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Presentation of the content

In the first article we present, *Regulation of Artificial Intelligence systems, databases, and intellectual property*, by Orozco-Orozco, José Zócimo with adscripcion in the Universidad de Guadalajara, in the next article we present, *AI regulation in relation to training databases*, by Orozco-Orozco, José Zócimo, with adscription in the Universidad de Guadalajara, in the next article we present, *Corporate social responsibility and its relationship with the performance of Mexican SMEs*, by Alcaraz-Vera, Esteban, Valdez-Barreto, Víctor Hugo and Lino-Gamiño, Juan Alfredo with adscription in the *Universidad de Colima*, in the last article we present, *Women's participation in industry: an ecofeminist approach to inclusion and social justice*, by Castillo-Flores, Esther Sarai, Perez-Cruz, Jorge Alberto, Castillo-Flores, Angela Liliana and Fernandez-Garcia, Luis Guillermo, with adscription in the Universidad Tecnologica de Altamira, Universidad Autonoma de Tamaulipas and Instituto Tecnologico de Altamira.

Content

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Article

Regulation of Artificial Intelligence systems, databases, and intellectual property

Regulación de los sistemas de Inteligencia Artificial IA, las bases de datos y la propiedad intelectual

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Abstract

This Article refers to the regulation of AI systems, databases and intelectual property. Directive 96/9/CE of the European Council of March 11, 1996, which is pioneering legislation for the legal protection of databases and introduces concepts for the study database regulation as well as a sui generis right for the protection of substantial investments made in databases. Next we will review a report on copyright and artificial intelligence issued by the United States Copyright Office.

Regulating Artificial Intelligence (AI) Systems, Databases, and Intellectual Property		
OBJECTIVES	**METHODOLOGY**	**CONTRIBUTION**
The international legal protection surrounding databases in the field of AI and intellectual property was analyzed. The study also examines proposals for the use of data in training databases and artificial .	A qualitative approach, documentary research, and a comparative legal analysis are used. Conclusions are drawn regarding the legal treatment of data use for AI training databases in the field of intellectual property.	The protection of fundamental rights in the use of AI training databases within the field of intellectual property is examined. The legal requirements regarding the use of data and artificial intelligence in intellectual property law are also studied.

AI System, Databases, Intellectual Property

Resumen

Este artículo se refiere a la regulación de los sistemas de IA, las bases de datos y la propiedad intelectual. La Directiva 96/9/CE del Parlamento Europeo y del Consejo de 11 de marzo de 1996 que es una legislación para la protección jurídica de las bases de datos que introduce conceptos para el estudio de la regulación de las bases de datos así como un derecho sui generis para la protección de la inversión sustancial que se realiza en bases de datos. Después veremos un informe sobre derechos de Autor e inteligencia Artificial emitido por la Oficina de Derechos de Autor e Inteligencia Artificial emito por la oficina de Derechos de Autor de Estados Unidos.

Regulación de los sistemas de Inteligencia Artificial IA, las bases de datos y la propiedad intelectual.		
OBJETIVOS	**METODOLOGÍA**	**CONTRIBUCIÓN**
Se analizó la protección jurídica internacional alrededor de las bases de datos en materia de IA y la propiedad intelectual. Observar las propuestas para el uso de datos en materia de bases de datos de entrenamiento e IA en México	Se utiliza un enfoque cualitativo y la investigación documental y un análisis jurídico comparativo. conclusiones sobre el tratamiento legal del uso de datos para las bases de datos de entrenamiento de IA en materia de propiedad intelectual.	Se observa la protección de los derechos fundamentales en el uso de bases de datos de entrenamiento de IA en materia de propiedad intelectual. Se estudian los requisitos legales en materia de propiedad intelectual para el uso de datos e IA.

Sistema de IA, Bases de Datos , Propiedad Intelectual

Area: Promotion of frontier research and basic science in all fields of knowledge

Citation: Orozco-Orozco, José Zócimo. [2025]. Regulation of Artificial Intelligence systems, databases, and intellectual property. Journal-Industrial Organization. 9[15]1-8: e1915108.

Introduction

This article discusses databases, high-risk AI systems, and intellectual property.

This article is important because it examines the regulation of international AI systems and AI systems in Mexico.

It will review the European Union's leading directives on AI system legislation.

A report from the United States Copyright Office will be examined, and finally, Mexican legislation on this matter will be reviewed.

Regulation of Artificial Intelligence systems, databases, and intellectual property.

European Union. [2019]. Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases

4. Whereas Member States recognise copyright protection in different ways with regard to databases and the lack of harmonisation may affect the free movement of goods and services within the Community if these differences continue to exist in the laws of the Member States.

5. Whereas copyright creates an appropriate form of exclusive rights for the authors of databases.

7. The creation of a database requires a substantial investment in terms of human, technical and financial resources, and databases can be copied or accessed at a cost far below that of creating them independently.

Article 1

This Directive concerns the legal protection of databases, whatever their form.

Article 2

Databases shall be considered to be compilations of works, data or other independent elements arranged in a systematic or methodical manner and individually accessible by electronic or other means.

Article 3

1. Databases which, by virtue of their content, constitute an intellectual creation shall be protected as such by copyright. 2 Copyright protection shall not extend to the contents of the database, notwithstanding any rights that may subsist in those contents.

Article 4

The author of a database shall be the natural person or group of persons who created the database or, where the legislation of the States so permits, the legal person designated by that legislation as the owner of the right.

Article 5

The author of a database has the exclusive right with respect to the form of expression of that database, including the right to perform or authorise:

a] Temporary or permanent reproduction, in whole or in part, by any means or in any form.

b] Translation, adaptation, reorganisation and any other modification.

c] Any form of distribution to the public of the database or copies thereof.

Chapter III Sui Generis Right

Article 7

1. Member States shall provide that the maker of a database may prohibit the extraction and/or re-utilisation of the whole or a substantial part of the contents, where the verification or presentation of such contents represents a substantial investment in quantitative or qualitative terms.

2. For the purposes of this chapter, the following definitions shall apply: a] extraction means the permanent or temporary transfer of all or part of the contents of a database or other medium, regardless of the means by which this is done. b] re-utilisation means any form of making available to the public all or a substantial part of the contents of the database by means of distribution of copies, rental or other means.

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The first sale of a copy of a database in the Community extinguishes the right to control subsequent sales of that copy in the Community.

Article 9 Exceptions to the Sui Generis Right

Member States may provide that the lawful user of a database may extract and/or use a substantial part of its contents:

a. In the case of extraction for private purposes of the contents of a non-electronic database

b. In the case of extraction for the purposes of illustration for teaching or scientific research, provided that the source is indicated and to the extent justified by a non-commercial purpose.

c. When the extraction or reuse is for public security purposes for the purposes of administrative or judicial proceedings.

Article 10

1 The right referred to in Article 7 shall arise at the moment when the process of creating the database is completed. It shall expire 15 years after 1 January of the year following the date on which that process was completed.

Article 11

1. The right referred to in Article 7 shall apply to databases whose manufacturers or rightholders are nationals of a Member State or have their habitual residence in the territory of the Community.

2. Paragraph 1 shall also apply to companies and undertakings incorporated under the law of a Member State and having their official headquarters in the Community.

Directive [EU] 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market, amending Directives 96/9/EC and 2001/29/EC

According to Directive [EU] 2019/790 of the European Parliament and of the Council [European Union, 2019], article 3

Text and data mining for research purposes

1. Member States shall provide for an exception to the rights provided for in Article 5[a] and Article 7[1] of Directive 96797Ce , Article 2 of Directive 2001/29/EC and Article 15[1] of this Directive with regard to reproductions and extractions made by research organisations and cultural heritage institutions for the purposes of scientific research, text and data mining of works or other subject matter lawfully accessible.

2. Copies made in accordance with paragraph 1 shall be stored with an optimal level of security and may be retained for scientific research purposes to verify the results of the research.

3. Right holders shall be authorised to implement measures to ensure the security and integrity of stored networks and databases. These measures may not go beyond what is necessary to achieve this objective.

4. Member States shall encourage right holders, research organisations and cultural heritage institutions to work together to establish common best practices for the obligation of the measures referred to in paragraphs 2 and 3 respectively.

Regulation [EU] 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending various EU Regulations and Directives

Regulation [EU] 2024/1689 of the European Parliament and of the Council [2024], in recital 48 of its preamble, states: The magnitude of the adverse consequences of an AI system for the fundamental rights protected by the Charter is particularly important for classifying an AI system as high risk.

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These rights include the right to dignity, respect for private and family life, the protection of personal data, freedom of expression and information, freedom of assembly and association, the right to non-discrimination, the right to education, consumer protection, workers' rights, the rights of persons with disabilities, equality between men and women, intellectual property rights, the right to effective judicial protection and to a fair trial, the rights of the defence and the presumption of innocence, and the right to good administration. In addition to these rights, the rights of minors are enshrined in Article 24 and in the United Nations Convention on the Rights of the Child.

88. Throughout the AI value chain, not only are AI systems, tools and services provided, but also components or processes that the supplier incorporates into the AI system for various purposes, such as model training, software integration or other aspects of model development, model retraining, software integration or other aspects of model development.

The parties must provide the aforementioned supplier, by written agreement, with the information, capabilities, technical access and other assistance necessary to enable the supplier to fully comply with the obligations set out in this regulation without compromising their own intellectual and industrial property rights or trade secrets.

104. Providers of licensed and open-source AI models whose parameters, including weight, information on model architecture and information on model usage made available to the public, should be subject to exemptions from transparency requirements, unless they are considered a systemic risk. in which case the fact that the model is transparent and accompanied by an open-source licence should not be considered sufficient reason for it to be exempt from compliance with the obligations of this Regulation.

