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Study on Artificial Intelligence Applied to Transfer Pricing

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Glossary

OECD: Organization for Economic Cooperation and Development.
IA: Artificial Intelligence
NLP: Natural Language Processing
CIAT: Inter-American Center of Tax Administrations
ISORA: International Survey on Revenue Administration
RPA: Robotic Process Automation
CbCr: Country-by-Country Report
IRS: Internal Revenue Service
HMRC: His Majesty's Revenue & Customs
OCR: Optical Character Recognition; its main function is to convert text images into editable digital text
PDF: Portable Document Format; its main function is to view documents with preserved format
API: Application Programming Interface
SEC: United States Securities and Exchange Commission

1. Introduction and Justification of the Study

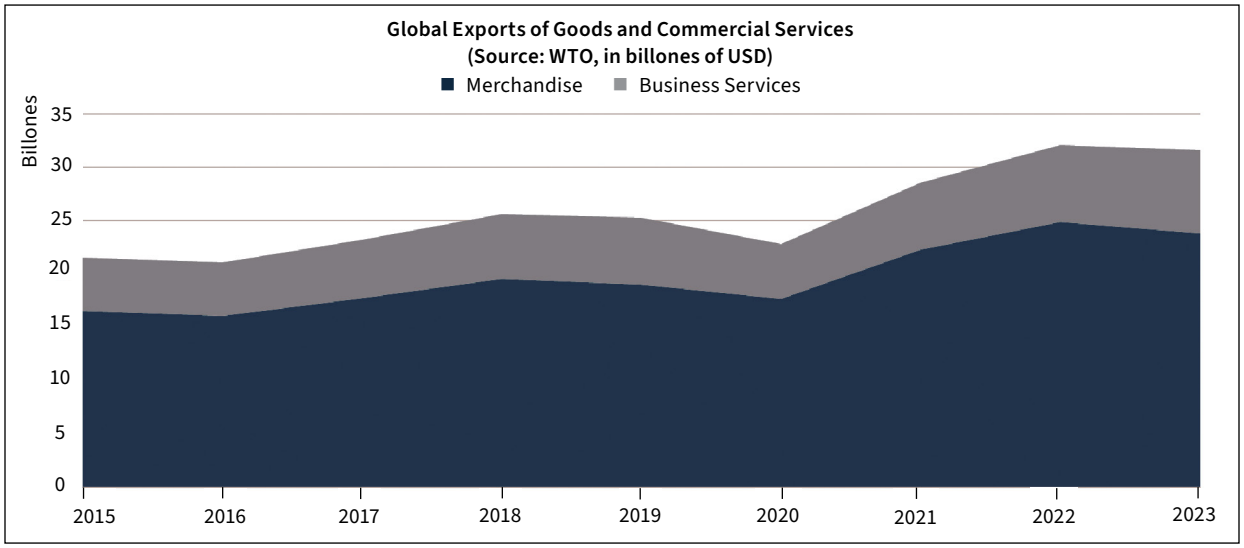
1.1. The global context of Transfer Pricing

A brief description of the importance of transfer pricing in international taxation. Main challenges in determining transfer pricing.

Transfer pricing is a financial optimization tool for multinational business groups and a control tool in determining the correct tax base for intra-group transactions for tax administrations around the world.

The global economy has been interrelated over time starting with the internationalization of business in the seventeenth century. In that century, the first multinational companies were created; being the case of the Dutch East India Company the first one that could be considered as a multinational company.[1] Although on the other hand it is said that the beginning of the internationalization of business was at the end of the sixteenth century and the beginning of the seventeenth; the notable consolidation and expansion of multinational companies was only during the nineteenth century in the context of globalization.

Illustration 1. Historical global exports 2015 – 2023



Source: *World Trade Organization / Created by: Jairo A. Godoy G.*

The world economy moved more than 31.6 trillion dollars per year (2023) according to the World Trade Organization. It is estimated that between 30% and 50% of these operations take place at the intra-group or intra-company level; that is, they are carried out between related parties or members of the same business group.

1 *Encyclopedia Brittanica, Inc. (n.d.) East India Company. https://www.britannica.com/topic/East-India-Company*

While for private organizations transfer pricing can be a tool that allows them to transfer the benefits of a transaction between the parties involved, for tax administrations they represent an important challenge when trying to determine the precise amount of the taxable base on which to calculate the corresponding income tax on related transactions.

