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Research Paper

Neural Networks as a Means to Study the Factors Having Influence on Adjusted Net Savings

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ABSTRACT

The purpose of the study is to prove the existence of a relationship between the inflow of foreign direct investment, inflation and the level of income from taxation on adjusted net savings. The researchers used a combination of regression analysis and analogy with the human brain in terms of information intake and processing as well as any factors of biological nature. During the study, the author applied both general scientific and special methods: scientific abstraction, analysis and synthesis, historical and logical method, systematic approach, method of theoretical generalization and comparison. They used methods of regression analysis at the first stage of the study and the method of neural networks at the second stage to build an input-output model of investment in a particular country. They compared obtained results with each other and formulated a model of the possible impact of investment inflows to countries by transnational corporations. The results of the study confirm that the national and foreign investment policies of the host countries transform the role of investment in economic development while improving the standard of living in the countries studied. The author proved that the higher the tax burden in a country, the more the level of adjusted net savings changes.

HIGHLIGHTS

- The article is devoted to the main problems of transformation of the investment behaviour of transnational corporations under the influence of the sustainable development concept and the allocation of adjusted net savings as one of the most influential factors of changes in the attraction and accumulation of investments.

Keywords: Investment, investment behaviour, correlation, multinational corporations, regression analysis

In modern realities, technological advance is one of the most important reasons for the economic development of the country (Shrestha, 2012). Without a sufficiently high level of technology development, the country and its producers can no longer be competitive in the international market. However, this not only raises the living standards of the population, but also contributes to scientific development, while the expertise becomes the basis for building new inventions (Boon, 2006). The development of neural networks helped to form new conclusions based on the analysis of statistical data volumes. In general, neural networks are mathematical models (or their software or hardware embodiment) that function on the principle of building of biological neural networks of living organisms, also called the networks of nerve cells (Schramowski *et al.* 2020).

The study of P. Buckley and M. Casson (1998) demonstrates an interesting phenomenon when transnational corporations (TNCs) face new challenges that force them to transform the national system of host countries, namely uncertainty and

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market volatility, coordination within joint ventures and business networks, competence of corporate managers at any level of the TNC and cooperation with employees of the corporation. In a later work, P. Buckley and M. Casson (2003) discussed possible risks, which require consideration.

J. Krenek *et al.* (2014) explore the general development of existing programs that allow making research using neural networks. X. Wang (2017) also worked on a similar topic, studying the role and prospects of neural networks, when O.I. Abiodun *et al.* (2018) focused on modern possibilities of using this technology in various scientific fields. A. Ruospo *et al.* (2021) pointed not only to the benefits of using neural networks to analyse statistical data but also to the existing shortcomings, in particular, problems in the context of forecasting. It is also worth mentioning the works that investigated other phenomena not related to net savings but using neural networks as well. E.C. Mamatzakis *et al.* (2022) studied changes in household lending during the COVID-19 pandemic while M. Barrachina (2021) investigated entrepreneurship development based on various variables.

The aim of the study is to prove the existence of the relationship between the inflow of foreign direct investment (FDI), inflation rate and the level of income from taxation on adjusted net savings (ANS) in the form of a combination of regression analysis using a neural network. The object of the study was the actual data volumes processed and analysed using neural networks.

MATERIALS AND METHODS

In this paper, the author carried out regression analysis of the data and another analysis using neural networks. The countries making the subject of the study were USA, Chile, China, Germany and Ukraine as explained later in the text. Author presented all the collected data in tabular form for clarity. Further, author investigated the relationship between adjusted net savings and inflation, FDI inflows, tax income, and CO_2 emissions in the countries analysed using Statistica 12.0 and Excel 2016 in the first stage of calculation by method of regression analysis. The data for the USA are shown in Table 1.

Data for Chile are shown in Table 2.

Table 1: Data for regression analysis and neural networks from 2010-2018 for the USA

Year	FDI inflows, (BoP, current US$)	Inflation rate, %	Level of income tax revenue, % of GDP	Adjusted net savings, (current US$)	CO_2 emission, metric tons per capita
2010	2.64039E+11	1.64	8.595888	-62193544000	17.44286
2011	2.63497E+11	3.15	9.573699	1.02312E+11	16.97696
2012	2.50345E+11	2.06	9.796872	4.73529E+11	16.31047
2013	2.88131E+11	1.46	10.51961	5.46362E+11	16.32348
2014	2.51856E+11	1.62	10.95153	7.66533E+11	16.50284
2015	5.09087E+11	0.11	11.2046	7.65609E+11	17.23184
2016	4.94457E+11	1.26	10.98294	5.10637E+11	17.11206
2017	3.54828E+11	2.13	11.94741	5.8149E+11	16.99227
2018	2.67081E+11	2.44	10.40535	4.46041E+11	16.87248

