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Machine Learning for Analyzing Effects of Various Factors on Business Economic

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ABSTRACT

In the last few decades, machine learning has become very useful in many areas of human life, such as medicine, farming, the military, transportation systems, and more. Machine learning is a great way to look at and guess how different things will affect the corporate economy. Businesses can use regression, decision trees, support vector machines, neural networks, clustering algorithms, and time series models to simulate and anticipate how changes in the economy, society, politics, and technology will affect them. These methods help organizations make better choices in many areas, such as risk analysis, demand forecasting, pricing management, policy effect simulation, and resource management. They also help firms come up with better plans in the ever-changing and complicated world of business. We will use machine learning methods to look at several things that have an effect on the corporate economy in this study.

1. Introduction

In today's complex and dynamic world, businesses and global economies are affected by various factors, including market changes, government policies, social developments, and technological advancements. Accurately analyzing these factors and predicting their effects on a business's economic performance, especially in times of rapid change and uncertainty, requires advanced and precise tools. Recent studies have also emphasized the growing role of artificial intelligence in shaping economic behaviors and improving analytical insight, such as the work of Pezeshgi et al. [1] on AI-driven behavioral mechanisms and Karizaki et al. [2] on automated assessment systems that enhance data-driven decision-making. Additionally, recent studies highlight the importance of AI-driven digital services and strategic competitive capabilities in modern businesses, as emphasized by Nikzat and Hosseinzade [3] in their model for evaluating e-service quality in crypto wallets and by Nikzat [4] in his analysis of AI-enabled competitive advantage. One such tool is machine learning, which is known as a new technology for data analysis and predicting economic behaviors. Machine

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learning allows businesses to make accurate predictions and better decisions by using historical data and complex patterns. This research studies how to use machine learning to analyze the effects of various factors on the business economy and its benefits.

This article is organized into five sections. In the second section, we will provide explanations about machine learning and some of its applications in the business economy. In the third section, we will look at the most important factors affecting the business economy. In the fourth section, we will review research conducted by various researchers on using machine learning techniques to find factors influencing the business economy, and finally, we will have the conclusion and state the existing challenges.

2. Machine Learning

Machine learning is one of the branches of artificial intelligence that allows systems to learn from data and make predictions without explicit programming. In this process, algorithms and mathematical models are used to extract patterns from existing data and use them to predict future results. This technology can be especially useful in analyzing the business economy because economic patterns are usually complex and have non-linear interactions that might not be fully simulated with traditional data analysis methods [5].

2.1 Some of the Most Used Machine Learning Algorithms in Business Economy Analysis

Machine Learning (ML [5]) is a branch of artificial intelligence that has created a huge change in data analysis and predicting economic trends. In the business world, various factors, including economic, social, political, competitive, and technological conditions, can affect the performance and profitability of businesses. Analyzing and predicting the effects of these factors on the business economy requires advanced tools that can process a large volume of complex data and extract useful patterns [5].

Machine learning, by using its different techniques, can help businesses simulate and predict the effects of these factors. This helps them make better decisions to optimize their economic and commercial strategies. This article looks at different machine learning techniques and how they are used to analyze the effects of factors influencing the business economy.

2.1.1 Linear regression and multiple regression

One of the simplest and most basic machine learning methods for modeling the relationship between a dependent variable and one or more independent variables is linear regression. This method can be used in business economics to look at how changes in interest rates, inflation, and exchange rates affect a business's profits or other economic indicators [6]:

i. Simple Linear Regression: This model looks at one independent variable (like the interest rate) and one dependent variable (like how much money a business makes). The model shows how changes in the interest rate will affect the profits of businesses.
ii. Multiple Regression: In this model, several independent variables (such as inflation rate, unemployment rate, and changes in oil prices) are used to predict one dependent variable (for example, business revenue).

In general, the regression technique is suitable for simulating the direct and simple effects of various factors on the business economy. However, it also has limitations because economic relationships are often more complex than what can be explained by a simple linear model.

2.1.2 Decision trees

Decision trees are a powerful method in machine learning, particularly used for analyzing complex and non-linear data. This technique is particularly useful for modeling and simulating decision-making in various conditions. Decision trees can be effectively used to analyze the effects of various factors on the business economy. For example, using a decision tree, it can be predicted how factors such as changes in tax policies, exchange rates, or economic crises will affect a business's investment decisions and profitability [7].