However, addressing the problem or the tax risks generated by transactions between related entities, and especially if they are in different tax regimes, has required international consensus around a tax principle or standard such as the Arm's Length Principle or "*Arm's Length Principle*", for its acronym in English. The application of this principle has not been easy and faces permanent challenges such as subjectivity when determining comparable transactions or companies; as well as when using information for comparison.

To address the concerns of both tax authorities and multinational enterprises, the Organization for Economic Cooperation and Development (OECD) developed a document that has become the international guide or primary technical reference for the application of the Arm's Length Principle. This document, titled "*OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations*," also known in the field as 'the Guidelines', serves as the primary standard in OECD member countries, additionally transfer pricing regimes in many non-OECD countries have been developed with the same basis.

These Guidelines have been developed to address the risk of tax manipulation and evasion; with the erosion of the tax base and the transfer of profits being one of the main concerns addressed, a relevant issue for both developed and developing countries. It is estimated, according to the *Global Tax Evasion Report 2024*[2], that one trillion dollars were transferred to tax havens; this is equivalent to 35% of the profits accounted for by multinational companies outside the jurisdictions where their parent companies are located.

One of the challenges faced by taxpayers subject to transfer pricing rules involves documenting and complying with the requirements set forth in the tax laws of each jurisdiction in which their businesses operate and where members of the corporate group are located. For tax authorities, verifying, reprocessing, and validating the information submitted and analyzed by taxpayers in their transfer pricing documentation typically requires the allocation of significant resources, including human and technological.

Conducting transfer pricing audits can be time-consuming for tax authorities and may require investment in technological resources—which can sometimes be costly, such as licenses for access to commercial databases—or in training staff across a wide range of subject areas to effectively address the various industries involved in transfer pricing.

Finally, there is the increasing complexity of the transactions that legally and economically structure business groups for the flow of their commercial and/or financial operations locally and internationally.

2 Annette Alstadsaeter, Sara Gordar, Panayiotis Nicolaides, Gabriel Zucman. Global Tax Evasion Report 2024. Eu-Tax Observatory. 2023, 91 p. halshs-04563948

1.2. Reasons for implementing artificial intelligence

Manually, reviewing related transactions can be costly and resource intensive. The advancement of AI technologies, such as Machine Learning, NLP or Deep Learning can provide new tools to optimize analysis processes, risk detection and evaluation of the consistency of transfer pricing studies.

There are several control processes that tax administrations use depending on their organizational structures, resources, risk model, etc.; These can range from those of a massive nature to those more specific ones as in the case of audits. Tax audits are investigation-intensive control processes; significant resources are devoted to collecting, processing, analyzing, and reviewing the documentation submitted by the taxpayer, as well as their processes, products, transactions, etc., in order to determine the correct tax base on which taxes are due.

Auditors may face a significant workload when examining large taxpayers or complex, interrelated transactions involving multinational companies with global operations. According to the data presented in the document "Overview of Tax Administrations in CIAT Countries," Results of the 2023 ISORA Survey, Volume II, 75% of the countries have staff specialized in international tax audits, and 61% have staff specialized in negotiating advance pricing agreements. On the other hand, almost 89% of CIAT member countries have the practice of detecting inconsistencies by comparing third-party data prior to the initiation of audit processes; 72% of them request additional information; and finally, 75% detect anomalies or outliers through data analysis. In conclusion, tax administrations, especially those in Latin America and the Caribbean, must face enormous amounts of data for their standardization, processing and analysis; that, depending on the reality of the tax administration, can mean a very high workload.

Within this preamble and the reality faced by tax administrations, the use of technology becomes relevant and necessary. Artificial intelligence technologies such as: "*Machine Learning*", "*Natural Language Processing*" and-"*Deep Learning*" could become assistance tools both in data processing and analysis, as well as in the identification of potential tax risks. In various countries of the world, tax authorities, are already using tools related to the "*Big Data*" in risk management, for example: the case of Indonesia[3].