Where the disclosure of general-purpose AI models under a free and open-source licence does not necessarily reveal information about the dataset used to train the model or make adjustments, or about how compliance with copyright law was ensured, the above exception should not exempt the obligation to provide a summary of the content used for training the model or the obligation to adopt guidelines for compliance with Union copyright law, in particular to identify and respect the reservation of rights provided for in Article 4[3] of Directive [EU] 2019/790 of the European Parliament and of the Council.

105. General-purpose AI models, in particular large generative AI models capable of generating text, images and other content, are presented as opportunities for innovation, but they also represent a challenge for artists, authors and other creators in terms of how their creative content is created, distributed, used and consumed.

The development and training of these models requires access to large amounts of text, images, video and other data. Text and data mining techniques are used in this context to retrieve and analyse such content, which may be protected by copyright and related rights.

Any use of copyright-protected content requires the authorisation of the rights holder, unless the relevant exceptions and limitations to copyright apply.

EU Directive 2019/790 introduced exceptions and limitations that allow the reproduction and extraction of works and other performances for the purposes of text and data mining in certain circumstances.

Under these rules, rightholders may reserve their rights in relation to their works or other performances to prevent text and data mining, unless the purpose is scientific research. Where the rightholder has adequately reserved the right of exclusion, providers of general-purpose AI models must obtain authorisation from the rightholders to carry out text and data mining of such works.

106. Providers of AI models must take measures to comply with Union law on copyright and related rights, as well as detect and comply with the reservation of rights expressed by Directive [EU] 2019/790. Any provider placing a general AI model on the Union market must comply with the above obligation regardless of the jurisdiction in which the acts supporting the training of general-purpose AI models take place.

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107. In order to increase transparency in relation to the data used in the pre-training and training of general-purpose AI models, including texts and data protected by copyright, providers of such models shall produce and make publicly available a detailed summary of the content used for the training of the general-purpose AI model. This summary should take into account the need to protect trade secrets and confidential business information and, at the same time, should be comprehensive in its technically detailed scope in order to facilitate the exercise and enforcement of rights by parties with legitimate interests under Union law. An example is to list the main data sets or compilations used to train the model, such as large data files or private or public databases, and to provide explanations of the data sources used.

108. With regard to the obligations imposed on AI model providers in relation to copyright and making a summary of the content used for training available to the public, the AI office is required to monitor whether the provider has complied with these obligations without individually verifying the training data works for copyright compliance.

167. All parties involved in the application of this Regulation shall respect the confidentiality of the information and data obtained in the performance of their duties. They shall perform their duties and activities in such a way as to protect intellectual and industrial property rights, confidential business information and trade secrets, the application of the Regulation, public and national security interests, the integrity of criminal and administrative proceedings, and the integrity of classified information.

Article 25

1. Any distributor, importer, deployment manager or third party shall be considered a supplier of a high-risk system for the purposes of this Regulation.

5. Paragraphs 2 [requirements for high-risk AI systems] and 3 [obligations of suppliers and persons responsible for the deployment of high-risk AI systems and other parties] shall be understood without prejudice to the need to observe and protect intellectual and industrial property rights, confidential business information and trade secrets, in accordance with Union and national law.

Article 52 Procedure

The provider of a general-purpose AI model that meets the condition in Article 51[1][a] [general risk model with systemic risk] shall notify the Commission without delay.

6. The Commission shall ensure that a list of systemic risk AI models is published and kept up to date, without prejudice to the need to respect and protect intellectual and industrial property rights and confidential business information or trade secrets in accordance with Union and national law.

Article 53

Obligations of providers of general-purpose AI models

[b] They shall develop and maintain information and documentation and make it available to providers of AI systems with the intention of integrating the general-purpose AI model into their AI systems.

This is without prejudice to the need to observe and protect intellectual and industrial property rights and confidential information or trade secrets in accordance with Union and national law.

Article 78 Confidentiality

1. The Commission, market surveillance authorities, notified bodies, including any natural or legal person involved in the application of this Regulation, shall respect the confidentiality of information and data obtained in the performance of their tasks in such a way that, in particular, the following are protected:

[a] the intellectual and industrial property rights and confidential business information or trade secrets of a natural or legal person, including source code, except in the cases referred to in Article 5 [exceptions relating to the protection of undisclosed technical knowledge and business information [trade secrets] against their unlawful acquisition and disclosure] of Directive [EU] 2016/294 of the European Parliament and of the Council.

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Annex VII

In accordance with the assessment of the quality management system and the assessment of the technical documentation.

4.5 The notified body shall be granted access to the training model and trained model of the AI system, with their corresponding parameters, once all reasonable means of verifying the substantiated claim have been shown to be insufficient, in order to assess the conformity of the high-risk AI system with the requirements set out in Chapter 3, Section 2.

Such access shall be subject to applicable Union law on intellectual and industrial property and trade secrets.

Report on Copyright and Artificial Intelligence issued by the United States Copyright Office

Part 2 published on 29 January 2025

Report by the Copyright Office

U.S. Copyright Office. [2025, 29 de enero].

This second part of the report addresses the copyright protectability of results generated by AI systems. It analyses the type and level of human contribution required for such results to fall within the scope of protection of US copyright law.

The report reaches the following conclusions:

Copyright issues related to AI can be resolved without changes to existing law.

The use of AI tools as support does not affect the protection of the final work.

Copyright protects original expression created by a human that includes AI-generated material.

Copyright does not extend to purely AI-generated material or material where the human has no control over the elements of expression.

If the person contributes sufficiently to the results generated by AI, authorship should be analysed on a case-by-case basis.

Based on the technology available today, prompts or instructions would not provide sufficient control.

Humans have copyright over their works that are perceptible in AI-generated results, as well as the creative selection, coordination or arrangement of material in the results or in the creative modifications of the output elements.

At this time, there is no justification for a new type of additional or sui generis protection for

AI-generated content.

In the case of Mexico

In Mexico, databases are regulated by the Federal Copyright Law, which states:

According to the Federal Copyright Law [1996].

Art. 108

Databases that are not original are protected for exclusive use by the person who created them for a period of five years.

Art. 109

Access to private information relating to individuals contained in the databases referred to in the previous article, as well as the publication, reproduction, disclosure, public communication and transmission of such information, shall require the prior authorisation of the individuals concerned.

Exceptions shall be made for investigations by the authorities responsible for the prosecution and administration of justice, and access to public archives by persons authorised by law, provided that the consultation is carried out in accordance with the respective procedures.

Article 110

The holder of the economic rights to a database has the exclusive right with respect to the form of expression of the structure of said database to authorise or prohibit:

I.Its permanent or temporary reproduction, in whole or in part, by any means and in any form;

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II. Its translation, adaptation, rearrangement, or any other modification;

III. The distribution of the original or copies of the database;

IV. Its communication to the public; and

V. The reproduction, distribution, or public communication of the results of the operations mentioned in section II of this article.

Federal Law on the Protection of Industrial Property

According to the Article 5 of the Federal Law on the Protection of Industrial Property [2020], states that the Mexican Institute of Industrial Property, the administrative authority in matters of industrial property, is a decentralised body with legal personality and its own assets, whose powers include:

Section XXVIII. To promote international cooperation through the exchange of administrative and legal experiences with institutions responsible for the registration and legal protection of industrial property in other countries, including, among others: the professional training and education of personnel, the transfer of work methodologies and organisation, the exchange of publications, and the updating of documentary collections and databases.

Sui generis law in Mexico

Dice De la Parra Trujillo, [2004], states that while the European directive protects non-original databases in terms of their substantial investment, in Mexico we cannot presume that the legislator intended to protect the content of non-original databases, but only their structure.

Conclusions

In conclusion, intellectual property is an institution that must be safeguarded in the development of AI to ensure respect for intellectual property rights holders.

Intellectual property must be respected in the training databases of AI systems.

Generative AI poses a challenge for AI system providers when training models; the documentation must include a description of the data used to train the AI.

Mexico has adequate legislation for the protection of intellectual property, but it must continue to work on updating and adapting its regulatory framework to technological advances.

Declarations

Conflict of interest.

The author declares that there is no conflict of interest.

Author contribution

The author contributed to the entire research process, including study design, data analysis, writing, and results expressed in conclusions and proposals.

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Abbreviations

AI, Artificial Intelligence.

References

Background

Directiva 96/9/CE del Parlamento Europeo y del Consejo de 11 de marzo de 1996 sobre la protección jurídica de las bases de datos.

Basics

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Support

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Article

AI regulation in relation to training databases

La regulación de la IA en materia de Bases de Datos de Entrenamiento

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Abstract

AI systems are increasingly advancing technologically, while their regulation lags behind in terms of the risks AI can pose to people´s fundamental rights. We will start with regulation [EU] 2024/1689 of the European Parliament and of the Council of june 13,2024. Which is a leading legislation on AI systems. The regulation includes the implementation, introduction to market and public introduction, monitoring, reporting documentation and other technical requirements specific to this systems.

AI Regulation Concerning Training Databases		
OBJECTIVES	**METHODOLOGY**	**CONTRIBUTION**
To investigate the regulation of artificial intelligence in relation to training databases. To analyze the legal protection of data used for AI training. To study the proposals that would allow AI models to use training data in Mexico.	The methodology is qualitative and documentary. It includes the problem statement, defining the research objectives, the justification, and the context. Data collection was documentary. The conclusions interpret the current context of AI training databases.	The legal protection of AI training databases was investigated. The protection of fundamental rights in the regulatory treatment of AI training databases was promoted

Databases, AI providers, High-Risk AI Systems

Resumen

Los sistemas de IA cada vez presentan más avances tecnológicos, en tanto, su regulación sufre un retraso en cuanto a los riesgos que la IA puede representar a los derechos fundamentales de las personas. Se empezará por comentar el Reglamento UE 2024/1689 del Parlamento Europeo y del Consejo de 13 de junio de 2024, el cual es una legislación pionera en la regulación de los sistemas de IA para la puesta en marcha, introducción al mercado y al público, la vigilancia, la elaboración de reportes, llevar a cabo la documentación y otros requerimientos técnicos propios de estos sistemas.