Some of the advantages of decision trees include: This model can model complex and non-linear relationships between different factors and their effects. Additionally, decision trees are interpretable and their results are easily understandable.

Some disadvantages of using decision trees include: decision trees can be easily sensitive to noisy data, and if the tree depth is too large, the model overfits the training data.

2.1.3 Support Vector Machines (SVM)

Support vector machines are a sophisticated machine learning method employed mostly for intricate data classification and forecasting. You can use this method to look at how different things affect businesses and guess what will happen to the economy in the future [6].

This algorithm aims to find a decision boundary (hyperplane) that separates the data into two groups. This is how SVM works. This formula can be used to figure out if a business will make money in certain economic situations, including during a recession or when prices are rising.

Some of the benefits of SVM are that it works well with complicated and non-linear data and can make very accurate predictions. Some problems with SVM are that it may need a lot of processing, especially for data with a lot of dimensions.

2.1.4 Neural networks

Neural networks are one of the most powerful and complicated ways to utilize machine learning to model non-linear and complicated interactions between variables. This is especially useful for difficulties in economic forecasting and analysis. Neural networks are very good at looking at big, complicated datasets with features that don't interact in a straight line.

Some ways that neural networks can be used in business economics analysis are to predict how different factors will affect businesses in complex ways, such as by forecasting sales, analyzing demand, simulating the effects of changes in interest rates or inflation, and even predicting economic crises [8].

The benefits of employing neural networks in business economics analysis are that this method can learn complicated and non-linear correlations between data and operate better with additional data. The drawbacks of employing neural networks in business economics analysis include the necessity for extensive datasets and intricate, time-intensive processing to train the model.

2.1.5 Clustering methods

Analysts can use clustering algorithms like K-Means and DBSCAN to group related pieces of data together. This method is helpful for finding hidden patterns in data and grouping businesses or sectors by what they have in common. In business economics, clustering algorithms can be used to group organizations into different groups depending on things like their profitability, pricing tactics,

or economic hazards. This study can assist companies come up with better plans for each type of business or industry [9]. Clustering algorithms can find hidden patterns and sort data into groups that are similar to each other. This is useful in business economics analysis. When utilizing clustering algorithms to analyze company economics, you have to carefully choose the number of clusters, and they don't work well with noisy data.

2.1.6 Time series forecasting

One key use of machine learning in economic research is time series forecasting. This method uses past data to guess what will happen to things like the Gross Domestic Product (GDP), the inflation rate, or stock prices in the future. ARIMA and LSTM are two of the most common models used to make predictions about time series. The ARIMA model works with linear data, and the LSTM model works with data that isn't linear and is more complicated. In business economics, these models can be used to predict how changes in the economy would affect businesses and different economic indicators over the long period [10]. Furthermore, ongoing methodological research is focused on enhancing the robustness and efficiency of complex models, such as work on supervised optimal transport for graph summarization and robust subgraph learning by monitoring training representations [11; 12].

Machine learning is a great way to look at how different elements affect the corporate economy. Businesses can use regression, decision trees, neural networks, SVM, and time series forecasting algorithms to model the complicated and non-linear effects of different economic, social, technological, and competitive factors and make accurate predictions for their strategic decisions. Businesses can take advantage of opportunities and deal with economic risks and complicated marketplaces more successfully by using these methods.

2.2 Business Economics Analysis using Machine Learning

Some domains where machine learning can be used to analyze the effects of numerous elements on the corporate economy are [13] (Figure 1). These applications often involve complex optimization tasks, such as multi-objective optimization using models like ANN and MLP [14], or supply chain management problems like reorder decision-making, which can be addressed using modern metaheuristic algorithms like the African Vulture Optimizer [15].

2.2.1 Predicting demand and supply

Machine learning can forecast economic sector demand and supply. Machine learning algorithms estimate demand by examining past sales data, price fluctuations, seasons, and external influences like economic crises and political upheavals. This helps companies plan production, inventories, and sales.

2.2.2 Analysis of risks

Businesses face financial, operational, political, and societal risks. Machine learning can identify hazards using historical data and simulate situations, helping managers choose risk management techniques. Advanced models like decision trees and neural networks can replicate complex factor connections and predict risk accurately.

2.2.3 Analysis of the impact of economic policies

Businesses are greatly affected by economic policies including interest rates, tax legislation, and tariffs. Machine learning can assess these changes. Machine learning models can anticipate how interest rate changes would affect stock prices, investment, and business profitability using economic and financial data.

