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ORIGINAL

Business Conditions in OECD Countries (2010-2019): A Longitudinal Analysis Applying Machine Learning

Condiciones empresariales en los países de la OCDE (2010-2019): Un análisis longitudinal aplicando aprendizaje automático

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ABSTRACT

The purpose of this research is to determine what are the uses of GPT Chat in Marketing according to the academic literature published between 2020 and 2023? It seeks to analyze the applications of GPT chat in the Marketing industry, achieving: (i) to explain the main characteristics of GPT Chat, based on the collection of information from Open AI; (ii) to identify the advantages and disadvantages of the applications of GPT chat in marketing, based on the review of scientific papers, and (iii) to compare the applications of GPT chat in marketing. To this end, a qualitative research was developed with a descriptive scope based on the review of literature indexed in EBSCO, Science Direct and Google Scholar between 2020 and 2023, specifically 30 papers. This provided evidence that GPT chat can be used for content creation, consumer insight, personalized marketing strategy development, segment targeting, copywriting, market research, report development and cost reduction. Despite the advantages of GPT Chat, its implementation faces great challenges, due to the lack of knowledge about its scope and social impact, causing people to feel mistrust about its reliability.

Keywords: GPT Chat; Automation; Reinforcement Learning; Natural Language Processing; Transformer Architecture.

RESUMEN

La presente investigación tiene como propósito determinar ¿cuáles son los usos del Chat GPT en Marketing de acuerdo con la literatura académica publicada entre 2020 y 2023? Se busca analizar las aplicaciones del chat GPT en la industria del Marketing, logrando: (i) explicar las características principales del Chat GPT, a partir de la recopilación de información procedente de Open AI; (ii) identificar las ventajas y desventajas de las aplicaciones del chat GPT en marketing, a partir de la revisión de documentos científicos, y (iii) comparar las aplicaciones del chat GPT en marketing. Para este fin, se desarrolló una investigación cualitativa con un alcance descriptivo basado en la revisión de la literatura indexada en EBSCO, Science Direct y Google académico entre 2020 y 2023,

específicamente 30 documentos. Esto permitió evidenciar que, el chat GPT puede emplearse para la creación de contenido, conocimiento del consumidor, desarrollo de estrategias de marketing personalizado, selección de segmentos, redacción de pautas publicitarias, investigación de mercados, desarrollo de informes y reducción de costos. Pese a las ventajas del Chat GPT, su implementación enfrenta grandes retos, a causa del desconocimiento existente sobre sus alcances e impacto social, generando que las personas sientan desconfianza sobre su fiabilidad.

Palabras clave: Chat GPT; Automatización; Aprendizaje por Refuerzo; Procesamiento del Lenguaje Natural; Arquitectura de Transformadores.

INTRODUCTION

Business conditions play a pivotal role in a nation's economic development.⁽¹⁾ These conditions encompass the regulatory environment, determining the ease with which companies can establish, compete, and expand within a given territory or region.⁽²⁾ Wang et al. (2023) demonstrated that business decision-making regarding expansion is influenced by financial incentives and opportunity costs.⁽³⁾ Furthermore, the evolving global economic landscape poses significant challenges for companies seeking international expansion, especially considering factors such as GDP growth volatility and heightened national regulations.^(4,5,6,7) These dynamics necessitate firms to adapt to emerging opportunities.⁽⁸⁾

The business environment encompasses employment, education, healthcare, infrastructure, governance, and natural factors.⁽⁹⁾ As such, governments are keen on fostering entrepreneurial ecosystems and promoting innovation to stimulate economic growth and job creation.⁽¹⁰⁾

Variables constituting the business ecosystem, include culture, formal institutions, demand, digital platform utilization, infrastructure, and services. These elements synergize within each region or country's context to propel business development.⁽¹¹⁾ Consequently, suboptimal environmental conditions can significantly undermine investment, financing, marketing efforts, and other corporate endeavours.^(12,13)