La regulación de la IA en materia de Bases de Datos de Entrenamiento		
OBJETIVOS	**METODOLOGÍA**	**CONTRIBUCIÓN**
Investigar la regulación de la IA de Bases de Datos deEntrenamiento. Analizar la protección legal de los datos para el entrenamiento de la IA. Estudiar las propuestas para que los modelos de IA usen datos de entrenamiento en México.	La metodología es de tipo cualitativo y documental. Incluye el planteamiento del problema, definir los objetivos de investigación, la justificación y el contexto. La recolección de datos documental.	Se investigó la protección legal de las bases de dato de entrenamiento en materia de IA. Se promovió la protección de los derechos fundamentales para la regulación de las bases de datos de entrenamiento de la IA.

Bases de Datos, Proveedores de IA, Sistemas de IA de Alto Riesgo.

Area: Promotion of frontier research and basic science in all fields of knowledge

Citation: Orozco-Orozco, José Zócimo. [2025]. AI regulation in relation to training databases. Journal-Industrial Organization. 9[15]1-8: e2915108.

Introduction

This article deals with the regulation of AI, more precisely in terms of training databases, obligations of AI system providers, and finally, we will look at the draft bill to regulate AI in Mexico.

EU Regulation 2024/1689 of the European Parliament and of the Council of 13 June 2024.The regulation of AI in terms of training databases.

Regulation [EU] 2024/1689 of the European Parliament and of the Council [2024].

The regulation aims to promote the development and adoption of safe and reliable Artificial Intelligence [AI] systems in the European Union, in both the private and public sectors, to ensure the health and safety of Union citizens.

67. High-quality data and access to high-quality data are necessary to provide structure and ensure the functioning of many AI systems, especially when model training techniques are used to ensure that high-risk AI systems function as intended and safely and do not become a source of any form of discrimination prohibited by Union law.

Data management and governance practices should be put in place to ensure that the data sets for training, validation and testing are of high quality.

The data sets should be relevant and sufficiently representative and, as far as possible, free from errors and complete in accordance with the intended purpose of the system.
In order to comply with European Union law on data protection, including Regulation [EU] 2016/679, data management and governance practices must include transparency regarding the original purpose of data collection.

Data sets must have the appropriate statistical properties in relation to individuals or groups of individuals in relation to the intended use of the high-risk AI system, seeking to mitigate possible biases in data sets that could affect the health and safety of individuals, possible negative impacts on fundamental rights or give rise to any form of discrimination prohibited by Union law...

The requirement that data sets be as complete and error-free as possible should not affect the use of techniques for protecting sensitive data to the extent required by their intended purpose, features, characteristics or particular elements of the geographical, contextual, behavioural or functional environment in which AI systems are intended to be used.

Governance requirements may be met by using third parties that offer compliance services, including verification of data governance, data set integrity and data training, validation and testing practices, to the extent that compliance with the data requirements of this Regulation is ensured.

68. In order to develop and evaluate high-risk AI systems, providers and other relevant bodies and entities such as European digital innovation hubs, testing and experimentation facilities and researchers must have access to high-quality data sets in their areas of activity related to this Regulation and must be able to use them.

The European common data spaces established by the Commission and the facilitation of data exchange between businesses and with governments in the public interest are essential to provide reliability and accountability in access to AI systems, and in a non-discriminatory manner, to high-quality data with which to train, validate and test AI systems.

The relevant competent authorities, including sectoral authorities that provide or facilitate access to data, can also support the provision of high-quality data with which to train, validate and test AI systems.

69. Measures taken by providers to ensure the right to privacy and the protection of personal data may include not only anonymisation and encryption, but also the use of technology that allows algorithms to access data and train AI systems...

76. Cyberattacks against AI systems may target specific AI assets such as training datasets. Providers of high-risk AI systems should take appropriate measures such as security controls, taking into account the underlying ICT infrastructure where appropriate.

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104. Providers of licensed and open-source AI models whose parameters, including weights, information on the model architecture and information on the use of the model, are made publicly available should be subject to exemptions from transparency requirements, unless they are considered a systemic risk. in which case the fact that the model is transparent and accompanied by an open-source licence should not be considered sufficient reason for it to be exempt from compliance with the obligations of this Regulation.

Where the disclosure of general-purpose AI models under a free and open-source licence does not necessarily reveal information about the dataset used to train the model or make adjustments, nor about how compliance with copyright law was ensured, the above exception should not exempt from the obligation to provide a summary of the content used for training the model or the obligation to adopt guidelines for compliance with Union copyright law, in particular to identify and respect the reservation of rights provided for in Article 4[3] of Directive [EU] 2019/790 of the European Parliament and of the Council.

109. AI model providers who develop or use models for professional or scientific research purposes should be exempted from compliance with the applicable obligations; compliance with these obligations should be voluntary for these providers.

Compliance with these obligations should not entail excessive costs or discourage the use of such models.

Section 2

Requirements for high-risk AI systems

Article 8

2. Providers shall be responsible for ensuring that their product complies with all applicable requirements of Union legislative acts.

Article 9

A risk management system shall be implemented, documented and maintained in relation to high-risk AI systems.

3. The risks referred to in this Article are only those that can be reasonably mitigated or eliminated through the development or design of the high-risk AI system.

Article 10

Data and data governance

1. High-risk AI systems developed using AI model training techniques with data shall be developed from a data set, validation and testing that meet the quality criteria referred to in paragraphs 2 to 5, provided that such data sets are used.

2. Governance practices for the training, validation and testing data set shall focus on the following:

a] Design decisions, b] Data collection and sourcing processes, c] Data preparation operations, including cleansing, updating, enrichment and aggregation, d] Formulation of assumptions for measuring and representing data, e] Assessment of the availability, quantity and adequacy of datasets, f] Biases that may affect the health and safety of individuals, that may adversely affect fundamental rights or generate any type of discrimination prohibited by Union law, g] Effective measures to detect, prevent and mitigate biases detected as established in the previous paragraph, h] Detection of deficiencies that prevent compliance with this regulation.

3. The training, validation and testing data sets shall be relevant, as representative as possible and free from errors, and shall be complete for their intended purpose, either as individual data sets or in combination.

Article 11. Technical documentation

The technical documentation for a high-risk AI system shall be drawn up before it is placed on the market or put into service and shall be kept up to date.

The documentation shall be drafted in such a way as to demonstrate that the high-risk AI system complies with the requirements of this section of this Regulation and shall provide the authorities with the information necessary to assess the high-risk AI system.

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Article 12. Record keeping

High-risk AI systems shall technically enable the automatic recording of events throughout the entire life cycle of the system.

Article 13

1. High-risk AI systems shall be designed and developed with a sufficient level of transparency to enable the correct use of their output results.

2. High-risk AI systems shall be accompanied by instructions for use in digital format.

The instructions shall contain at least the following information:

a]. The identity and contact details of the supplier and its designated representative b] the characteristics, capabilities and limitations of the functioning of the high-risk AI system, including i] intended purpose ii] the level of accuracy, robustness and cybersecurity iii] any known or foreseeable circumstances associated with the high-risk AI system in accordance with its intended purpose that could give rise to risks to health, safety or fundamental rights. iv] the capabilities and technical characteristics of the high-risk AI system to provide information explaining its output results] changes to the high-risk AI system and its operation predetermined by the supplier at the time of the initial assessment. d] human oversight measures, including technical measures to facilitate the interpretation of output results from high-risk AI systems. e] the necessary IT and hardware resources, the expected lifespan of the high-risk AI system, and the necessary maintenance and care measures [including their frequency to ensure the proper functioning of the system, including software updates]. f] where possible, a description of the mechanisms that enable the correct deployment, storage, and interpretation of log files.

Article 14 Human supervision

High-risk AI systems shall be developed in such a way that they can be supervised by natural persons during the period they are in use.

The purpose of human supervision is to prevent or reduce risks to fundamental rights arising when a high-risk AI system is used or when it is misused in a reasonably foreseeable manner.

3. Supervisory measures shall be proportionate to the risks, level of autonomy and context of use of the high-risk AI system. The measures may be:

a. Measures defined by the supplier prior to placing on the market or putting into service

b. Measures defined by the supplier prior to the introduction of the high-risk AI system and suitable for implementation by the deployment manager.

4. For the purposes of implementing paragraphs 1, 2, and 3, the high-risk AI system shall be offered to the person responsible for deployment in such a way that the natural persons entrusted with human supervision:

a] understand the capabilities and limitations of AI systems and adequately monitor their functioning.

b] raise awareness of the potential tendency to rely automatically or excessively on the output of a high-risk AI system, in particular in high-risk AI systems that are used to provide information or recommendations for the purpose of human decision-making. c] correctly interpret the output results of the high-risk AI system d] decide in any specific situation not to use the high-risk AI system or to discard, invalidate or reverse the output results generated by this system. E] intervene in the operation of the high-risk AI system or interrupt its operation so that the AI systems are safely shut down.

5. The requirement for verification by at least two natural persons shall not apply to high-risk systems used for the purposes of law enforcement, migration, border control or asylum where national or Union law considers this requirement to be disproportionate.