2.2.4 Pricing optimization

Pricing is one of the biggest commercial challenges. Businesses can optimize pricing via machine learning. Machine learning models can optimize product and service pricing to maximize business profitability by assessing customer, competitor, cost, and market data.

2.2.5 Economic change simulation and prediction

Simulation and prediction of economic developments are another use of machine learning. Machine learning models may assess how financial crises, exchange rate volatility, and oil prices affect a country's economy or industry. These forecasts help companies adapt to future conditions.

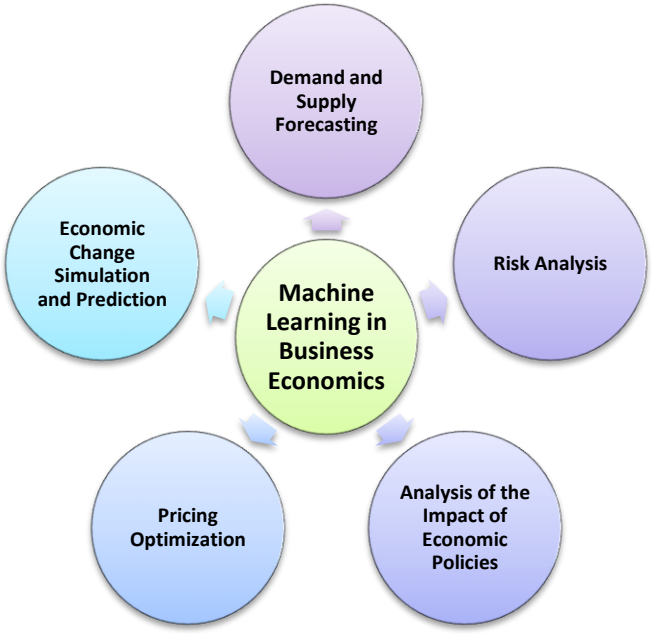

Fig. 1. Applications of ML models in business economics

2.3 Advantages of Using Machine Learning in Business Economic Analysis

Using machine learning to analyze a business's finances has many good points. Some of the main ones are [16]: Great Accuracy: It can find very precise patterns in huge amounts of complicated information. Often, these are patterns people would miss. On-Time Predictions: The tool can make predictions as things happen. This is very important for making quick decisions in business.

Self-Training and Always Getting Better: The models get better on their own when they get new data. This means they can change when the market or economy changes. Lower Costs: It lets businesses spend less money on analyzing data. They can get quick and accurate insights instead [17].

Flexibility: It can work with many kinds of information—like numbers, text, and pictures. This helps it handle a wide variety of money-related problems.

3. The Most Important Factors Influencing Business Economics

Business economics refers to all the economic activities involved in producing goods and services and providing value to customers. This area is influenced by many different factors that can affect how a business performs, grows, and develops. Knowing these factors and understanding how they work can help managers and decision-makers create the right strategies to handle challenges and take advantage of opportunities.

This section looks at the most important factors influencing business economics and analyzes how each one affects the growth and performance of businesses [18] (Figure 2).

3.1 Economic Factors (Macroeconomics)

Some of the most important economic factors are:

i. Interest Rates: The interest rate is one of the most important economic factors affecting business decisions. If interest rates go up, the cost of borrowing money increases. This can have a negative effect on decisions about investment and business expansion. On the other hand, lower interest rates can create better conditions for business development and growth.
ii. Inflation: Inflation, which is a general increase in prices, affects the cost of production and consumption. During inflationary times, businesses may face higher costs. This can lead to lower profits and force them to increase the prices of their products and services.
iii. Unemployment Rate: The unemployment rate shows how much labor is available in the market. Higher unemployment can mean people have less money to spend, which reduces demand for products and services. As a result, business income can be negatively affected.
iv. Changes in Exchange Rates: Fluctuations in currency exchange rates can greatly impact businesses that depend on imports and exports. If the national currency loses value, the cost of importing goods goes up. At the same time, demand for exported products may increase.

3.2. Social and Cultural Factors

Some of the most important social and cultural factors are:

i. Demographic Changes: Changes in population structure, such as population increases or decreases, shifts in age and gender distribution, and population movements, can impact the demand for various products and services. For example, changes in the elderly population can increase demand for healthcare services.
ii. Social and Cultural Trends: Changes in social attitudes and behaviors can have a significant impact on businesses. For example, the growing interest in the environment and sustainable products has led to the growth of the organic and green products market. Additionally, changes in lifestyle and consumer preferences can lead to shifts in demand for specific products and services.
iii. Education and Skills: The level of education and skills in a workforce within a society impacts the productivity and efficiency of businesses. A society with a skilled workforce

can help businesses produce higher-quality products and provide better services. This domain of workforce quality necessitates specialized research, including analyses of cognitive demands in standardized testing and pedagogical choices, such as teachers' decisions on using mathematical proof [19; 20].