Furthermore, favourable business conditions must yield social welfare improvements and an enhanced quality of life.⁽¹⁴⁾ In this vein, assessing a region's business effectiveness should commence with an analysis of socioeconomic factors, such as the well-being and happiness of its inhabitants.⁽¹⁵⁾

Economic sustainability is intrinsically tied to business growth, serving as a linchpin for poverty eradication by curbing the growth of the informal economy, which gives rise to precarious working conditions and hinders sustainable development. Aligned with this perspective, Queirós et al., (2019)⁽¹⁶⁾ posit that companies demonstrating robust market performance become pivotal drivers of economic growth, contributing to wealth creation and distribution.⁽¹⁷⁾

Empirical evidence underscores the nexus between economic performance and business conditions. Cui et al., 2022⁽¹⁸⁾ employed the World Bank's Doing Business Ease of Doing Score from 2004 to 2018 and established that, beyond a certain economic development threshold, business environments exert a positive and substantial influence on the economic growth of trading partners. Samoilikova et al., (2023)⁽¹⁹⁾ examine the correlation between education, particularly its innovative aspects, and business facilitation across 28 countries. It identifies four key indicators and establishes a positive relationship, indicating that a 1 % increase in digital development leads to a 0,79 % improvement in business facilitation.⁽²⁰⁾

Companies within the same territory exhibit varying levels of evolution and business progress due to the historical and cultural context shaping business conditions. This can lead some firms to struggle to assimilate knowledge developed over time, owing to evolving business landscapes, globalization, and technological integration in corporate environments, among other factors.⁽²¹⁾

Public expenditure on healthcare is pivotal for enhancing the quality of human capital engaged in firms. Moreover, this expenditure exerts an impact on economic development. Tandrayen Ragoobur & Narsoo (2022)⁽²²⁾ demonstrate that investments in health and early education contribute to heightened economic growth, providing evidence of the enduring effects of positive shifts in health and education indicators on long-term growth.^(23,24,25,26)

While numerous authors have explored the correlation between health and economic growth, further exploration in this area is warranted.⁽²⁷⁾ Thus, research should scrutinize the interplay between business conditions and economic growth, as well as the relationship between these conditions and human health.⁽²⁸⁾

Environmental regulations also play a pivotal role in business development.⁽²⁹⁾ As demonstrated by Hinton (2021), green economic growth necessitates substantial changes in economic institutions, potentially presenting a hurdle for some companies. The transformation of firms is observed in dimensions such as profit orientation, governance structure, size, and geographical reach.^(30,31,32,33)

The OECD (Organization for Economic Cooperation and Development) assumes a central role in global economic development by aggregating ideas, facilitating discussions, and orchestrating the implementation of measures for the collective benefit of member countries.^(34,35,36,37,38,39) Consequently, countries within the OECD exhibit conducive business conditions conducive to sustained development.⁽⁴⁰⁾

Hence, this study endeavours to address the following query: How did education, governance, health, and the natural environment influence the shaping of business conditions in OECD member countries between 2010 and 2019? To this end, we constructed a panel comprising the 36 OECD member countries, utilizing data from the Legatum (IL) Prosperity Index and CO2 emissions.⁽⁴¹⁾

Studying the interplay between various socio-economic and environmental factors, as elucidated in this research, holds paramount significance in comprehending the nuanced dynamics influencing business conditions within OECD member countries.⁽⁴²⁾ By employing a quantitative, longitudinal approach, this study navigates through a comprehensive array of variables, ranging from economic quality and governance to health, education, and environmental sustainability.^(43,44)

Prior studies have validated the positive impact of health on economic growth. Nevertheless, these studies often overlook the endogeneity inherent in these models. Moreover, they underscore that a higher level of education and more favourable environmental conditions amplify this effect (Ridhwan et al., 2022).⁽⁴⁵⁾ In this context, this study employs supervised learning algorithms, including neural networks, decision trees, and linear regression with the Ridge regularization method.