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Article 15

High-risk AI systems shall be designed to achieve an adequate level of accuracy, robustness and cybersecurity and to function uniformly throughout their life cycle.

Technical solutions to address vulnerabilities shall include measures to prevent, detect, combat, resolve and control attacks that seek to manipulate the training data set or components previously used for training, input information to cause the AI model to make an error, confidentiality attacks or model defects.

Article 16

Providers of high-risk AI systems shall
shall ensure that their high-risk AI systems comply with the requirements in Section 2.

a] Ensure that high-risk AI systems comply with the requirements in Section 2 b] indicate on the high-risk AI system, on the packaging or in the accompanying documentation, its trade name or brand name and contact details c] have a quality management system d] keep documentation 3] retain the records f] ensure that AI systems undergo the assessment referred to in Article 43 before being placed on the market or put into service g] draw up an EU declaration of conformity in accordance with Article 47 h] affix the CE marking to the high-risk system or the accompanying documentation in accordance with Article 48 i] comply with the registration obligations j] take the necessary corrective measures l] ensure that the high-risk AI system complies with the accessibility requirements of the Union guidelines.

Chapter V General-purpose models Section 1 Article 51 Classification rules for general-purpose AI models with risk.

2. A general-purpose AI model is presumed to have high-impact capabilities when the cumulative amount of computation used for its training, measured in floating-point operations, exceeds .

Article 53

Providers of general-purpose AI models shall

[a] develop and maintain technical documentation of the model, including information on the training and testing process and the results of its evaluation.

[d] make available to the public a detailed summary of the content used for training the general-purpose AI model.

Article 56

Codes of good practice

2. The AI Office and the AI Council shall ensure that codes of good practice include:

[b] th appropriate level of detail regarding the summary of the content used for training.

Article 57

Member States shall ensure that their competent authorities establish a controlled space for AI testing at national level.

5 The controlled spaces for AI testing established shall provide a controlled environment to foster innovation and facilitate the development, training, testing and validation of AI systems for a limited period in accordance with the controlled testing space plan.

Article 59

In the controlled testing environment, personal data lawfully collected for other purposes may be processed solely for the purpose of developing, training and testing specific AI systems where the following conditions are met: [i] they keep a complete and detailed description of the process and logic underlying the training, testing and validation of the AI system together with the results of the testing process as part of the technical documentation.

Article 74

12. Where applicable, suppliers shall grant market surveillance authorities full access to the documentation, as well as to the training, validation and testing data sets used for the development of high-risk AI systems.

Annex III

High-risk systems referred to in Article 6

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High-risk AI systems pursuant to Article 6[2] are AI systems that form part of the following areas:

1. Biometrics

2. Critical infrastructure. AI systems intended as security and management components in the operation of digital infrastructures, traffic or the supply of water, gas, electricity or power.

3. Education and vocational training

4. Employment, worker management and access to self-employment

5. Access to essential private services and essential public services and benefits, and the enjoyment of these services and benefits.

6. Ensuring compliance with the law, to the extent that its use is permitted by applicable Union or national law.

7. Migration, asylum and border control management, to the extent that its use is permitted by applicable Union or national law:

8. Administration of justice and democratic processes.

Annex IV

The technical documentation referred to in Article 11[1] shall include at least the information applicable to the relevant AI system: 1.d] data requirements, in the form of technical specifications describing the training methodologies and techniques, the training data sets, a general description of those data sets and information about their origin, scope and main characteristics, the manner in which the data were obtained and selected, the labelling procedures and data cleansing methodologies.

Directive [EU] 2019/70 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market, amending Directives 96/9/EC and 2001/29/EC

Code of Practice on Security of General Purpose AI Models

According to the European Commission [2025], the Security chapter of the Code of Good Practices establishes obligations for individuals, companies or entities that develop, place on the market or use AI models that may have broad and significant impacts on security, fundamental rights or critical infrastructure.

It does not apply to all general AI systems, only those that may generate systemic risks.

Main obligations of suppliers

Security and Risk Framework

Create, implement and update security frameworks [structures for developing software] throughout the model's life cycle.

Carry out an assessment of the model and its trigger points, e.g. training time, development stages, user access, inference computation and/or functionalities.

2 Identify and analyse systemic risks

- Identify potential risks of the model

- Develop risk scenarios and analyse them with technical and scientific rigour

- Estimate the probability and severity of damage.

3. Risk assessment

- Establish criteria for deciding whether risks are acceptable

- Refrain from launching a model on the market if the risks are not considered acceptable.

4 Determination of risk acceptance.

- Proceed or not proceed in the event of systemic risks.

- Implement security measures [against data theft, unauthorised access].

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5. Implement functional security measures [training data filtering, monitoring input and output, as well as gradual access].

6 Mitigation measures

- Establish security goals and mitigation measures.
- These security measures will be implemented until the parameters are made available to the public or the model is securely deleted.

7. Security and reporting models.

- Develop a reporting model that includes
- A detailed justification of why the systemic risk for the model is acceptable, including details of the safety margins
- The conditions under which the justification in the previous point would no longer be valid.
- A description of how the decision to proceed with development, market release and/or use was made and how external evaluators influenced that decision.

8. Definition of responsibilities

Establish mechanisms to monitor, support and follow up on systemic risk, provide assurances about the adequacy of processes and the mitigation of this risk.

9. Reports of serious incidents

Review other sources of information
Facilitate the reporting of relevant information about incidents to the signatory or the AI office or the competent authorities.

10 Additional documentation and competence

If required by the AI office: a detailed description of the architecture model, a description of how the models are integrated into AI systems, a description of the model evaluation, and a detailed description of the mitigation systems implemented.

The assessment teams will be provided with Information including the model specification [including the instruction system], relevant training data, data sets, and past evaluation models appropriate for a] systemic risk, and b] the model evaluation method.

Guidelines on the Scope of Obligations for General-Purpose AI Models Established by the AI Act

European Commission. [2025, July 18]. Article 3[63] of the AI Act defines a general-purpose AI model as an AI model, including when such an AI model is trained on large amounts of data using large-scale self-supervision, that demonstrates significant generality and is capable of competently performing a wide range of distinct tasks, regardless of how the model is marketed.

This definition generally lists the factors that determine whether a model is considered general-purpose but does not establish specific criteria that potential providers can use to assess whether their model qualifies as a general-purpose AI model.

The case of Mexico

Initiative with draft decree issuing the the Federal Law regulating Artificial Intelligence

Presented by Senator Ricardo Monreal Ávila, Senator of the Republic and member of the MORENA party parliamentary group in the LXV legislatura, Mexico, Senate of the Republic. [2024, April 2].

Among its points, the following stand out:

Article 1

This law is of public order and general observance throughout the national territory in federal matters and has the following objectives:

To regulate the development and commercialisation of artificial intelligence systems.

To guarantee respect for the human rights of users.

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To protect intellectual property rights and facilitate the national development of artificial intelligence systems.

Article 21.- Developers and suppliers of artificial intelligence systems based on Large Language Models, who use databases of information generated or created by third parties for the training of these systems, may only use this information or content with the prior agreement of the intellectual property rights holders of that information or content.

Article 22.- If 90 calendar days have elapsed since the developer or supplier of the artificial intelligence system referred to in Article 21 formally requested an agreement with the owner of the intellectual property rights of the information or content intended to be used for the purposes of training the artificial intelligence system, they may request the Institute to resolve the terms and conditions that could not be agreed upon.

The Institute shall resolve the matter within a period not exceeding 120 calendar days from the date on which either party has notified it of the disagreement.

Conclusions

European legislation continues to lead the world in the field of AI systems
.

AI system providers must have greater control and oversight of AI systems in order to eliminate or mitigate the risks associated with these systems as far as possible.

AI systems must have continuous human supervision in case they fail under reasonable use to avoid or mitigate risks to fundamental rights.

The fact that an AI system is open source does not exempt providers from having controls, documentation, monitoring, sending periodic reports, having mitigation plans and other controls.

Declarations

Conflict of interest

The author declares that there is no conflict of interest.

Author contribution

The author contributed to the entire research process, including study design, data analysis, writing, and results expressed in conclusions and proposals.

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Abbreviations

AI, Artificial Intelligence.

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Background

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Article

Corporate social responsibility and its relationship with the performance of Mexican SMEs

Responsabilidad social empresarial y su relación con el desempeño de las PYMEs Mexicanas

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Abstract

This research aims to analyze the role of Corporate Social Responsibility [CSR] in Mexican small and medium-sized enterprises [SMEs]. Through a systematic document review based on the PRISMA model, various recent academic sources addressing the relationship between CSR and SMEs were compiled and analyzed. The findings suggest that CSR has a positive impact on the reputation, sustainability, and economic performance of SMEs, although its implementation faces barriers such as a lack of resources and institutional support. It is concluded that integrating CSR into organizational strategy allows SMEs to generate shared value and adapt to changing economic and social contexts.

Objective	Methodology	Contribution
Analyze the role of Corporate Social Responsibility (CSR) in Mexican small and médium Sized enterprises (SMEs) and its relationship with their performance	Revisión documental sistemática basada en al modelo PRISMA	La RSE tiene un impacto positivo en la reputación, sostenibilidad y desempeño económico de las PYMES, aunque su implementación enfrenta barreras como la falta de recursos y apoyo institucional

Corporate social responsibility, Small and medium-sized enterprises [SMEs], performance

Resumen

La presente investigación tiene como objetivo analizar el papel de la Responsabilidad Social Empresarial [RSE] en las pequeñas y medianas empresas [PYMES] mexicanas y su relación con el desempeño de las mismas. A través de una revisión documental sistemática basada en el modelo PRISMA, se recopilaron y analizaron diversas fuentes académicas recientes que abordan la relación entre la RSE y las PYMES. Los hallazgos sugieren que la RSE tiene un impacto positivo en la reputación, sostenibilidad y desempeño económico de las PYMES, aunque su implementación enfrenta barreras como la falta de recursos y apoyo institucional. Se concluye que integrar la RSE en la estrategia organizacional permite a las PYMES generar valor compartido y adaptarse a contextos económicos y sociales cambiantes.