***Note**: BoP – balance of payments; GDP – gross domestic product; **Source**: World Bank Data (2022).*

Table 2: Data for regression analysis and neural networks from 2010-2018 for Chile

Year	FDI inflows, (BoP, current US$)	Inflation rate, %	Level of income tax revenue, % of GDP	Adjusted net savings, (current US$)	CO_2 emission, metric tons per capita
2010	16019683111	1.41	17.35	26966367948	4.234476
2011	24149598879	3.34	18.85	27188368529	4.598226
2012	30292554797	3	18.99	26719089880	4.653625
2013	20824865443	1.78	17.38	25240705216	4.736431
2014	23736252540	4.71	16.97	23161886125	4.649062
2015	21055618323	4.34	17.44	21299122136	4.883101
2016	12135710063	3.78	17.39	18653217394	4.976906
2017	5852183238	2.18	17.41	17785439361	5.07071
2018	6082221197	2.43	18.48	26381557011	5.164515

***Source**: World Bank Data (2022).*

Data for People's Republic of China (PRC) are shown in Table 3.

Data for Germany shown in Table 4.

Similarly, author presents data for Ukraine (Table 5).

Having consolidated all the necessary data for further research, we will calculate the regression analysis according to the following formula within the linear regression:

$$y = a_0 + a_1 X, \quad \ldots(1)$$

where: y is adjusted net savings; X is a certain factor under study; a_1 and a_0 are regression coefficients.

This function helps to determine the impact of a set of factors on adjusted net savings (y), namely: FDI inflow – x_1, inflation rate – x_2, level of income tax revenue – x_3, CO_2 emission – x_4, that means

Table 3: Data for regression analysis and neural networks for 2010-2018 for China

Year	FDI inflows, (BoP, current US$)	Inflation rate, %	Level of income tax revenue, % of GDP	Adjusted net savings, (current US$)	CO_2 emission, metric tons per capita
2010	243703434558	3.17	10.2120475	1.98163E+12	6.56052
2011	280072219150	5.55	10.3127945	2.2319E+12	7.241515
2012	241213868161	2.61	10.9159845	2.36891E+12	7.424751
2013	290928431467	2.62	9.90773308	2.46665E+12	7.557211
2014	268097181064	1.92	9.71306785	2.65924E+12	7.543908
2015	242489331627	1.43	9.41608683	2.63468E+12	7.377379
2016	174749584584	2	9.20099957	2.51151E+12	7.623849
2017	166083755722	1.59	8.95517645	2.76513E+12	7.870319
2018	203492014029	2.07	8.71345829	2.68967E+12	8.116789

***Source**: World Bank Data (2022).*

Table 4: Data for regression analysis and neural networks for 2010-2018 for Germany

Year	FDI inflows, (BoP, current US$)	Inflation rate, %	Level of income tax revenue, % of GDP	Adjusted net savings, (current US$)	CO_2 emission, metric tons per capita
2010	86053684912	1.1	11.11579	2.52611E+11	9.279634
2011	97480731020	2.07	11.44178	3.58532E+11	9.124859
2012	65464274951	2	11.57121	3.01202E+11	9.1993
2013	67407574807	1.5	11.55001	3.11359E+11	9.390623
2014	19778357284	0.9	11.43902	3.6874E+11	8.88937
2015	62462264553	0.51	11.34788	3.55389E+11	8.789557
2016	62617264989	0.49	11.18187	3.74476E+11	8.692102
2017	83415033637	1.5	11.35656	3.94701E+11	8.594648
2018	1.05277E+11	1.73	11.31653	3.65221E+11	8.497194

***Source**: World Bank Data (2022).*

Table 5: Data for regression analysis and neural networks from 2010-2018 for Ukraine

Year	FDI inflows, (BoP, current US$)	Inflation rate, %	Level of income tax revenue, % of GDP	Adjusted net savings, (current US$)	CO_2 emission, metric tons per capita
2010	6451000000	9.372931	15.57052	4391013276	6.64135
2011	7207000000	7.955725	18.51505	3795214107	6.265962
2012	8175000000	0.568728	18.31656	500413570.2	6.487603
2013	4509000000	-0.23895	17.56138	-8134029767	5.976642
2014	847000000	12.07186	17.29435	-3371033613	5.020747
2015	3050000000	48.69986	20.45137	3315383474	5.182218
2016	3441000000	13.91271	19.63012	4246172254	5.013495
2017	2827000000	14.43832	20.03453	6534362791	4.844772
2018	2476000000	10.95186	20.48092	4130777311	4.676049

***Source**: World Bank Data (2022).*

how much the second parameter will change on average when the first one changes by a certain unit of measurement.