METHODS

The research methodology adopted was quantitative, longitudinal, and non-experimental, with an explanatory and predictive focus. To construct the panel, data from the Legatum Prosperity Index (IL) and CO2 emissions spanning from 2010 to 2019 were utilized for the 36 OECD member countries.⁽⁴⁶⁾

The Legatum Prosperity Index, calculated annually for 110 countries, evaluates 89 variables categorized into eight sub-indices: economy, entrepreneurs and opportunities, governance, education, health, security and protection, personal freedom, and social capital. This comprehensive assessment aims to gauge prosperity levels in the analysed countries.

As highlighted by Budsaratragoon & Jitmaneroj (2021),⁽⁴⁷⁾ the Legatum Prosperity Index stands out as a transformative tool, providing a distinctive perspective on the global evolution of prosperity. This definition is noteworthy for its emphasis on measuring prosperity worldwide and its direct correlation with regional development. Consequently, the variables assume a pivotal role in this study, enabling the quantitative analysis of fundamental aspects in both individual lives and society, including security, education, economy, and health, among others.

The research methodology employed was quantitative, longitudinal, and non-experimental, with an emphasis on explanation and prediction. The target variable was the score attributed to countries in the

Legatum business conditions pillar. This metric assesses the extent to which regulations within a specific territory or region facilitate the establishment, competition, and expansion of businesses.

The selected predictors met one of the following criteria:

- Pertain to the health of individuals, encompassing health indicators, CO2 emissions, environmental factors, and living conditions.
- Are control variables identified in the literature that exert an influence on business conditions.

The chosen predictors encompass economic quality, investment environment, infrastructure, and market access. These factors were included due to their substantial impact on various stages of a company's lifecycle, including company formation, permit acquisition, electricity provision, property registration, credit availability, investor protection, financial backing, tax compliance, international trade, contract enforcement, insolvency resolution, economic growth, business culture, leadership, knowledge management, innovation, and employment practices.

Moreover, the social environment also plays a crucial role in shaping business conditions. This was corroborated by Choudhury & Mandal (2021)⁽⁴⁸⁾ in their study examining the influence of family, social, educational, and business environments on the entrepreneurial intentions of university students in Bangladesh. Their findings from ordinal logistic regression revealed that both an improved business environment and favourable familial perceptions had a positive impact on students' inclination towards entrepreneurship post-graduation.

In alignment with this perspective, Queirós et al., (2021)⁽⁴⁹⁾ highlighted the persisting disparities in the ability to initiate and manage entrepreneurial ventures. Drawing on data from OECD, Eurostat, and HOFSTEDE for 35 countries, the authors employed multiple linear regression analysis, uncovering a positive correlation between high business growth, company size, and distance to power index.

Governance and education were included as pillars in recognition of their pivotal role in fostering optimal business conditions. This assertion was reaffirmed by Hansson & Sok (2021)⁽⁵⁰⁾ in their investigation of perceived barriers to business development in a developed OECD country like Sweden. Their findings underscored that farmers' decisions to abstain from entrepreneurship were primarily influenced by challenges in accessing financial resources, a lack of technical and academic proficiency in critical business functions, and geographical considerations.

In this context, a myriad of variables come into play in influencing business development in a globalized landscape, as revealed by Kluza et al., (2021)⁽⁵¹⁾ in their study on the impact of factors related to innovation, governance, and environmental and social conditions on the business environment.

Additionally, Bahía Gama et al., (2018)⁽⁵²⁾ demonstrated that interactions between companies and governments wield a substantial influence on the growth decisions of business groups. A historical alignment with the political interests of the public sector was identified as a necessary and sufficient condition for growth through diversification. Furthermore, Ben Jabeur *et al.*, (2021)⁽⁵³⁾ delved into the impact of institutional and macroeconomic conditions on aggregate corporate failure in a sample of European countries from 2004 to 2017. Their comparative analysis involving fuzzy sets and partial least squares regression revealed that countries with low corruption indices and high levels of government effectiveness could mitigate insolvency.