3.3 Political and Legal Factors

The most important political and legal factors are:

i. Government Policies: Government economic and fiscal policies such as taxes, subsidies, and government support can have a significant impact on businesses. For example, reducing corporate taxes can lead to business growth and attract more investment.
ii. Laws and Regulations: Government laws and regulations can impact how businesses operate. These laws may include tax, environmental, labor, and consumer rights regulations. Changes to these regulations could increase businesses' operating costs or introduce new conditions for their operations.
iii. Political Stability: Countries with political stability are typically more attractive for investment and business development. Political instability can lead to a decrease in investor confidence and a reduction in economic activity in the country.

3.4 Technological Factors

Some technological variables are:

i. Technological advancements: New technologies and improvements can have a direct effect on enterprises. New technologies like artificial intelligence, the Internet of Things, and blockchain can help businesses become more efficient, save money, and provide customers a better experience.
ii. Automation and Digitalization: By automating production and service processes, firms may boost their productivity and cut their operating expenses. Digitalization can also help enterprises reach global markets and become more competitive.
iii. Cyber Threats: As organizations depend more and more on technology, cyber threats have become a big problem. Data breaches and cyberattacks can hurt customer trust and cost firms a lot of money. Research in this domain, which is crucial for modern business, includes novel security-based routing methods in IoT networks using algorithms like Ant Colony Optimization and analyses of the individual, social, and organizational factors influencing cybersecurity [21; 22].

3.5 Competitive Factors

Some of these factors are:

i. Competition in the market: Competition is one of the most important things that affects the corporate economy. How competitive an industry is can affect how businesses set prices, the quality of their goods and services, and their ability to come up with new ideas. In marketplaces with a lot of competition, organizations have to keep making their tactics better to keep their market share.
ii. Entry of New Competitors: When new businesses enter the market, they can put a lot of pressure on the ones that are already there. Businesses need to get better at spotting

and dealing with new risks, and they need to come up with creative ways to get new consumers and keep the ones they already have.

iii. Bargaining Power of Customers and Suppliers: Customers and suppliers have bargaining power, which can affect prices, product quality, and services. If consumers or suppliers have a lot of influence, firms may have to agree to certain terms in order to keep their commercial connections, which will cost them more money.

3.6 Environmental Factors

Some important environmental elements include [23]:

i. Climate Change: Changes in the weather and other environmental problems can hurt a business's bottom line. For instance, natural disasters or rising global temperatures might affect the production and supply of products and services.

ii. Environmental Issues: People are more conscious of environmental issues now, which has made corporations feel more pressure to meet their social and environmental duties. Companies who don't care about the environment may get bad press and see a drop in demand. For instance, the integration of Green Supply Chain Management and Total Quality Management using advanced analytical methods like SEM-ANN has been studied to enhance performance in SMEs [24], and the necessary legal framework for emerging technologies like blockchain smart contracts is also a subject of recent research [25]. The broader challenge of sustainability is addressed by studies focusing on re-evaluating urban management through digital technologies and planning ecosystem services for CO2 mitigation and resilient cities [26-28].