In this case, it can be distinguished two hypotheses: H1: adjusted net savings are most affected by FDI inflows and level of income tax revenues in the USA and Germany; H2: adjusted net savings are most affected by FDI inflows and CO_2 emissions in PRC and USA.

Having found the dependence between the adjusted net savings and the studied factors in these countries, author calculates the following formula using the neural network method:

$$o(X) = f\left(w\downarrow o + w\downarrow 1 f\right) \left(w\downarrow 01 + \sum i = 1\uparrow 4 + w\downarrow i'1\right) \quad \ldots(2)$$

where: o denotes the adjusted net savings; $w\downarrow i$ denotes the weight (output neuron); $x\downarrow i$ denotes the input i for i = 1.2.3.4; $w\downarrow 0$ is the intercept (output neuron); $w\downarrow 01$ is the intercept of the hidden neuron; $w\downarrow 1$ is the synaptic weight corresponding to the synapse starting from the hidden neuron and leading to the output neuron.

Thus, using these two methods author finds the dependence and calculate the main consequences of the influence of the studied factors.

RESULTS

The international economists consider investments as one of the sources of development and scientific and technological progress (Natera and Castellacci, 2021). International investment occurs due to the transfer of capital by a certain subject of international economic relations to a profitable and allegedly almost risk-free investment object. In this study, it was interesting to use the method of neural networks and regression analysis to identify the influence of such factors as inflow of foreign direct investment, inflation rate, level of tax income (% of GDP) on adjusted net savings in the countries as USA, Chile, China, Germany and Ukraine (Table 6).

For the calculation, the author used statistical information of Ukraine for the period 1990-2018, which is associated with the greatest completeness of the data found and the beginning of the development of the economic system of Ukraine (Table 7).

The designed neural network model aims to analyse the influence of carbon dioxide emissions, income tax revenue, inflation rate, and FDI inflow on adjusted net savings. Now author interprets this neural network in the mathematical dimension. Having conducted the research, author presents results in Table 8.

These calculations confirm hypothesis that there is a strong relationship between selected factors and adjusted net savings. For four countries, the correlation almost reaches 1, revealing a close dependence. In Ukraine there is an average closeness of connection, confirmed by both regression analysis and the use of neural networks.

DISCUSSION

The scientists W.S. McCulloch and W. Pitts (1943) first used the term "neural networks" in 1943 during the study of the composition of the neutron, which

Table 6: Top 10 largest TNC investors in development by country of origin in 2019

No.	Name of TNC	Country of origin	Field of activity	Expenditures on development and innovation, US$ billion
1	Amazon.com, Inc.	USA	Technology industry	28.8
2	Alphabet Inc.	USA	Technology industry	21.4
3	Samsung Electronics Co, Ltd	South Korea	Technology industry	16.5
4	Huawei Technologies	PRC	Technology industry	15.3
5	Microsoft Corp	USA	Technology industry	14.7
6	Apple Inc.	USA	Technology industry	14.2
7	Intel Corp	USA	Technology industry	13.5
8	Roche Holding AG	Switzerland	Pharmaceutical	12.3
9	Johnson and Johnson	USA	Pharmaceutical	10.8
10	Toyota Motor Corp	Japan	Motor Vehicle	10.0

***Source**: World Investment Report: Special Economic Zones (2019).*

Table 7: Calculations of correlation and regression analysis for selected countries