To summarize, the predictors considered in the study were as follows:

- Year
- Economic Quality: This metric gauges an economy's capacity for growth and financial well-being.
- Health: This encompasses access to health services, including health outcomes, health systems, risk factors, and mortality rates.
- Governance: It pertains to a government's ability to effectively manage operations without corruption, while ensuring proper control and regulation of commercial, social, political, cultural, and other facets.

- **Education:** This includes enrolment, performance, and the quality of education across preschool, primary, secondary, and university levels. It also encompasses the educational attainment of adults.
- **Investment Environment:** This measures a territory's capability to adequately oversee investments in its region, ensuring accessibility for potential investors.
- **Living Conditions:** It evaluates an individual's access to essential opportunities like shelter, food, healthcare, and primary material services, among others.
- **Natural Environment:** This indicator within the Legatum prosperity index assesses the physical aspects of the environment that impact people's lives, their interactions with society, and the long-term effects of an individual's presence in the world.
- **Infrastructure and Market Access:** This indicator seeks to quantify the level of development in the necessary structures for each country's commercial activities involving various products and services.
- **Personal Freedom:** This pillar measures advancements in individual freedoms, fundamental legal rights, and social tolerance.
- **Security and Protection:** It addresses how conflict, war, crime, and terrorism influence individuals' perceptions of security and protection.
- **Social Capital:** This indicator defines the strength of social and personal relationships, trust in institutions, adherence to norms, and societal participation within a country.
- **CO2 Emissions:** This refers to the emissions of one of the greenhouse gases produced by human activities.

After establishing the foundation, we applied three supervised learning algorithms using the Orange Data Mining platform: neural networks, decision trees, and linear regression with the Ridge regularization method. The Ridge regularization method operates by penalizing the sum of squared coefficients, thereby tempering their values without reducing them to zero. The working formula of the Ridge linear regression model, as outlined by Lever et al., (2017), is as follows:

$$\sum_{j=1}^m (Y_j - \beta_1 - \sum_{i=1}^n \beta_i X_{ij})^2 + \epsilon \sum_{i=1}^n \beta_i^2 \quad (1)$$

Similarly, the decision tree algorithm is tasked with partitioning the data into nodes based on class purity. The model's calibration parameters were set as follows:

- A binary tree divided into two secondary nodes.
- A maximum depth of 100 for the tree.
- Avoidance of sets with five or fewer data points for further division.

Halt iterations and node partitioning upon reaching a classification threshold of 95 %. In the neural network, we defined 100 neurons per hidden layer, utilized the rectified linear unit function as the activation function for the hidden layer, employed stochastic gradient descent as the weight optimization solver, and set the maximum number of iterations to 200.

RESULTS

The employed algorithms enabled us to identify the predictors influencing the behaviour of the dependent variable, which in this case pertains to the business conditions of the 36 OECD member countries spanning from 2010 to 2019. Across all three algorithms, the coefficients of determination fell within the range of 0,83 to 0,92, as detailed in table 1. Notably, the decision tree algorithm demonstrated the most robust performance, accounting for 92 % of the variance in the dependent variable explained by the independent variables.

Table 1. Model evaluation indicators

| Model | MSE | RMSE | MAE | R2 |
|-------------------|-------|------|------|------|
| Tree | 4,96 | 2,23 | 1,50 | 0,92 |
| Neural Network | 8,19 | 2,86 | 2,37 | 0,87 |
| Linear Regression | 10,79 | 3,29 | 2,71 | 0,83 |

The MSE (Mean Squared Error) highlighted a more pronounced disparity between the estimator and the actual estimate in linear regression. Conversely, the RMSE (Root-Mean-Square Error) indicated a lower degree of imperfection in the estimator's fit to the data in the case of the decision tree. Notably, the decision tree exhibited a closer alignment between predictions and actual outcomes, as demonstrated by the MAE (Mean Absolute Error), representing the average absolute error.