The *Big Data* technology refers to the handling and analysis of a set of data in large quantities, at high speeds and that are usually very complex to manage using conventional or traditional data processing tools. Accordingly, the three main characteristics of this technology have to do with:

- Volume of data; it is about large amounts of information that are generated by different sources. For example, data from user interactions on social networks or in the case of taxes; from the data provided by taxpayers in their different tax returns.

3 *Tax Audit in the Era of Big Data: The Case of Indonesia.* Journal of Tax Administration Vol. 7 (2022). A. Damoro y A. Pratama.

- Speed; the generated data must be processed in almost real time or immediately, so they require agile and efficient data processing systems.
- Variety; this means that the data can have a variety of structured formats such as databases, semi-structured or unstructured (texts, images, etc.).

It is a fact that as time progresses tax administrations have been getting more technical and a sample of that progress, for example, has been electronic invoicing; which has brought by the hand a huge amount of data about taxpayers and their daily transactions. This tax innovation has meant a source of data for tax administrations in large volumes and its use may require immediate processing so the technology of the *Big Data* is here to stay in the tax field. Processing, analyzing and using this data in risk management will require tax administrations to invest, engage and develop technologies related to the *Machine Learning* or *Deep Learning,* for example. Consequently, greater efficiency in the use of the obtained data will be needed, cost reduction in processing and detection of risks or anomalies in taxpayers' returns or taxation; as well as an optimization of resources in tax administrations.

1.3. Objectives of the study

To evaluate the applicability and feasibility of AI tools to optimize and strengthen the review of transfer pricing in tax administrations.

The main objective of this work is to evaluate the applicability and feasibility of using artificial intelligence tools to optimize and strengthen the controls and analysis of transactions achieved by the transfer pricing regime.

More specifically this work pursues the following objectives:

- To identify the types of AI methodologies most suitable for the analysis of transfer pricing data.
- To design a frame of reference for AI in the workflow of a transfer pricing analysis.

1.4. Scope

Specific area of transfer pricing that this study will focus on. Types of AI tools or techniques that will be considered. Limitations, such as data availability, infrastructure, legal and regulatory framework.

The control of transfer prices involves a wide range of topics; in particular when verifying the implementation of the arm's length principle, therefore, it becomes necessary to delimit the topics on which a study of this type will focus for a better development of the research.

The main issues in the analysis and verification of the correct application of the arm's length principle have to do with the verification of the linkages, delineation and precise definition of the linked transactions, as well as all the subtopics that make up the comparability analysis.

In this sense, the scope of this document is to evaluate the applicability of artificial intelligence in transfer pricing on an important issue and to support the work carried out by professionals in transfer pricing. This topic is the analysis in the documentation of potentially comparable companies of the comparison factors. Factors that aim to establish the economically relevant characteristics related to the characteristics of goods or services, business strategies, contractual obligations, functions, assets, risks and economic circumstances. Applying AI to review these five comparison factors in extensive documents, such as the annual reports, of potentially comparable companies and supporting technical work; as well as, reducing the review times of this type of documentation is what this document explores. That is, when defining this scope, what is sought is to determine if it is feasible to use artificial intelligence to help supervisors or analysts to perform a review of the SEC's 10-K annual reports in less time and with greater technical precision.

2. Theoretical Framework and Literature Review

2.1. Transfer Pricing and Comparability Analysis

Review of the recommendations made by the OECD Guidelines on comparability analysis.

The comparability analysis constitutes one of the fundamental pillars within the recommendations for the correct application of the arm's length principle established by the OECD Guidelines. Its main objective is to determine to what extent a transaction made between related parties can be compared with a transaction made between independent parties; this is to establish whether the conditions agreed between the related parties conform to those that would have been agreed by independent entities acting under similar economic conditions.

The Guidelines indicate that a transaction is considered comparable with another if there are no material differences that significantly affect the conditions that would be considered by independent parties, or if such differences can be adequately adjusted to eliminate their effects. This principle implies not only a formal or superficial comparison between companies or transactions, but a thorough examination of the implicit economic factors that influence the commercial and financial behavior of the entities involved.