Objetivo	Metodología	Contribución
Analizar el papel de la Responsabilidad Social Empresarial (RSE) en las Pequeñas y medianas empresas (PYMES) mexicanas y su relación con el Desempeño de las mismas	Revisión documental sistemática basada en al modelo PRISMA	La RSE tiene un impacto positivo en la reputación, sostenibilidad y desempeño económico de las PYMES, aunque su implementación enfrenta barreras como la falta de recursos y apoyo institucional

Responsabilidad social empresarial, Pequeñas y medianas empresas [PYMES], desempeño

Area: Development of strategic leading-edge technologies and open innovation for social transformation

Citation: Alcaraz-Vera, Esteban, Valdez-Barreto, Víctor Hugo and Lino-Gamiño, Juan Alfredo. [2025]. Corporate social responsibility and its relationship with the performance of Mexican SMEs. Journal-Industrial Organization. 9[15]1-11: e3915111.

Introduction

Based on data presented by the Ministry of Economy [2024], Micro, Small and Medium Enterprises [MSMEs] represent 99.8% of enterprises in Mexico with a total of 4.7 million establishments, generate 52% of national income and employ 68.4% of the total number of people working in the business sector. Their distribution is broken down as follows: 4.5 million are Micro, 190,000 are small and 38,000 are medium-sized.

In terms of distribution by sector, small and medium-sized enterprises are mainly located in the commerce sector, both with 19.7%, followed by the service commerce sector with 18.1% in the case of small and 18.7% for medium-sized enterprises. Finally, the manufacturing sector accounts for 3.6% of small and 15.9% of medium-sized enterprises, as shown in Graph 1.

Box 1

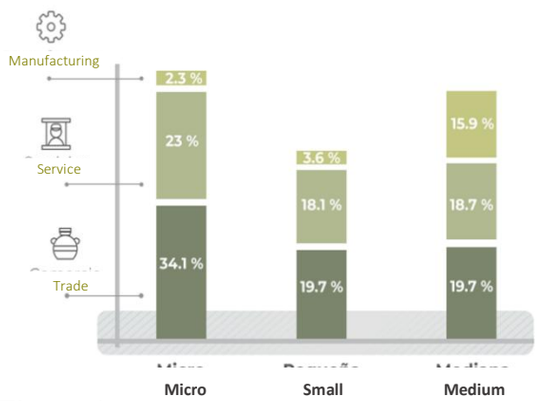

Figure 1

Distribution of SMEs by sector.

Source: Ministry of Economy, 2024

In this regard, the Ministry of Economy [2024] considers MSMEs to be economic, social, cultural, and environmental actors that are fundamental to the development of society.

Hafidzi et al. 2023, as cited in Quispe et al. [2025] point out that, in the current context of globalisation, environmental crises and growing social demands, small and medium-sized enterprises [SMEs] face the challenge of remaining competitive without compromising the sustainability of their operations. In this regard, Corporate Social Responsibility [CSR] has emerged as a strategic tool that allows organisations not only to meet their economic objectives, but also to contribute to social and environmental well-being.

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Based on the data presented, in Mexico, SMEs represent a fundamental part of the economic fabric, but their voluntary adoption of CSR practices is still limited [Herrera et al, 2013]. Several studies [Freeman & McVea, 2001; Alvarado & Schlesinger, 2008; Rangel & Toscano, 2022] have shown that CSR can generate tangible benefits for these organisations, including their relationships with stakeholders, improvements in corporate image and reputation, operational efficiency, and access to new markets.

However, there are also some significant obstacles that hinder its implementation, such as a lack of financial and human resources, a weak organisational culture around sustainability, and the perception that the effects of CSR actions are not always immediate, but rather manifest themselves in the long term [Herrera et al., 2013; López, 2013; Camargo & Ruiz, 2023].

Objective

To identify the main theoretical approaches, empirical findings, and relevant contributions regarding the implementation of CSR actions in small and medium-sized enterprises and their relationship with performance.

Research question

The aim is to answer the central question: how does the implementation of CSR influence the competitiveness of Mexican SMEs?

Justification

The main relevance of this article lies in the theoretical, practical and social aspects of the topic addressed. On a theoretical level, it aims to enrich knowledge about the relationship between CSR and performance in SMEs, given their importance in the economic, social and environmental development of the communities where they operate, as their proximity to their environment and their ability to generate value and social links represent a fundamental channel for the implementation of socially responsible practices.

On a practical level, the article offers elements of analysis that can be used by entrepreneurs who are seeking to approach CSR or are in the process of implementing CSR strategies or actions in their companies.

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From a social perspective, given the relevance of the impact that SMEs have on their environment, this research aims to generate useful knowledge that encourages the owners of these companies to take a more active role in contributing to local development by adopting practices that promote economic, social and environmental development.

Components of the text

This document is composed of several sections. It begins with the Abstract, followed by the Introduction, which includes the problem statement, the study objective, the guiding question and the justification. This is followed by the main body of the work, consisting of the sections Materials and Methods, Literature Review, Results and Discussion. Finally, the Conclusions and the list of References are presented.

Methodology

This study is part of a documentary-type research project, using a qualitative approach to analysis. The PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses] model [Page et al., 2021] was used as a guide to conduct a systematic review of secondary sources focused on Corporate Social Responsibility [CSR] applied to SMEs in Mexico.

Box 2

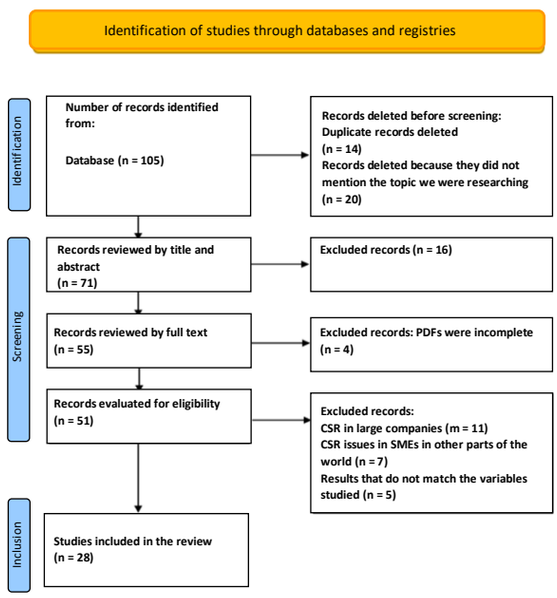

Figure 1

PRISMA flow chart

Source: Own elaboration based on Page et al.., [2021]

The information gathering process was carried out primarily by identifying 105 records in databases such as Google Scholar, Redalyc, Scielo, Ebsco ResearchGate and Dialnet. These records included scientific articles, theses and empirical studies related to the topics of corporate social responsibility and social responsibility linked to private sector organisations. Subsequently, screening was carried out. Once 14 duplicate records and 20 records that did not address the study topic were eliminated, a total of 71 records remained, which were analysed mainly through their titles and abstracts. Of these, 16 were excluded for not meeting the established thematic criteria.

The full text of the remaining 55 records was then reviewed to assess their inclusion or exclusion based on the criteria required for the analysis. At this stage, four documents were initially excluded because the PDF files were incomplete. Of the 51 complete files, the following inclusion criteria were applied for analysis:

- Studies focused on CSR applied to SMEs.
- Contextual focus on Mexican SMEs or SMEs from other regions with the possibility of adaptation to the Mexican context.
- Results associated with economic, social or environmental performance.
- Accessible or available documents with ISSN or DOI indexed to an academic journal.
- As a result of this analysis, 23 records were excluded for the following reasons:
- Studies focused exclusively on large companies. [n=11]
- Contextual focus on other regions outside Mexico without the possibility of adaptation. [n=7]
- Results not associated with economic, social or environmental performance. [n=5]

Finally, 28 studies that met the methodological and thematic criteria of this research were included.

Literature review

This section breaks down two main thematic blocks derived from the literature analysis: 1.

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Theoretical approaches to CSR and 2. CSR in the context of Mexican SMEs and their performance.

Theoretical approaches to CSR

CSR has evolved significantly since the mid-20th century, moving from a philanthropic approach to a more strategic and comprehensive perspective of the organisation. This evolution has mainly occurred in response to the various contextual changes faced by contemporary organisations [Carroll, 1999; Hernández et al. 2024].

In this process, Porter & Kramer [2006, cited in Aguilar & Raufflet, 2010] mention that its adoption in the private sector has gone from being considered an imposition to becoming a voluntary and strategic practice. Similarly, Sarmiento [2011] argues that CSR 'should be recognised as a new paradigm that requires strategic management that generates competitive advantage and, as such, should be leveraged for the permanence of a company in such a changing market' [p.13].

One of the most influential theories related to CSR is the stakeholder theory, or stakeholder approach, proposed by Freeman [1984], which states that stakeholders are all those who can affect or be affected by the company's objectives, such as: government, competitors, customers, employees, civil society, suppliers and shareholders, as shown in Figure 2.