	Ukraine				Germany			
Indicators	**Impact on the ANS of the CO_2 emission**	**Impact on the ANS of income tax revenue**	**Impact on the ANS of the inflation rate**	**Impact on the ANS of FDI inflows**	**Impact on the ANS of the CO_2 emission**	**Impact on the ANS of income tax revenue**	**Impact on the ANS of the inflation rate**	**Impact on the ANS of FDI inflows**
Multiple R	0.24767	0.02950062	0.155337	0.449648	0.755976	0.246002	0.19422	0.172852
R Square	0.06134	0.00087028	0.02413	0.202183	0.5715	0.060517	0.037721	0.029878
Adjusted R Square	0.023794	-0.03909490	-0.01491	0.170271	0.555629	0.025721	0.002081	-0.00605
Standard Error	5.28E+09	5451536490	5.39E+09	4.87E+09	7.03E+10	1.04E+11	1.05E+11	1.06E+11
Observations	27	27	27	27	29	29	29	29
	USA				**PRC**			
Multiple R	0.021644	0.757366	0.145278	0.371842	0.989559	0.861185	0.273845	0.934183
R Square	0.000468	0.573604	0.021106	0.138267	0.979227	0.741639	0.074991	0.872697
Adjusted R Square	-0.03655	0.557812	-0.01515	0.106351	0.978458	0.73207	0.040731	0.867982
Standard Error	2.49E+1	1.63E+11	2.46E+11	2.31E+11	1.5E+11	5.29E+11	1E+12	3.71E+11
Observations	29	29	29	29	29	29	29	29
	Chile							
Multiple R	0.823549	0.762726	0.53895	0.825644				
R Square	0.678234	0.581751	0.290467	0.681688				
Adjusted R Square	0.666316	0.566261	0.264188	0.669899				
Standard Error	5.01E+09	5.71E+09	7.44E+09	4.98E+09				
Observations	29	29	29	29				

***Note**: ANS – adjusted net savings; Source: compiled by the author.*

Table 8: Calculated neural networks for the studied countries

					Germany					
Net name	**Training perf.**	**Test perf.**	**Validation perf.**	**Training error**	**Test error**	**Validation error**	**Training algorithm**	**Error function**	**Hidden activation**	**Output activation**
MLP 4-3-1	0.984879	0.980711	0.968144	1.577843E+20	5.274275E+20	8.145437E+20	BFGS 38	SOS	Tanh	Exponential
MLP 4-6-1	0.951877	0.940024	0.976485	4.972433E+20	1.846033E+21	7.955451E+20	BFGS 29	SOS	Tanh	Tanh
MLP 4-6-1	0.939664	0.967600	0.951550	6.111736E+20	8.973036E+20	1.578438E+21	BFGS 19	SOS	Tanh	Identity
MLP 4-6-1	0.964880	0.985018	0.991252	3.566486E+20	1.817476E+21	2.579622E+20	BFGS 55	SOS	Logistic	Exponential
MLP 4-7-1	0.868244	0.954256	0.927423	1.280748E+21	4.123503E+21	7.276008E+20	BFGS 12	SOS	Identity	Exponential
					USA					
MLP 4-4-1	0.815670	0.919354	0.979397	2.608472E+22	1.109925E+21	2.865651E+21	BFGS 4	SOS	Tanh	Exponential
MLP 4-10-1	0.952578	0.949515	0.993302	3.239548E+21	1.763247E+21	3.461837E+21	BFGS 31	SOS	Tanh	Logistic
MLP 4-4-1	0.814113	0.931374	0.977190	3.195639E+22	5.274994E+21	7.386769E+21	BFGS 2	SOS	Logistic	Sine
MLP 4-5-1	0.832138	0.970057	0.976006	1.853762E+22	9.981057E+20	1.438293E+21	BFGS 3	SOS	Exponential	Exponential
MLP 4-10-1	0.835789	0.941558	0.981181	2.409423E+22	8.674856E+20	2.290611E+21	BFGS 2	SOS	Tanh	Identity
					China					
MLP 4-4-1	0.995828	0.999498	0.999167	4.313973E+21	9.307418E+20	4.317030E+21	BFGS 17	SOS	Tanh	Logistic
MLP 4-7-1	0.997136	0.999056	0.999985	2.892181E+21	1.682798E+21	1.699190E+21	BFGS 25	SOS	Logistic	Logistic
MLP 4-9-1	0.993285	0.999022	0.999644	7.305140E+21	2.548677E+21	3.363920E+21	BFGS 15	SOS	Logistic	Exponential
MLP 4-9-1	0.998430	0.999813	0.999394	1.510221E+21	3.819908E+21	2.428537E+21	BFGS 42	SOS	Tanh	Exponential
MLP 4-4-1	0.996362	0.999603	0.999343	4.005232E+21	5.573595E+20	2.819643E+21	BFGS 11	SOS	Identity	Logistic
					Chile					
MLP 4-5-1	0.980708	0.979410	0.976295	1.354039E+18	4.378586E+18	5.518159E+18	BFGS 22	SOS	Logistic	Logistic
MLP 4-7-1	0.986551	0.995561	0.964121	9.698367E+17	1.816398E+18	2.475650E+18	BFGS 30	SOS	Logistic	Exponential
MLP 4-7-1	0.989836	0.969475	0.955727	7.209669E+17	5.521654E+18	9.788406E+18	BFGS 30	SOS	Tanh	Identity
MLP 4-4-1	0.982815	0.961128	0.954276	1.270482E+18	4.605849E+18	5.077883E+18	BFGS 12	SOS	Tanh	Exponential
MLP 4-9-1	0.994136	0.950273	0.990851	4.129874E+17	5.037762E+18	7.508289E+18	BFGS 34	SOS	Tanh	Identity

