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Review on Machine Learning Techniques for International Trade Trends Prediction

Vaishali Gupta
IGDTUW, Delhi, India
vaishaliagraw@gmail.com

Ela Kumar
IGDTUW, Delhi, India
ela_kumar@igdtuw.ac.in

Abstract*— Now days, analyzing the past trend and make future predictions has become an important aspect for every field to growth. By analyzing the economic trends and knowing the future value of important economic variables makes a country more efficient in country's economic planning and developing policies. This can be achieved by increased application of machine learning more effectively and accurately. In recent years, Machine Learning techniques have been suggested as alternative approach to traditional statistical methods by many authors in the field of economics. As international trade policies critically affects employment and wages of a country that is important aspect for growth of a country, for policy makers all across the world, predicting future patterns of international trade is a top priority. This paper presented a literature review of the works where machine-learning techniques have been used in international trade trends prediction. The findings reveal that there is a growing interest in developing machine learning models for economic forecasting in comparison to conventional statistical methods.

Keywords- International Trade trends, machine-learning, artificial neural network, literature review, prediction.

I. INTRODUCTION

International trade refers to a country's economic activity that is related to another country's economic relationship. International trade flow of a country consists of goods and services that a country exports to and imports from other countries of the world. To comprehend the interplay between international trade policy and domestic policies, both the exports and imports are important indicators used by policymakers. However, policymakers highly concentrate on enhancing exports as the foreign exchange earned through these exports help in financing the imports of a country. Prediction of international trade trends is very important, as these are significant determinants of a country's macroeconomic stability, economic development and growth. The exports also create employment and wages in the domestic economy, and hence, predicting future patterns of exports or international trade trends is a high-priority for policy makers around the world. Trade policy research traditionally focused on using wide range of conventional statistical and econometric approaches for analyzing and forecasting exports. In recent times, there is notable recognition for artificial intelligence and machine learning algorithms that have high superiority over traditional econometric models in terms of efficiency and forecasting accuracy. Machine learning is a novel and flexible approach of artificial intelligence that can be used for advanced statistical analysis and problem solving. Machine learning is big data sets driven approach to model relationships either supervised or unsupervised. In order to compute prediction accuracy, relationships are derived from one or more training data sets and applied to a test data sets in order to fit very complex non-linear systems with huge economic data by improving forecasting accuracy and prediction results.

II. LITERATURE REVIEW

Isaac Wohl and Jim Kennedy [1] presented an attempt to analyze international trade data using neural networks. They trained neural network for predicting trade between United States and its major trading partners countries on World Bank data set from 1986 to 2006 and made trade predictions between 2007 and 2016. Results shows that trade estimations predicted by neural network are reasonably close to actual trade values. Jingwen Sun et al [2] analyzed imports and exports data (1960-2017 period) of all countries to predict future imports and exports by evaluating trade statistics correlations. They also looked at trade data and analyzed several machine learning algorithms for predicting a country's GDP based on import and export values. They investigated the best performing machine learning algorithms for a better analysis of trade data and to forecast country GDP using five machine learning algorithms: Linear Regression (LR), RBF Regressor (RBF), Support Vector Machine (SVM), Regression by Discretization (RD), and Reduced Error Pruning Tress (REP). The results of the trade study demonstrate that trade statistics have a significant positive linear association. Imports and exports increased in lockstep as the world's commerce activity expanded. The United States, China, Japan, and India, in particular, have achieved significant gains in both imports and exports during the last decade. This research pursued two alternative paths. The first was to look at the top 10 import/export countries to see if there was any correlation in trade data, and the second was to look into different machine learning algorithms to see which one was best for predicting trade data and GDP. The results demonstrate that while all five algorithms had high correlations, the RBF approach outperformed the others. Munisamy Gopinath et al [3] applied deep-learning processes, supervised and unsupervised machine-learning techniques to the gravity model of bilateral trade flow to decipher patterns of trade. The Machine Learning models were trained on several major agricultural commodities data to make future prediction of trade flow. Results revealed the high relevance of machine learning techniques in comparison of traditional conventional econometric approaches to predicting trade flow patterns. Teg Alam [4] applied Artificial Neural Network (ANN) and Autoregressive Integrated Moving average (ARIMA) models for forecasting total annual exports and imports of the Kingdom of Saudi Arabia. The findings show that the ANN, ARIMA (0,1,1) and ARIMA(1,1,2) found as the appropriate models for forecasting country's total annual exports and imports.

