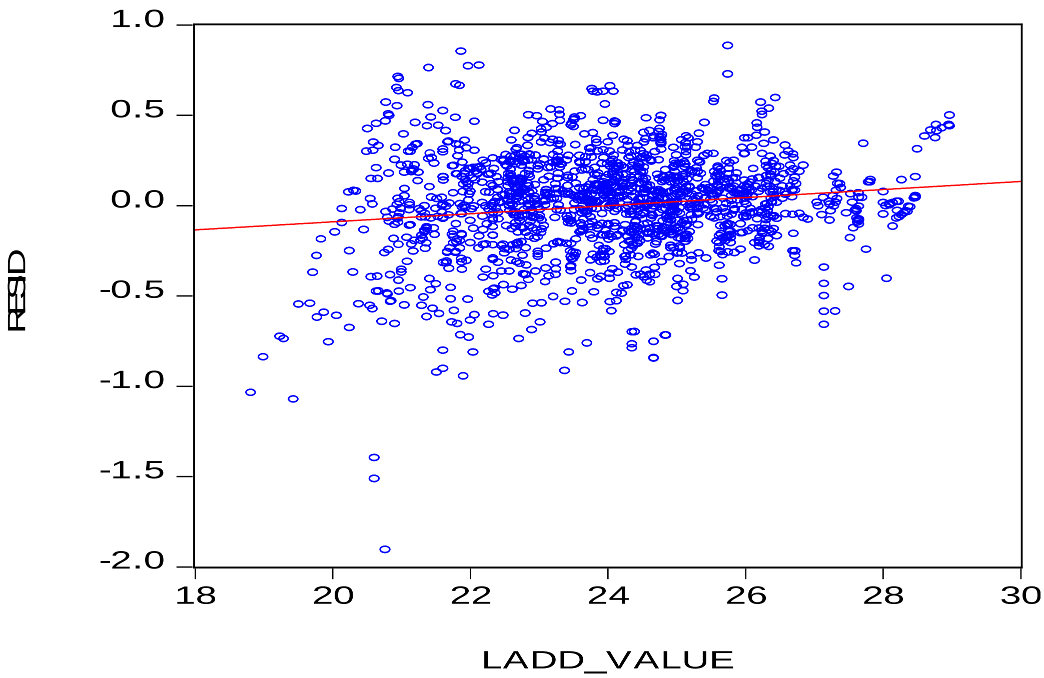


Figure 10.Heteroscedasticity test

The diagram shows that there is a relation between residual and add value in the form of a straight line. Meaning that there are heterogeneous disturbances in a linear regression model.

Appendix of study

Table 7.Pooled regression

Dependent Variable: LADD_VALUE				
Method: Panel Least Squares				
Date: 10/24/21 Time: 09:59				
Sample: 2000 2022				
Periods included: 23				
Cross-sections included: 72				
Total panel (unbalanced) observations: 1563				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.90768	0.164582	108.8072	0.0000
LNANOTECHNOLOGY	0.514532	0.014434	35.64754	0.0000
LHIGH_TECH	0.971748	0.058078	16.73172	0.0000
R-squared	0.695488	Mean dependent var		24.01758
Adjusted R-squared	0.695098	S.D. dependent var		1.844109
S.E. of regression	1.018279	Akaike info criterion		2.876022
Sum squared resid	1617.551	Schwarz criterion		2.886299
Log likelihood	-2244.611	Hannan-Quinn criter.		2.879842
F-statistic	1781.479	Durbin-Watson stat		0.065180
Prob(F-statistic)	0.000000			

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Table 8.Fixed test

Dependent Variable: LADD_VALUE				
Method: Panel Least Squares				
Date: 10/24/21 Time: 10:01				
Sample: 2000 2022				
Periods included: 23				
Cross-sections included: 72				
Total panel (unbalanced) observations: 1563				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.18767	0.118806	186.7549	0.0000
LNANOTECHNOLOGY	0.274375	0.006727	40.78767	0.0000
LHIGH_TECH	0.097909	0.035642	2.747007	0.0061
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.977658	Mean dependent var		24.01758
Adjusted R-squared	0.976562	S.D. dependent var		1.844109
S.E. of regression	0.282320	Akaike info criterion		0.354639
Sum squared resid	118.6804	Schwarz criterion		0.608140
Log likelihood	-203.1502	Hannan-Quinn criter.		0.448883
F-statistic	892.5523	Durbin-Watson stat		0.375851
Prob(F-statistic)	0.000000			

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Table 9.Random test

Dependent Variable: LADD_VALUE				
Method: Panel EGLS (Cross-section random effects)				
Date: 10/24/21 Time: 10:04				
Sample: 2000 2022				
Periods included: 23				
Cross-sections included: 72				
Total panel (unbalanced) observations: 1563				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.02747	0.159243	138.3261	0.0000
LNANOTECHNOLOGY	0.279149	0.006693	41.70706	0.0000
LHIGH_TECH	0.138922	0.035225	3.943864	0.0001
	Effects Specification			
			S.D.	Rho
Cross-section random			0.916322	0.9133
Idiosyncratic random			0.282320	0.0867
	Weighted Statistics			
R-squared	0.540060	Mean dependent var		1.584024
Adjusted R-squared	0.539471	S.D. dependent var		0.428328
S.E. of regression	0.289862	Sum squared resid		131.0712
F-statistic	915.8741	Durbin-Watson stat		0.345509
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R-squared	0.464605	Mean dependent var		24.01758
Sum squared resid	2843.989	Durbin-Watson stat		0.015924

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Table 10.Hausman Test

Correlated Random Effects-Hausman Test				
Equation: Untitled				
Test cross-section random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		81.244657	2	0.0000
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
LNANOTECHNOLOGY	0.274375	0.279149	0.000000	0.0000
LHIGH_TECH	0.097909	0.138922	0.000030	0.0000
Cross-section random effects test equation:				
Dependent Variable: LADD_VALUE				
Method: Panel Least Squares				
Date: 10/24/21 Time: 10:18				
Sample: 2000 2022				

Periods included: 23				
Cross-sections included: 72				
Total panel (unbalanced) observations: 1563				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.18767	0.118806	186.7549	0.0000
LNANOTECHNOLOGY	0.274375	0.006727	40.78767	0.0000
LHIGH_TECH	0.097909	0.035642	2.747007	0.0061
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.977658	Mean dependent var		24.01758
Adjusted R-squared	0.976562	S.D. dependent var		1.844109
S.E. of regression	0.282320	Akaike info criterion		0.354639
Sum squared resid	118.6804	Schwarz criterion		0.608140
Log likelihood	-203.1502	Hannan-Quinn criter.		0.448883
F-statistic	892.5523	Durbin-Watson stat		0.375851
Prob(F-statistic)	0.000000			

Source: Prepared by the researcher based on the statistical program EViews 10th Edition

Conclusion

The study provided an assessment of the econometric models to measure the impact of nanotechnology's contribution to raising economic growth rates, by examining the relationship between scientific research of nanotechnology and the added value of manufacturing in various countries, and making a contribution to explore the methods available to verify the relationship between them using panel analysis, then working on the development of a proposed model to integrate nanotechnology receiving the art of modern technologies and adapt them to serve economic development, leading to the development of scientific infrastructure as one of the pillars of economic growth.

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