Ukraine										
MLP 4-9-1	0.685608	0.756626	-0.256766	5.555549E+18	1.938058E+19	1.032254E+19	BFGS 11	SOS	Identity	Exponential
MLP 4-3-1	0.727953	0.783054	-0.133317	4.955995E+18	1.910629E+19	8.027901E+18	BFGS 14	SOS	Tanh	Exponential
MLP 4-3-1	0.765678	0.790200	-0.005817	4.539512E+18	1.949601E+19	6.477883E+18	BFGS 19	SOS	Tanh	Logistic
MLP 4-10-1	0.686090	0.756265	-0.274904	5.544982E+18	1.962097E+19	1.020061E+19	BFGS 11	SOS	Identity	Exponential
MLP 4-9-1	0.853414	0.930389	0.499914	2.879740E+18	1.700802E+19	3.343131E+18	BFGS 37	SOS	Tanh	Exponential

***Source**: Compiled by the author.*

the economists took as a basis for the formation of the future model. A. Sukhadeve (2017) noted that the neural networks in the computational world exist in the layers consisting of interconnected nodes that contain an activation function.

J. Krenek *et al.* (2014) investigate neural networks as a means of calculating considerable amounts of data. The authors describe a large number of tools for the development and management of artificial neural networks. X. Wang (2017) also explores the current state of development of neural networks. The scientist pays attention to the increasing role they are beginning to play in scientific research and how much they simplify data processing. A study conducted by O.I. Abiodun *et al.* (2018) has also shown that neural networks have very significant use among different scientific disciplines and applicable for different purposes. When studying the performance of neural networks, A. Ruospo *et al.* (2021) conclude that they are resistant to certain types of errors but have problems with predicting future trends.

The neural networks have wide application in study by E.C. Mamatzakis *et al.* (2022) on changes in household debt as a reaction to events related to the onset of the COVID-19 crisis. Using a vector auto-regression model (VAR model), the researchers were able to conclude that household debt will decrease due to COVID-19 mortality, although only in the short term. M. Barrachina (2021) provided advice for the formation of entrepreneurship development policy based on the analysis of various economic, fiscal and educational variables.

J.E. Stiglitz *et al.* (2009) proposed to estimate the level of investment using adjusted net savings, which reflects the balance of payments as a basis for assessing investment inflows. D. Plikynas and Y.H. Akbar (2006) suggested to explore investment activity in the context of inflows using neural networks as they show all the complexity of the process as well as the factors influencing the optimal investment decision and saving of own investments within the host country. H.A. Bobenič *et al.* (2018) studied the indicators of the dependence of risk investment using statistical methods with account of the error and found that only 12 studied models were effective and their factors can correlate with foreign direct investment.

G. Săvoiu and M. Ţaicu (2014) reveal the methods of neural networks research and give examples in graphical and mathematical form. The authors came to the conclusion about the high role of FDI as a factor of development even in times of recession. M. Qasim and A. Grimes (2018) covered models of the impact on adjusted net savings. This indicator was the main factor for assessing the total objective well-being.

CONCLUSION

The neural network is an interpretation and analogy with human brain activity, when external factors affecting neurons produce certain response to these stimuli. In the course of the study, the use of neural networks in economics, namely the study of tight connection turned out to be more accurate. This reveals the strong nature of the impact of the selected factors on adjusted net savings. The learning function gave us the opportunity to identify not only a linear relationship but also a logical, exponential and hyperbolic connection. It should be noted that investment activity really contains a high potential for development, as investments affect the experience of host countries, provide an opportunity to transform the staff of national corporations into highly qualified human capital and turn their own capital-intensive technologies into innovative technologies and nanotechnologies.