Box 3

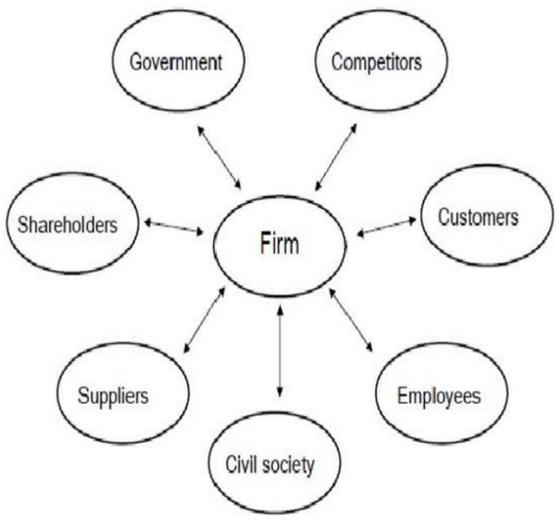

Figure 2
Stakeholder model
Source: Freeman, [1984]

That is, groups that have a direct or indirect relationship with their decisions and results. He also mentions that due to the emergence of various interest groups and the growing complexity of strategic challenges, this theory should not be understood solely as a management tool, but as a proposal that invites us to rethink the traditional role of the company. In this regard, Freeman and McVea [2001] suggest that, in contrast to traditional models that focus exclusively on maximising shareholder profits, the stakeholder approach is based on a more comprehensive vision that recognises the importance of actively managing strong relationships with all stakeholders, as well as incorporating shared values and ethical principles in order to strengthen the organisation's adaptability and resilience in the face of unforeseen changes in the environment.

For his part, Carroll [1991] formulated the Corporate Social Responsibility [CSR] pyramid, which categorises corporate responsibilities into four hierarchical levels: economic responsibility, legal responsibility, ethical responsibility and philanthropic responsibility.

At the base of the pyramid is economic responsibility, which implies that the organisation must be profitable and sustainable in order to maintain its operations and create value for its shareholders and that, without solid economic performance, the other responsibilities could not be met.

With regard to legal responsibility, Carroll [1991] mentions that companies must comply with the legislation in force in the countries where they operate, not only to avoid sanctions, but also to ensure that operations are fair. Fulfilling this responsibility reflects the organisation's commitment to socially accepted norms.

Beyond legality, the organisation must act with fairness, honesty and respect towards its stakeholders. In this sense, ethical responsibility implies behaving in an honourable and morally correct manner even when the law does not require it, as business ethics help to build a framework of trust and reputation.

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At the top of the pyramid is philanthropic responsibility, in which the company takes on a voluntary role in contributing to social and community well-being. Although not mandatory, supporting social causes or improving quality of life strengthens the corporate image and generates a positive impact on society. Figure 3 shows these categories.

Box 4

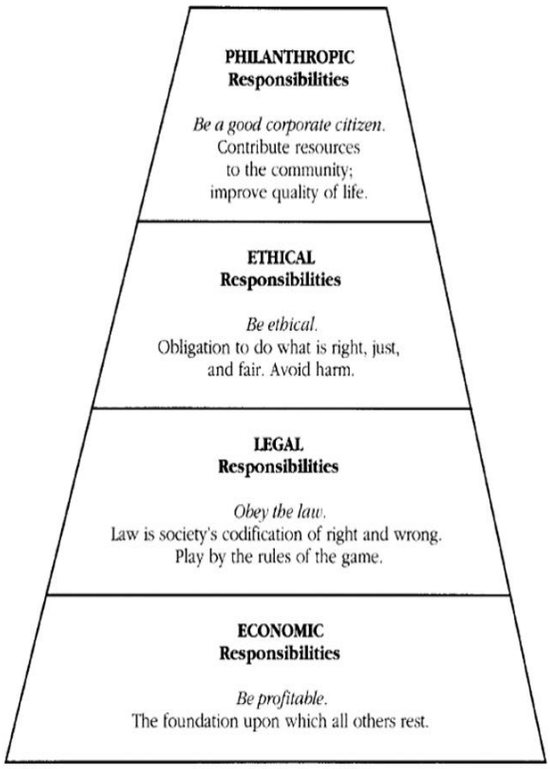

Figure 3

The Pyramid of Corporate Social Responsibility

Source: Carroll, [1991]

These responsibilities are not independent and must be addressed simultaneously for the company to be truly socially responsible [Carroll, 1999].

The triple bottom line is a term coined by Elkington [1997] in which he proposes that companies should not only evaluate their performance based on their financial profitability, but also on their social and environmental impact.

This vision implies that a more holistic and responsible approach must be adopted by executives who aspire to lead effectively in emerging challenges, taking into account the requirements and expectations driven by the triple bottom line of sustainability

Box 5

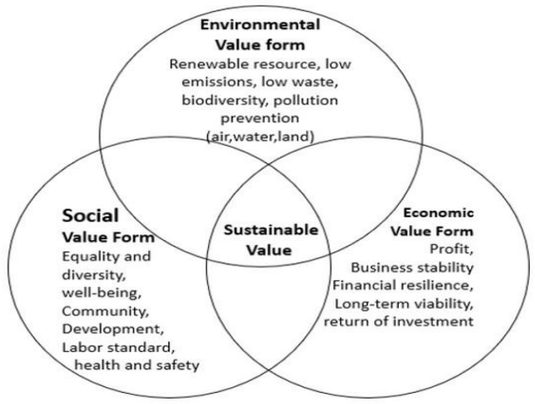

Figure 4

The Triple Bottom Line [Sustainable values]

Source: Evans et al., [2017]

This triple bottom line of sustainability focuses on economic, social and environmental dimensions. The economic bottom line remains essential because companies need to continue generating profits to remain viable, but it is not limited solely to profitability; it also includes the efficient use of resources and long-term stability.

The social bottom line focuses mainly on activities that affect people and the impact on the quality of life of other stakeholders. Finally, the environmental outcome assesses the ecological footprint of companies, taking into account the use of natural resources, waste generation, pollutant emissions and the effect on biodiversity.

This approach recognises that business success depends on the ability to generate value in these three dimensions in a balanced and sustainable manner.

CSR in the context of Mexican SMEs and their performance

Rangel & Toscano [2022] mention that most research in the Mexican context has demonstrated a positive relationship between CSR and business competitiveness, both directly and indirectly.

This relationship can be explained by the adoption of practices that transform their operational dynamics, favouring innovation, reputation, corporate image and value creation, which strengthens their competitive position in both national and international markets.

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Similarly, Ruiz et al. [2020] state that, although only 5% of the studies reviewed find a negative relationship, the majority demonstrate direct economic and reputational benefits derived from the adoption of responsible practices.

Despite its benefits, SMEs face significant barriers to the adoption of CSR. Herrera et al. [2013] identify the lack of human, intellectual and financial capital, as well as the lack of clear and effective regulatory frameworks, as the main constraints.

According to Hernández et al. [2024], Mexican SMEs have begun to adopt CSR strategies as a way to contribute to the Sustainable Development Goals [SDGs], although their application is still limited. In their analysis, they mention that one in ten companies has adopted a CSR strategy linked to the Sustainable Development Goals [SDGs], representing 598 companies in absolute terms. Even though they have the Socially Responsible Company [ESR] label, it is estimated that only some of them ethically implement the principles they claim to uphold. Furthermore, Hernández & Ricárdez [2023] emphasise that many SMEs seek to obtain the ESR distinction, but lack the transparent practices to sustain such recognition.

These shortcomings reflect a lack of institutionalisation and strategic planning around CSR.

Camargo and Ruíz [2023] highlight that the impacts of CSR are not always immediate or easily measurable, which can generate scepticism among entrepreneurs who expect short-term economic benefits. López [2013] points out that another significant barrier to the adoption of CSR practices is corporate culture, as these depend largely on the 'social awareness of the entrepreneur,' who is the key agent in integrating values into the organisation's strategy. Finally, Conraud et al. [2016] argue that many SMEs prioritise actions with low economic impact—such as community participation or fair working conditions—but fail to invest in sustainable technology and infrastructure due to their structural limitations.

Results

Based on the literature review in the Mexican context and the analysis of stakeholder models, the Corporate Social Responsibility pyramid, and the triple bottom line of sustainability [Freeman, 1984; Carroll, 1991; Elkington, 1997], three dimensions were identified with regard to the impact and application of CSR in Mexican SMEs: economic dimension, social and reputational dimension, and environmental and sustainability dimension.

Economic dimension

The results show that CSR can translate into tangible economic benefits, such as increased profitability and long-term financial sustainability. Parrales et al. [2021] show that investment in CSR can translate into significant increases in profitability, as reflected in data from companies that grew 7.2% in revenue in one year after adopting such strategies. In studies applied to SMEs, Hernández & Sánchez [2016] show that the economic dimension has the greatest influence on business results, explaining up to 59.3% of the variance in these results, which means that SMEs prioritise economic benefits when implementing CSR practices.

For Ruiz et al. [2020], the conscious implementation of CSR can generate economic benefits for organisations, as it improves their profitability by strengthening their corporate image with stakeholders.

They also conclude that only a small proportion of studies found a negative relationship between CSR and profitability, which reinforces the generalised positive perception.

For his part, Le [2022] mentions that CSR has a positive and significant association with the financial performance of SMEs in emerging economies.

However, on the contrary, Avendaño [2024] found a non-significant relationship between CSR and economic performance, which he attributes mainly to the high initial costs faced by companies when adopting CSR practices such as the implementation of clean technologies.

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Social and reputational dimension

Several studies agree that the implementation of CSR improves corporate reputation, increases consumer confidence, and strengthens relationships with stakeholders [Freeman & McVea, 2001; Alvarado & Schlesinger, 2008; Ruiz et al. 2020]. In the case of SMEs, these actions are reflected in greater customer loyalty and employee commitment, even when responsible practices are low-cost or voluntary [Conraud et al., 2016].