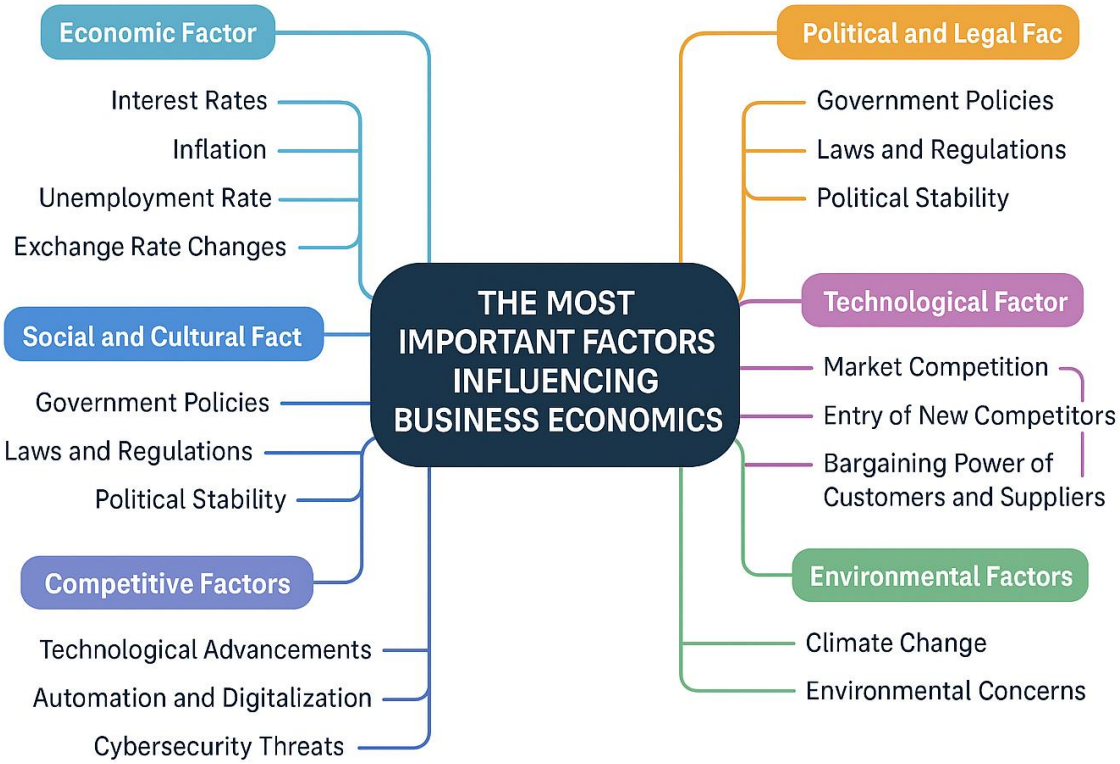

Fig.2. The Most Important Factors Influencing Business Economics

4. Relevant Studies

This section presents fifteen research and applied articles on the use of machine learning for analyzing and examining factors influencing the business economy. These articles specifically analyze data and simulate the effects of various economic, social, political, technological, and competitive factors on businesses (Table 1).

Liu et al. [29] investigated the use of machine learning algorithms (such as decision trees and neural networks) for predicting stock market fluctuations. In this study, the impact of factors such as interest rates, inflation rates, and economic changes on financial markets has been predicted using machine learning models. This research showed that machine learning can provide accurate predictions in this field. Yang et al. [30] investigated the use of machine learning algorithms to predict economic indicators such as Gross Domestic Product (GDP), unemployment rate, and inflation. The results of this research indicate that machine learning models provide better predictions compared to traditional methods. Khan et al. [31] explored various applications of machine learning in business economic analysis (including risk analysis, demand forecasting, market analysis, and pricing). These researchers have explored the applications of decision tree algorithms, SVM, and neural networks in this field. Jabeen et al. [32] analyzed the impact of macroeconomic factors such as interest rates, inflation, and exchange rates on business performance using machine learning algorithms. Linear regression and neural network algorithms were used for data analysis.

Yadav et al. [33] investigated the use of machine learning algorithms for predicting business bankruptcy. In this study, decision tree and SVM algorithms were used to simulate bankruptcy risk. Simionescu et al. [34] examined the impact of sentiment analysis on the economic analysis of businesses. In this research, deep learning techniques were used to analyze textual data from social networks and economic news. Horal et al. [35] used machine learning to predict the effects of changes in economic policies (such as tax or interest rate changes) on business performance. These researchers used decision tree and SVM algorithm models to analyze the data. Leo et al. [36] analyzed the impact of machine learning on risk management in businesses. In this research, neural network and decision tree algorithms were used to predict and evaluate economic and financial risks in businesses.

Borrellas et al. [37] investigated the use of machine learning to analyze the effects of technological changes on businesses. They used time series models to predict technological trends and analyze their impact on the business economy. Athey et al. [38] investigated the use of machine learning to analyze the impact of economic policies on various businesses and industries. In this study, multiple regression algorithms and neural networks were used to simulate the effects of different policies on economic variables. Sarabhai et al. [39] analyzed consumer behavior using machine learning. In this research, clustering and decision tree models have been used to identify purchasing patterns and predict consumer behavior. Semwal et al. [40] investigated the use of machine learning to optimize pricing strategies in businesses. In this study, regression models and neural networks were used to simulate the effects of pricing on demand and profitability.