In this sense, the comparability analysis should address five key factors that the Guidelines consider essential to determine the comparability between transactions:

- The characteristics of the goods or services of the analyzed transaction. This includes physical specifications, quality, reliability, availability and volume. In the case of intangible assets, it is pertinent to consider aspects such as the nature of the intangible, its stage of development, legal protection, contractual rights and expected benefits. For services, it is important to identify the type of service, its complexity and the value it brings to the recipient of it.
- The functional analysis identifies and compares the functions performed, the assets used and the risks assumed by the parties to the transaction. This analysis is fundamental to delimit the economic role of each entity and establish whether the functional profile of the analyzed part can be considered equivalent to that of an independent company. The Guidelines call for a qualitative and quantitative assessment of the economic contribution of each party, paying special attention to strategic functions performed such as the development of intangibles, the assumption of commercial or financial risks, and key decision-making.
- The contractual terms, which provide the legal framework within which the transaction is executed. It is essential to analyze the formal documentation existing between the related parties, but also to verify whether the terms faithfully reflect the economic substance of the transaction. The Guidelines highlight the importance of the "precise delineation" of the transaction, which may involve rejecting the formal terms if they do not conform to the operational reality of the parties.

- Business strategies, such as long-term orientation, market positioning, growth policy, market penetration or price reduction. Although these strategies can explain differences in financial results, their inclusion in the comparative analysis requires concrete evidence of their existence and application in the compared companies.
- The economic circumstances, which involve the market environment in which each entity operates, include the level of competition, applicable regulation, geographical location, macroeconomic conditions and sectoral dynamics. These conditions can significantly influence the prices or margins observed and should be controlled or adjusted in comparability studies.

One of the most demanding aspects of the comparability analysis, according to the Guidelines, is the need to have reliable and specific information, both on controlled and independent transactions. In this regard, it is recognized that the availability of public information may be limited, and that the commercial databases used to identify comparables do not always contain sufficient details about the functional analysis or the contractual conditions. Therefore, it is required to apply strict selection criteria, and in case of using segmented or aggregated information, justify its economic validity.

In addition, the importance of making reasonable and quantifiable adjustments to eliminate material differences between the compared operations. The Guidelines emphasize paying attention to the use of generic, arbitrary or unsubstantiated adjustments, and propose to apply only those that can be measured reliably and that reflect a real improvement in comparability. A common adjustment is usually the one related to working capital differences, or also those related to asset structures, risk level and functions performed.

Another point pointed out by the Guidelines is the need to consider the controlled transaction in its full economic context, which implies avoiding mechanical or overly formalistic approaches in the selection of comparables. The OECD emphasizes that it is not enough to identify companies in the same sector or with similar margins, but that there must be a functional and risk correlation between the analyzed parties. In this sense, the advantage of using complete documentary sources (such as the 10-K reports filed with the SEC) to improve the understanding of the economic profile of companies and facilitate a deeper and more robust comparability analysis is highlighted.

The inclusion of the comparability analysis as a preliminary and essential step in the application of any transfer pricing method shows its central role in the analysis of this topic. Its correct execution not only improves the quality of the technical analysis but also strengthens the taxpayer's defensive position against possible adjustments by the tax administrations.

In conclusion, the comparability analysis, as developed by the OECD Guidelines, requires a combination of technical rigor, professional judgment and access to detailed economic information. This approach, while representing an operational challenge, offers a solid foundation for developing AI-based solutions aimed at automating the review of public documents (such as the SEC's 10-K filings), in order to identify comparable entities and evaluate their economic performance efficiently, accurately and in accordance with the arm's length principle.

2.2. AI in the tax scope and Transfer Pricing

A brief review of AI use cases in taxation (p. use of data mining techniques by some Tax Administrations for fraud detection).

The use of artificial intelligence (AI) has been spreading, not only in the private sphere but also in the public. There are cases of tax administrations and private companies, related to taxation, using or developing tools for the application of AI in their processes related to the issue of transfer pricing. Below are some cases of the use of AI-related tools to support, develop or deepen tax investigations or controls.