The results obtained from the decision tree underscored that higher scores were correlated with superior performance, particularly from 2016 onwards, in the dimensions of economic quality, investment environment, governance, and market infrastructure. Conversely, lower scores in business conditions were indicative of subpar performance in health, living conditions, natural environment, and social capital, as illustrated in figure 1.

The outcomes of the linear regression model indicated that stricter regulations in areas such as personal freedom, safety and security, the natural environment, and economic quality (as presented in table 2) have an adverse impact on the advancement of business conditions.

On the flip side, the pillars that demonstrated a positive influence on business conditions in the examined countries encompassed governance, education, health, favourable environmental conditions for investment, improved living conditions, enhanced infrastructure for market access, strengthened social capital, and controlled CO2 emissions (as detailed in table 2).

Table 2. Estimated coefficients linear regression models

| Variable | Coefficient |
|----------------------------------|-------------|
| Intercept | -47,3088 |
| Year | 0,015492 |
| Economic quality | -0,136765 |
| Education | 0,0314019 |
| Governance | 0,117223 |
| Health | 0,104676 |
| investment environment | 0,36721 |
| Living conditions | 0,00612048 |
| Market access and infrastructure | 0,584654 |
| Natural environment | -0,0259213 |
| Personal freedom | -0,0706816 |
| Safety and security | -0,00641162 |
| Social capital | 0,115574 |
| Emissions CO2 | 34,6737 |

By comparing two out of the three algorithms and identifying the variables of significance in both models, we can ascertain that the most crucial predictors include health, natural environment, living conditions, economic quality, social capital, governance, investment environment, and access to market infrastructure (as outlined in table 3).

Regarding CO2 emissions, this study reveals that a more comprehensive analysis necessitates establishing a bidirectional relationship concerning business conditions. One plausible approach for such an analysis could be through the utilization of Generalized Structural Equation Modelling (GSEM).

| Variable | RIDGE Regression | Decision tree |
|---------------------------------|------------------|---------------|
| Economic quality | Significant | Significant |
| Education | Significant | |
| Governance | Significant | Significant |
| Bless you | Significant | Significant |
| Investment environment | Significant | Significant |
| Living conditions | Significant | Significant |
| Market access to infrastructure | Significant | Significant |
| Natural environment | Significant | Significant |
| Personal freedom | Significant | |
| Safety and security | Significant | |
| Capital social | Significant | Significant |
| CO2 emissions | Significant | |