However, the purpose of CSR must go beyond obtaining a good image or achieving social legitimacy [Sánchez, 2015]; it is about generating shared benefits with stakeholders. Along these lines, Sarmiento [2011] adds that a positive image should not be the sole purpose of CSR, but rather a consequence of a comprehensive strategy that generates shared social value.

Beyond the economic sphere, the dimensions of CSR have a positive effect on other key aspects of organisations, such as quality, customer satisfaction, business ethics, community development and adequate working conditions [Bermúdez, 2018]. Among the effective strategies for greater impact on society are strategic alliances with the public sector or non-profit organisations [Cifuentes et al., 2021].

Despite the challenges and limitations of CSR, it is recognised as a more profound and enriching perspective for a deeper understanding of the relationship between business and society [Fernández & Bajo, 2012]. In the case of Mexico, although it has been incorporated as a tool aimed at mutual benefit between business and society, previous studies indicate that it has not reached a consolidated level of maturity [Lara & Sánchez, 2021]. In this sense, evaluating and measuring CSR is essential not only to project a better image to the outside world, but also to carry out an internal exercise of reflection [Rozas, 2009]

Environmental dimension and sustainability

CSR should be understood as a central component in the strategy of organisations, as it allows for the generation of shared value and long-term sustainability by serving the interests of stakeholders [Freeman & McVea, 2001], and its effective integration has a positive impact on the environment [Quispe, et al. 2025].

In this regard, Fernández & Bajo [2012] assert that CSR represents the most coherent way to advance towards sustainability in business.

Companies are increasingly aware of the need to promote sustainable development that ensures their future viability, recognising that their activity depends largely on the responsible use of natural resources [Aguilera & Puerto, 2012].

Thus, sustainable business development focuses on ensuring economic sustainability through careful management of the environment, which is conceived as an essential resource for supporting economic growth [Díaz & Mogollón, 2021, cited in Quispe et al., 2025]. However, environmental management in Mexico is still one of the areas where the implementation of CSR faces the most challenges, as Avendaño et al. [2024] point out that, in Mexico, only 0.03% of companies are environmentally certified, despite the existence of regulatory frameworks such as the National Environmental Audit Programme. Added to this is the fact that many companies obtain symbolic certifications without applying sustained and verifiable practices [Hernández & Ricárdez, 2023].

Discussion

The findings of this literature review confirm that CSR is not only applicable to large corporations but also constitutes a relevant strategic tool for SMEs, especially in the Mexican context [Herrera et al., 2016]. An analysis of the specialised literature reveals a consensus on the benefits that CSR can generate in terms of economic performance, sustainability and reputation.

One of the most notable elements is the positive relationship between CSR and economic performance, even when the benefits are not always immediate. Ruiz et al. [2020] and Parrales et al. [2021] provide empirical evidence of the positive impact on profitability, while Camargo & Ruíz [2023] point out that the benefits may materialise in the long term and not necessarily in direct financial indicators. This suggests that CSR should be considered a strategic investment rather than an operating expense.

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On the other hand, stakeholder management appears to be an essential component of CSR in SMEs. Models such as the one proposed by Freeman [1984] are useful for understanding how a company can generate sustainable value from ethical relationships with its stakeholders. This value-based management allows SMEs to adapt to diverse national environments [Harrison et al., 2015] and reflects their strategic value in emerging economies [Le, 2022] such as Mexico.

However, the results also show a significant gap between discourse and practice. Although many SMEs express interest in adopting CSR, its actual implementation is hampered by a lack of resources, technical knowledge, and institutional support [Herrera et al., 2013; López, 2013]. Certifications such as the ESR Distinction represent important advances, but in some cases they lack verification mechanisms to ensure the effective application of responsible practices [Hernández & Ricárdez, 2023].

It is important to highlight that the emerging good practices identified, such as strategic alliances and organisational capacity building, represent opportunities to strengthen the implementation of CSR in the Mexican business ecosystem. These initiatives reflect a progressive cultural change, pointing towards a business vision that is more committed to the social and environmental context.

Although the degree of implementation varies among companies, both in terms of their level of development and scope, leading to heterogeneity in how they apply it [Soriano & Fong, 2024], overall, the findings suggest that CSR can be a lever for structural transformation for SMEs, provided that it is integrated as a central part of their strategy and not as a peripheral or symbolic action.

Conclusions

Although CSR offers tangible benefits and represents a key tool for promoting the comprehensive development of SMEs in Mexico, its adoption still requires overcoming various structural and cultural obstacles that must be addressed in order to consolidate its impact. In this regard, the following considerations are shared:

- In the economic sphere, it is related to improvements in economic performance and profitability, although challenges remain due to the high initial costs of its implementation.

- CSR should be a key strategy for strengthening the performance and sustainability of SMEs by consolidating their links with stakeholders.

- In the social sphere, it strengthens corporate reputation.

- The incorporation of socially responsible strategies or actions not only favours the development of the organisation but also contributes to the social, economic and environmental well-being of the country.

- In the environmental dimension, it is fundamental for long-term sustainability and, although obtaining certifications and complying with environmental regulations represent significant progress, more rigorous and transparent mechanisms are required to guarantee the authenticity of responsible practices.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Alcaraz-Vera, Esteban: Contributed to the design and conceptualization of the idea, literature review, methodology, results and conclusions.

Valdez-Barreto, Víctor Hugo: Contributed to the literature review.

Lino-Gamiño, Juan Alfredo: Contributed to the proofreading and reference.

Availability of data and materials

Given the nature of the research, the data collected were available.

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Abbreviations

PYMEs	Pequeñas y medianas empresas
RSE	Responsabilidad social empresarial

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Article

Women's participation in industry: an ecofeminist approach to inclusion and social justice

Participación de las mujeres en la industria: un enfoque ecofeminista hacia la inclusión y la justicia social

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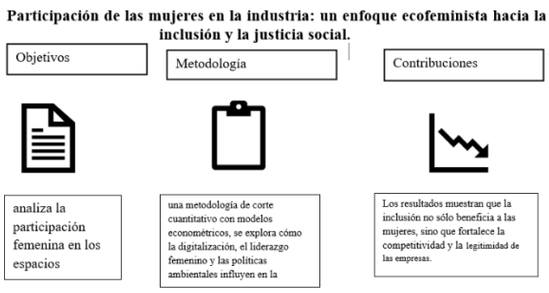
Abstract

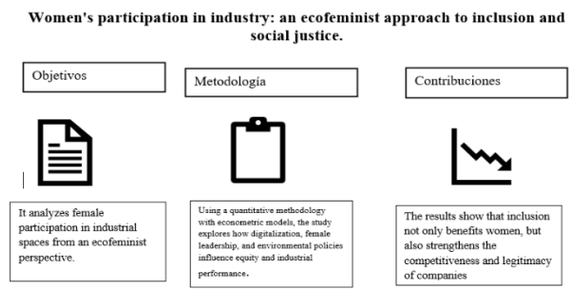
La presencia de las mujeres en la industria no es sólo una cuestión de estadísticas laborales: es un reflejo de la capacidad de una sociedad para integrar la diversidad como fuerza productiva y ética. Este artículo analiza la participación femenina en los espacios industriales desde una mirada ecofeminista, entendiendo que la inclusión no se limita a ocupar un puesto de trabajo, sino a transformar las estructuras de poder, reducir brechas salariales, y construir modelos sostenibles de producción. A partir de una metodología de corte cuantitativo con modelos econométricos, se explora cómo la digitalización, el liderazgo femenino y las políticas ambientales influyen en la equidad y el desempeño industrial. Los resultados muestran que la inclusión no sólo beneficia a las mujeres, sino que fortalece la competitividad y la legitimidad de las empresas.



Participación femenina, industria ecofeminista, liderazgo femenino

Resumen

The presence of women in industry is not just a matter of labor statistics: it is a reflection of a society's capacity to integrate diversity as a productive and ethical force. This article analyzes female participation in industrial spaces from an ecofeminist perspective, understanding that inclusion is not limited to occupying a job, but also to transforming power structures, reducing wage gaps, and building sustainable production models. Using a quantitative methodology with econometric models, the article explores how digitalization, female leadership, and environmental policies influence equity and industrial performance. The results show that inclusion not only benefits women but also strengthens the competitiveness and legitimacy of companies.



Female participation, ecofeminist industry, female leadership

Area: Promotion of frontier research and basic science in all fields of knowledge

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Introduction

HTalking about women in industry means acknowledging centuries of invisibility and, at the same time, advances that have shown that equality is not a concession, but a right. In Latin America, and particularly in Mexico, industry has been one of the sectors most resistant to incorporating women on equal terms. However, in recent years, digitalisation, pressure from international markets and ecofeminism have brought a necessary discussion to the table: how can we make industry inclusive, fair and sustainable?

Ecofeminism reminds us that the oppression of women and the exploitation of nature have common roots: patriarchal and extractivist structures that prioritise accumulation over care. From this perspective, female participation in industry is not only a matter of employment, but also of cultural and environmental transformation.

Women's participation in industry: between visibility and structural resistance

Industry has historically been conceived as a male space. From the Industrial Revolution to today's global value chains, the female workforce has been made invisible or relegated to secondary tasks. However, recent research shows a gradual change: women's participation in manufacturing, technology and logistics activities has increased, albeit with significant gaps compared to their male counterparts [Wu, Li & Zheng, 2024].

This process is not uniform, as it depends on the sector, the region and the public policies implemented.