Study confirms the effectiveness of using the neural network method in comparison with regression analysis. Therefore, reimagining the indicator of economic development in favour of adjusted net savings is tangible and redeemable. The author

thinks that the creation of new estimation models using neural networks is relevant for future research as well as finding new opportunities for using the indicator of adjusted net savings to assess the economic development of the country.

REFERENCES

Abiodun, O.I., Jantan, A., Omolara, A.E., Dada, K.V., Mohamed, N.A. and Arshad, H. 2018. State-of-the-art in artificial neural network applications: A survey. *Hel.*, **4**(11): e00938.

Barrachina, M. 2021. *Empirical International Entrepreneurship. A Handbook of Methods, Approaches, and Applications. International entrepreneurship rate prediction using neural networks.* Springer, Berlin.

Bobenič, H.A., Bruothová, M., Kubíková, Z. and Ručinský, R. 2018. Determinants of foreign direct investment inflows: A case of the Visegrad countries. *J. of Inter. Stud.*, **11**(2): 222-235.

Boon, M. 2006. How Science Is Applied in Technology. *Inter. Stud. in the Phil. of Sci.*, **20**(1): 27-47.

Buckley, P. and Casson, M. 1998. Models of the Multinational Enterprise. *J. of Inter. Bus. Stud.*, **29**: 21-44.

Buckley, P. and Casson, M. 2003. The Future of the Multinational Enterprise in retrospect and in prospect. *J. of Inter. Bus. Stud.*, **34**: 219-222.

Krenek, J., Kuca, K., Krejcar, O., Maresova, P., Sobeslav, V. and Blazek, P. 2014. Artificial Neural Network Tools for Computerised Data Modeling and Processing. *Conference: CINTI2014*, **1**: 1-6.

Mamatzakis, E.C., Ongena, S. and Tsionas, M.G. 2022. *The response of household debt to COVID-19 using a neural networks VAR in OECD*. https://link.springer.com/article/10.1007/s00181-022-02325-2. (Last Accessed on 31th December, 2022).

McCulloch, W.S. and Pitts, W. 1943. A logical calculus of the ideas immanent in nervous activity. *Bul. of Math. Biop.*, **5**: 115.

Natera, J.M. and Castellacci, F. 2021. Transformational complexity, systemic complexity and economic development. *Res. Pol.*, **50**(7): 104275.

Plikynas, D. and Akbar, Y.H. 2006. Neural Network Approaches to Estimating FDI Flows: Evidence from Central and Eastern Europe. *East. Eur. Econ.*, **44**(3): 29-59.

Qasim, M. and Grimes, A. 2018. *Sustainable economic policy and well-being: The relationship between adjusted net savings and subjective well-being*. Motu Economic and Public Policy Research, Wellington.

Ruospo, A., Sanchez, E., Traiola, M., O'Connor, I. and Bosio, A. 2021. Investigating data representation for efficient and reliable Convolutional Neural Networks. *Micr. and Micros.*, **86**: 104318.

Săvoiu, G. and Ţaicu, M. 2014. Foreign direct investment models, based on country risk for some post-socialist Central and Eastern European economies. *Proc. Econ. and Fin.*, **10**: 249-260.

Schramowski, P., Stammer, W., Teso, S., Brugger, A., Herbert, F., Shao, X., Luigs, H.-G., Mahlein, A.-K. and Kersting, K. 2020. Making deep neural networks right for the right scientific reasons by interacting with their explanations. *Nat. Mach. Intel.*, **2**: 476-486.

Shrestha, R. 2012. *Information Technology: The Gateway for the Development of Nation*. Department of Computer and Electronics Engineering, Kantipur City College Putalisadak, Kathmandu.

Stiglitz, J.E., Sen, A.K. and Fitoussi, J.-P. 2009. *Report by the commission on the measurement of economic performance and social progress.* https://goo.su/Sysa. (Last Accessed on 31th December, 2022).

Sukhadeve, A. 2017. *Understanding Neural Network: A beginner's guide.* https://www.datasciencecentral.com/profiles/blogs/understanding-neural-network-a-beginner-s-guide. (Last Accessed on 31th December, 2022).

Wang, X. 2017. Overview of the Research Status on Artificial Neural Networks. In: *2nd International Forum on Management, Education and Information Technology Application* (pp. 351-356). Dordrecht: Atlantis Press.

World Bank Data. 2022. https://data.worldbank.org/.(Last Accessed on 31th December, 2022).

World Investment Report: Special Economic Zones. 2019. https://unctad.org/system/files/official-document/wir2019_en.pdf. (Last Accessed on 31th December, 2022).