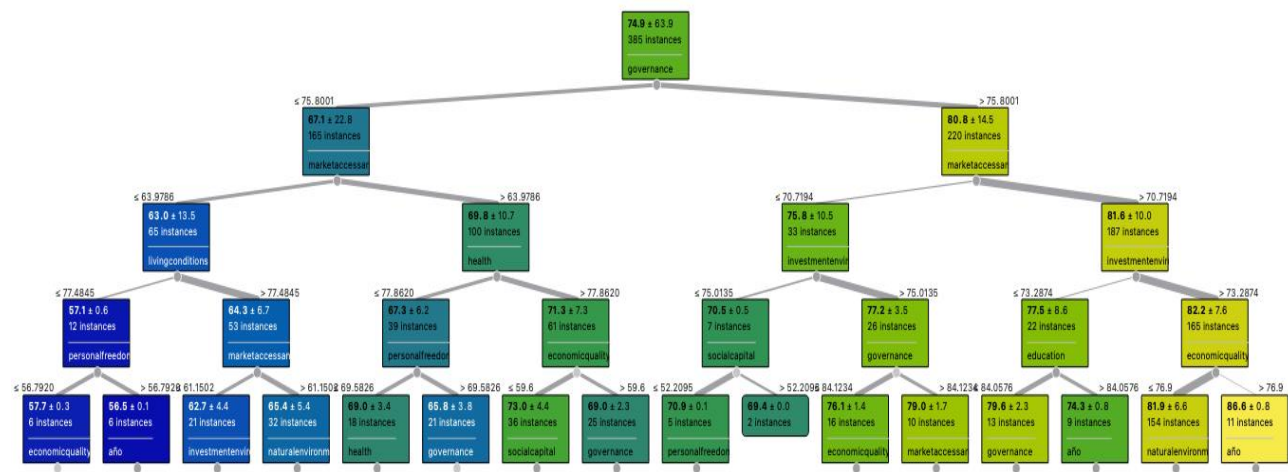


Figure 1. Decision tree

DISCUSSION

The results of this investigation confirm the findings of Wang *et al.*, (2022)⁽⁵⁴⁾ and Tandrayen Ragoobur & Narsoo (2022).⁽⁵⁵⁾ The algorithms reveal that OECD countries exhibit the most favourable business conditions, with particularly high scores in health and living conditions.^(56,57) These nations boast strong healthcare systems, low mortality rates, and provide opportunities for individuals in areas such as housing, food, healthcare, basic services, and essential amenities.⁽⁵⁸⁾

The findings of this study, which investigate the interplay between business conditions and CO2 emissions, corroborate the earlier research presented by Yousfi *et al.*, (2023).⁽⁵⁹⁾ This prior study also illuminated a correlation between the climate uncertainty index and CO2 emissions, with economic conditions exerting a discernible influence on this dynamic.⁽⁶⁰⁾

Furthermore, the results of this investigation are consistent with the insights presented by Hinton (2018).⁽⁶¹⁾ The logit regression with RIDGE showed a negative relationship between the natural environment pillar score and business conditions. Hinton (2018)⁽⁶²⁾ posits that the convergence of ecological and economic growth leads to environmental decoupling, which can be challenging for some companies.^(63,64)

On the other hand, empirical evidence highlights the positive relationships between the governance and social capital pillars and business conditions, as found by Kluza *et al.*, (2021)⁽⁶⁵⁾ for OECD countries. These authors link these pillars to sustainable business models in Europe. Additionally, education also

had a positive impact on business conditions in the analysed countries, as found by Choudhury & Mandal (2021)⁽⁶⁶⁾ in Bangladesh, where family, social, and educational environments play a significant role in motivating entrepreneurial pursuits.

CONCLUSIONS

This study employed three supervised learning algorithms: neural networks, decision trees, and linear regression with Ridge regularization. These models successfully predicted over 83 % of the variability in business conditions, as assessed by the Legatum index, across 36 OECD countries from 2010 to 2019.

Furthermore, the research illuminated that heightened protection of the natural environment had an adverse effect on business conditions. This discovery implies that in OECD countries with more rigorous environmental regulations, businesses encounter greater difficulties in initiation, competition, and expansion.

The analysis also revealed that OECD countries showcased the most favourable business conditions, achieving high scores in both health and living standards. These nations possess robust healthcare systems, low mortality rates, and ensure individuals have access to fundamental necessities such as housing, food, healthcare, primary services, and material resources.

In essence, the model's findings underscored that for an optimal business environment in OECD countries, robust infrastructure in health, education, market accessibility, and investment climate is imperative. These factors significantly contribute to a country's capacity to cultivate an environment conducive to investments. To summarize, among the predictors examined, the most influential factors encompass health, living conditions, economic quality, social capital, governance, investment climate, market infrastructure accessibility, and the natural environment.

It is crucial to acknowledge the limitations of this study, particularly the challenge of obtaining more recent data encompassing the pandemic period. Future research endeavours, including this one, strive to establish and scrutinize the factors influencing the evolution of business conditions in OECD countries between 2020 and 2021, notably during the period marked by the global Covid-19 pandemic. Additionally, replicating this study in other groups of countries would be valuable to juxtapose results and identify variations in predictors based on the analysed clusters.

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