In Latin America, the incorporation of women into industry faces additional tensions: patriarchal structures in the labour market, unequal distribution of care work and under-representation in management positions [Lorenzen, Martínez-Reyes & Orozco-Ramírez, 2023].

These factors create a double burden: on the one hand, the expectation to be productive in highly demanding industrial environments; on the other, the social obligation to sustain the well-being of their households.

Ecofeminism: a framework for rethinking industry

. Ecofeminism offers a bridge between feminist criticism and ecological criticism. It argues that the exploitation of nature and the subordination of women share the same root: patriarchal and extractivist power structures that prioritise accumulation over care [Lorenzen et al., 2023].

In this sense, rethinking industry from an ecofeminist perspective means placing not only labour inclusion but also the sustainability of production processes at the centre of the analysis.

This framework allows us to question not only how many women participate in industry, but also under what conditions they do so and how their presence transforms modes of production. Recent studies argue that companies that integrate environmental and gender policies not only enjoy greater social legitimacy, but also better long-term performance indicators [Basdekis, Katsampoxakis, Anathreptakis & Papachristopoulos, 2023].

Women's inclusion in the labour market continues to face a paradox: higher education and training do not always correspond to greater equality of opportunity in high-paying jobs. In the manufacturing industry, many women are concentrated in lower-skilled activities with less contractual stability [Abbey et al., 2023]. This reproduces occupational segmentation and perpetuates wage gaps.

Recent literature documents that digitalisation can reduce this gap, provided it is accompanied by technical training policies. Wu, Li and Zheng [2024] found that in China, the adoption of digital technologies in the manufacturing industry not only increased female participation but also reduced the gender wage gap on average. However, this effect is not automatic: it depends on the existence of training programmes and women's access to support networks.

Digitalisation, sustainability and female participation

Far from being a neutral process, the digitalisation of industry has differentiated gender effects.

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Studies such as that by Qiu et al. [2024] point out that the use of digital technologies in manufacturing companies increases the demand for technical and management skills, where female participation can grow if adequate training opportunities are made available. At the same time, women face greater obstacles to entering roles linked to automation and innovation, due to cultural biases that still associate these activities with masculinity.

On the other hand, when companies combine digitalisation with environmental policies, innovative spaces open up where women tend to excel: energy efficiency programmes, community recycling projects, or green certification initiatives. Ecofeminism helps to understand how these practices are not incidental, but part of a cultural transformation that places care at the centre of production [Lorenzen et al., 2023].

A crucial point in the theoretical framework is to understand that inclusion should not be treated as an instrumental indicator of profitability, but as an ethical and justice obligation. Recent literature insists that gender diversity in companies not only generates economic benefits, but also strengthens institutional legitimacy and the ability to adapt to crises [Basdekis et al., 2023; Abbey et al., 2023].

Box 1

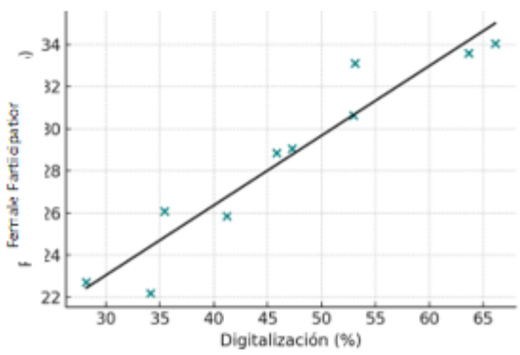

Figure 1
Relationship between digitisation and female inclusion

At the same time, ecofeminist studies in Latin America show that women not only participate in the industry as workers, but also as leaders of community processes that connect sustainability with the economy.

These contributions are vital for thinking about more comprehensive public policies, where digitalisation and gender inclusion are articulated with environmental sustainability..

Box 2

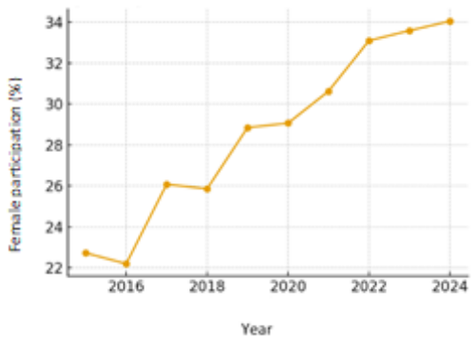

Figure 2
Evolution of female labour participation in Altamira [2015-2024]]

Box 3

Table 1
Proportion of women in managerial positions

Variable	Definition	Unit	Period
Female labour force participation	% of women in industrial EAP	Percentage	2015-2024
Industrial digitalisation	Companies using ICTs	%	2015-2024
Public investment	Expenditure on industrial infrastructure	Millions MXN	2015-2024
Wage gap	Average income gap H-M	%	2015-2024
Female leadership	Women in leadership	%	2015-2024
Exports	Value of industrial exports	USD	2015-2024

Methodology

A fixed effects data model is estimated, considering annual data for Altamira and Tamaulipas for the period 2015-2024. The model is specified as follows:

$$Y\_it = \beta 0 + \beta 1 * Digit\_it + \beta 2 * Inv\_it + \beta 3 * Brecha\_it + \beta 4 * Lider\_it + \beta 5 * Exp\_it + \gamma X\_it + \mu\_i + \lambda\_t + \varepsilon\_it$$

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Y_it: Female labour participation in industry.
Digit_it: Business digitisation.
Inv_it: Public investment.
Brecha_it: Gender pay gap.
Lider_it: Women in leadership positions.
Exp_it: Industrial exports.
X_it: Vector of socio-economic controls.
μ_i: Municipal fixed effects.
λ_t: Time fixed effects.
ε_it: Error term.

Box 4

Figure 3

Gender Pay Gap in Industry [Tamaulipas] 2015–2024]

Results

Digitalisation is positively associated with an increase in female participation. In firms adopting new technologies, women have more access to technical and specialised roles, reducing the wage gap by around 7% on average.

Firms with female leadership show better financial performance indicators, although with non-linear effects: a minimum threshold of participation is necessary for the change to be noticeable.

Box 5

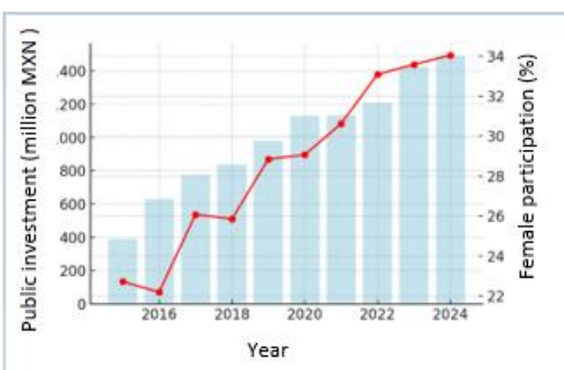

Figure 4

Public investment vs female participation [Altamira 2015-2024]]

Ecofeminist practices and companies that incorporate environmental policies with a gender perspective are associated with greater social legitimacy, investment attraction and positive reputation.

These results coincide with recent studies confirming that gender diversity and sustainability are not a cost, but an investment that improves competitiveness.

Conclusions

The inclusion of women in industry should not be conceived as a 'representation quota,' but as a strategic and ethical commitment. Digitalisation, if accompanied by training and care policies, can be a driving force for closing gaps. At the same time, the presence of women in leadership positions changes organisational culture: it drives more participatory and sustainable decisions.

Ecofeminism provides a necessary framework: it is not enough to talk about women in industry without recognising the interconnections between social justice and environmental justice. Including women is not just a matter of numbers, but of transforming the way we produce and consume.

Digitalisation with an inclusive approach creates real opportunities for women and helps to reduce the wage gap.

Female leadership strengthens the competitiveness of companies and fosters more democratic organisational cultures.

Ecofeminism is key to rethinking industry not only as an economic engine, but also as a space for social and environmental justice.

Public policies must integrate technical training, the provision of care services and the promotion of women in decision-making positions as central axes of industrial development.

Declarations

Conflict of interest

The authors declare no interest conflict.

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Author contribution

Castillo-Flores, Esther Sarai: Contributed to the project idea, research method and technique, revisión y diseño econométrico

Perez-Cruz, Jorge Alberto: Econometric review

Castillo-Flores, Angela Lilliana: Review and clasification results

Fernandez-Garcia, Luis Guillermo: Data analysis and interpretation

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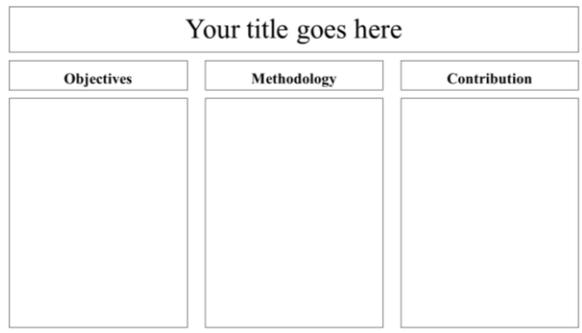

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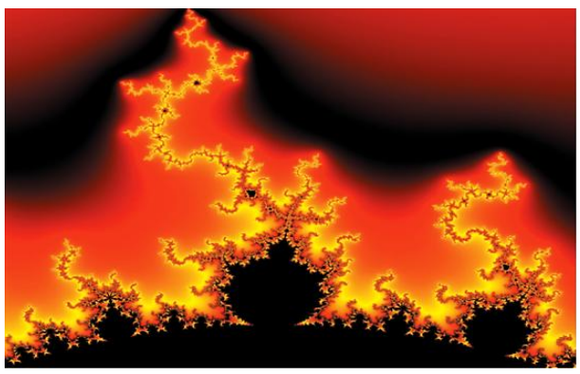

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