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Sonia Circlaeys et al [5] applied ML methods to predict pattern of bilateral trade flows with superior prediction quality. They used variety of linear regression and a neural network to train the model with set of economic and geographic input variables such as GDP of the country and distance between importer and exporter country. Due to capability of capturing nonlinear interaction among the features, neural network found as promising approach to predict future bilateral trade patterns. Feras A. Batarseh et al. [6] introduced Machine Learning algorithms for international trade settings to check their applicability on economical data and prediction quality. In the study, ML algorithms allowed to extract best economic variables that influence trade of specific commodities for example, for beef commodity, distance between importer and exporter countries had the highest influence among other economic variables. As a result study indicates the high relevance of ML methods in international trade settings than conventional statistical approaches. ML methods were found more accurate in predicting future trade patterns.

Tuomas Nummelin et al [7] tested and compared three ML methods namely, Support Vector Machine, Neural Network and Random Forest (ensemble method), to check their potential in predicting global bilateral trade trends of soft sawn wood by countries. The experimental results can be used in "what if analyses" to support policy maker's opinion. Francis Mark A. Quima et al [8] compared gravity model estimation procedures such as ordinary least squares (OLS), poisson pseudo maximum likelihood (PPML), and Gaussian processes (GPML) with the neural network in analysis and prediction of the trade flow. Experimental results show that in terms of describing the variability of dependent variable and accuracy of predictions, neural network estimation was found to be superior. Adam Richardson et al. [9] evaluated the real-time performance ML methods in nowcasting New Zealand's real GDP growth. They estimated popular ML models on the country's economic data (GDP data) that comprises a large feature sets of 550 domestic and international variables over the period 2009 -2018. They compared ML methods forecast accuracy with a naive autoregressive benchmark and other statistical models. The findings revealed that the ML methods in majority produced more accurate forecast results than autoregressive and other statistical benchmarks.

Jin-kyu Jung et al [10] employed a number of ML methods as a new approach to forecast. They applied the Elastic Net, SuperLearner, and Recurring Neural Network on macro data of seven advanced and emerging economies. Results show that these ML algorithms outperformed conventional statistical approaches and offering great potential in the area of economic forecasting. Jackie D. Urrutia et al [11] applied Autoregressive Integrated Moving Average (ARIMA) and Bayesian Artificial Neural Network (BANN) algorithms on economic data of Philippines to forecast imports and exports of the country. The authors formulated and compared the two models through a statistical test and applied their forecasting accuracy measures (error measures) to compare the performance of the two models. As a result of comparison, the authors concluded that BANN is the best-fitted model in forecasting the imports and export of the Philippines. Mohd Zukimehj Matjunoh [30] proposed the extension of neural network techniques and compared neural network and economic statistical procedures to predict Malaysia's GDP growth. They considered time series data over the period 1995-2000 that comprising many knowledge based economic indicators. Results indicate that the neural network offers great potential to predict country's GDP growth compared to the traditional econometric approach.