Jabeur et al. [41] analyzed the impact of environmental factors such as climate change, environmental regulations, and corporate social responsibility on businesses using machine learning. Devulapalli et al. [42] analyzed the impact of global crises such as the financial crisis and pandemics on business economies using machine learning models. They used time series models and neural networks to predict the effects of these crises. Naidu et al. [43] used machine learning algorithms to evaluate business performance. In this study, regression models and decision trees were used to predict the financial and operational performance of companies.

These articles show how machine learning is used to analyze business economics. Machine learning can analyze complex data, predict economic trends, optimize corporate plans, and manage economic risks, as shown in these articles. Decision trees, neural networks, SVM, and time series models help organizations make better decisions and maximize possibilities.

Table 1
Summary of literature

Ref	Authors	Focus Area	ML/Analytical Techniques Used
[29]	Liu et al.	Predicting stock market fluctuations (effects of interest rates, inflation, etc.)	Decision Trees, Neural Networks
[30]	Yang et al.	Predicting economic indicators (GDP, unemployment, inflation)	Machine Learning models (general)
[31]	Khan et al.	Various applications in business economic analysis (risk analysis, demand forecasting, market analysis, pricing)	Decision Tree algorithms, SVM, Neural Networks
[32]	Jabeen et al.	Impact of macroeconomic factors (interest rates, inflation, exchange rates) on business performance	Linear Regression, Neural Networks
[33]	Yadav et al.	Predicting business bankruptcies (simulating bankruptcy risks)	Decision Tree algorithms, SVM
[34]	Simionescu et al.	Impact of sentiment analysis on business economic analysis (textual data from social media/news)	Deep Learning techniques
[35]	Horal et al.	Predicting effects of changes in economic policies (taxes, interest rates) on business performance	Decision Tree, SVM models
[36]	Leo et al.	Impact of machine learning on risk management (predicting/assessing economic/financial risks)	Neural Networks, Decision Tree algorithms
[37]	Borrellas et al.	Analyzing effects of technological changes on businesses	Time Series models
[38]	Athey et al.	Analyzing the impact of economic policies on businesses and industries	Multiple Regression, Neural Network algorithms
[39]	Sarabhai et al.	Analyzing consumer behavior (identifying purchasing patterns)	Clustering models, Decision Trees
[40]	Semwal et al.	Optimizing pricing strategies (simulating effects on demand and profitability)	Regression models, Neural Networks
[41]	Jabeur et al.	Analyzing the impact of environmental factors (climate change, laws, CSR) on businesses	Machine Learning (general)
[42]	Devulapalli et al.	Examining the impact of global crises (financial crises, pandemics) on business economics	Time Series, Neural Network models
[43]	Naidu et al.	Evaluating business performance (predicting financial and operational performance)	Regression models, Decision Trees
[44]	Rivandi,	Analyzing the level and drivers of FinTech adoption across countries	(Analysis of global trends)
[45]	Rivandi and Oskouei	Developing intrusion detection systems for mobile social networks	A novel analytical approach for security

Table 1
Continued

[46]	Bagherabad et al.	Analyzing effects of various factors on business economics using ML	Machine Learning models (general)
[47]	Hosseinidoust et al.	Investigating interactions among healthcare indicators, income inequality, and economic growth	(Econometric analysis)
[48]	Massahi	Analyzing unintended consequences of driving policies on adolescent health outcomes	(Causal inference / Policy analysis)

5. Conclusion

Machine learning is useful for assessing business economy influences. Businesses can accurately predict strategic decisions by simulating the complex and non-linear effects of economic, social, technological, and competitive factors using regression, decision trees, neural networks, SVM, and time series forecasting algorithms. These methods help businesses seize opportunities and handle economic threats and complex markets. Thus, machine learning, an enhanced tool for studying the effects of many elements on the corporate economy, can help firms make better decisions, identify dangers, and generate accurate economic projections. Businesses need high-quality data and qualified machine learning model designers and implementers to use this technology. Machine learning can help firms improve their economic performance and predict future trends. Machine learning in business economics analysis has pros and cons:

i. Machine learning models need huge, accurate data: If data is incomplete or erroneous, forecasts may be wrong.
ii. Complexity in Modeling: Data analysis model selection and settings might be difficult. This field requires competence.
iii. Initial Costs: Machine learning systems may require technology and skilled staff.

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Conflicts of Interest
The authors declare no conflicts of interest

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