TABLE I. NOTABLE MACHINE LEARNING METHODS IN INTERNATIONAL TRADE PREDICTION

Research Objective	Authors	Database	Machine Learning Methods
Forecasting International Trade	Wohl,I. and Kenedy, J.[1], 2018.	World Bank Data	-Neural Network
Analysis of Bilateral Trade Flow and GDP Forecasting	Jingwen Sun et al.[2], 2018.	U.S. and Germany import and export data sets	-Linear regression(LR) -RBF regressor(RBF) -Support Vector Machine(SVM) -Regression by Discretization(RD) -Reduced Error Pruning Tree(REP)
Analysis of gravity model of bilateral flow for Agricultural Trade prediction	Munisamy Gopinath et al. [3], 2020.	UNCTAD TRAINS	-Supervised ML Models-Decision trees: Random Forests, Bagging and Boosting -Unsupervised ML Model- Neural Network
Forecasting exports and imports	Teg Alam [4], 2019.	SAMA	-Artificial Neural Network -Auto Regressive Integrated Moving Average (ARIMA)
Bilateral Trade Flow Prediction	S. Circlaeys et al. [5], 2017	CEPII's Tradhist	-Fully Connected, Feed forward Neural Network
Forecasting International Trade Trends	Feras et al. [6], 2019.	USDA's FAS-GATS	-Gboosting -XGBoosting -K-Means Clustering
Model for prediction of international trade of sawnwood	Tuomas Nummelin et al. [7], 2016.	FAO Databank	-Support Vector Machine -Neural Network -Random forest
Exploring Neural Network Models in Understanding Bilateral Trade in APEC	Francis Mark Quimba A. et al. [8], 2018.	World Bank and CEPII	-Neural Network
Nowcasting New Zealand GDP	Adam Richardson et al. [9], 2018	Macroeconomic and financial market statistics of New Zeland	-K Nearest Neighbour Regression (KNN) -Support Vector Machine (SVM) -Least Square Boosting (LSBoost) - Bayesian VAR (BVAR) -Feed Forward Neural Network
An Algorithmic	Jin-Kyu Jung et	World Economic	-Elastic Net -Recurrent Neural

Research Objective	Authors	Database	Machine Learning Methods
Crystal Ball: Forecasts-based on Machine Learning	al.[10], 2018	Outlook (WEO)	Network -Super Learner
Forecasting Philippines Imports and Exports	Jackie D. Urrutia et al [11], 2019	Philippines Statistical Authority	-Autoregressive Integrated Moving Average (ARIMA) -Bayesian Artificial Neural Network (BANN)
Predicting GDP Growth in Malaysia Using Knowledge-based Economy Indicators	Mohd Zukimehj Matjunoh [30],2004	Malaysia Trade Data	-Neural Network
Neuro Fuzzy Modelling for prediction of consumer Price Index	Godwin Ambukege et.al [31],2017	Tanzania NCPI Data	-Neuro-Fuzzy model

III. Artificial Neural Network for Trade Analysis

The findings reveal that among various machine-learning techniques, ANN models are most popular methods for economic analysis. ANN models, inspire from biological neuron, have ability to learn from infinite number of observations to provide superior data analysis. The learning in neural network comes from environment and, therefore, based on what has been observed in that environment, neural network develops strategies. It has been observed in review that neural networks were most popular choice for solving real economic issues including capturing relationships among different factors, assessing potential risks, which is important in making decisions, particularly on economic, finance, trade and other fields. *An artificial neural network (ANN)* is a machine-learning system that is designed to recognize patterns and is modeled after the human brain. ANNs are computer algorithms that are designed to mimic the functioning of the human brain, which is made up of biological units called "neurons." An artificial neural network is made up of multiple layers, each of which is made up of nodes. An artificial neuron is referred to as a node, and it is modeled after a neuron in the human brain. An Artificial Neural Network's fundamental model consists of three interconnected layers: one input layer, one output layer, and at least one hidden layer. The complexity of network training grows with each additional hidden layer. Figure 1 shows a basic ANN architecture with two hidden layers.

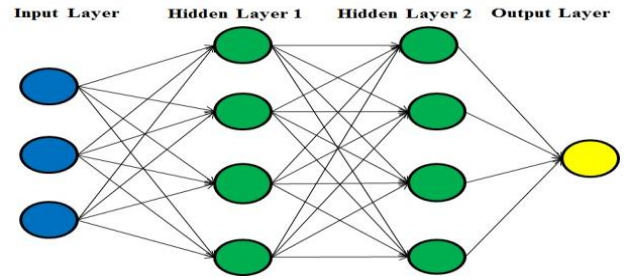

Fig.1 Artificial Neural Network

IV. Conclusion

The primary goal of this research is to examine research work in which authorss have used machine-learning techniques to forecast international trade patterns. The findings of this study show that, while traditional statistical approaches are still frequently employed for economic forecasting, there has been a significant movement toward the usage of machine learning and deep learning techniques. ANN models are the most popular and commonly utilised machine-learning approaches among researchers. Finally, it is stated that traditional statistical approaches have their own importance and value in the field of economic forecasting, but machine learning techniques are gaining popularity and, in many circumstances, delivering superior accuracy than traditional statistical methods.

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