United States (IRS) – Internal Revenue Service: The IRS is incorporating AI models to improve the selection of tax returns to be audited, focusing on large taxpayers and transactions between multinationals. These tools analyze huge volumes of data to identify statements with a high probability of errors or omissions, including possible transfer pricing adjustments. In 2023, a pilot AI model was launched to detect high-risk cases, managing to identify risky contributors more effectively than traditional methods[4] According to KPMG analysis, the IRS and other administrations expect AI to simplify transfer pricing audits, improve compliance and strengthen the detection of complex evasion schemes[5]

United Kingdom (HMRC) – UK Tax Authority: HM Revenue & Customs is developing an automated approach to big data analysis to monitor related-party transactions. In 2025 they proposed the introduction of a mandatory International Controlled Transactions Report (ICTS), which will standardize information on transactions between related parties. This data set will enable large-scale automated risk analysis (AI/data analytics) to prioritize transfer pricing audits and reduce the duration of investigations[6]. In other words, HMRC seeks to rely on AI to filter suspicious transactions and focus its audits on areas of higher risk, aligning with international practices.

France (DGFiP) – Directorate-General for Public Finance: The French tax administration uses AI algorithms and data mining techniques to guide its tax controls, including transfer pricing. In 2019, about a quarter of the tax audits conducted were the direct result of the intervention of intelligent systems, which allowed to collect about 11,000 million euros after such inspections – 30% more collection than the previous year[7]. By 2020, the proportion of audits initiated by AI rose to 32% of the total[8]. These tools cross-reference companies' financial and commercial data, helping to detect

4 https://www.gao.gov/blog/artificial-intelligence-may-help-irs-close-tax-gap#:~:text=Annual%20audits,to%20explain%20how%20it%20selected

5 https://kpmg.com/kpmg-us/content/dam/kpmg/taxnewsflash/pdf/2024/10/ai-transfer-pricing-risk-oct21-2024.pdf#:~:text=close%20the%20annual%20tax%20gap,enforcement%20success%20in%20transfer%20pricing

6 https://kpmg.com/uk/en/insights/tax/tmd-hmrc-proposals-to-enable-automated-tp-risk-assessment-at-scale.html#:~:text=The%20ICTS%20is%20aimed%20at,scope%20of%20the%20TP%20rules

7 https://www.20minutes.fr/economie/2848031-20200827-impots-intelligence-artificielle-permet-rendre-controles-fiscaux-plus-efficaces

8 https://www.bfmtv.com/economie/economie-social/france/le-controle-fiscal-a-logiquement-moins-rapporte-en-2020_AD-202108310195.html#:~:text=La%20part%20des%20contr%C3%B4les%20cibl%C3%A9s,d%27un%20tel%20ciblage%20en%202019

inconsistencies in margins or out-of-range transfer pricing practices, with a substantial impact on the effectiveness of the fight against tax fraud.

Austria (Ministry of Finance) – Predictive Analytics Center (PACC): The Austrian Ministry of Finance established a special unit, the Predictive Analytics Competence Centre, which uses AI and predictive models to identify tax evasion schemes across various taxes, including corporate tax (where transfer pricing plays a significant role). In 2023, these systems analyzed about 6.5 million cases from different tax areas and pointed out 375,000 "atypical" cases for review by human auditors. This intensive use of AI made it possible to recover approximately 185 million additional euros in taxes (VAT revenues, corporate income, etc.) in 2023 alone[9]. Authorities emphasize that the PACC's machine learning algorithms identify risk patterns in real time (for example, taxpayers reporting abnormally low income) and prioritize targeted audits, helping to increase tax revenue and proactively detect transfer pricing abuses and other violations.

In conclusion, it can be seen that the use of AI-based tools by tax administrations has served to enhance their work and do more with fewer resources. The use of a combination of tools or technologies based on artificial intelligence are helping the tax authorities of these countries to expand their scope and align with the current technological development as well as the amount of data that the modern economy generates today.

2.3. Main AI techniques and their potential for Transfer Pricing

Expert systems or rules based on AI for the determination of risks and other uses that can be given in tax administrations.

This section presents a set of technologies related to artificial intelligence that exist and which could be used in tasks related to the analysis and / or control of transfer prices.

- Automatic learning (*Machine Learning):*
  - It is the foundation and backbone of many AI-related applications. It is based on algorithms that can learn patterns from data; without the need for explicit programming.
  - Machine learning includes two (2) variants, these are: supervised and unsupervised learning.
- Analysis of graphs and networks (*Graph Analytics*):
  - It allows to represent the data as nodes and edges, that is, as networks and to use graph theory algorithms[10] to analyze them. This can be applied in the identification and structuring of business groups and linkages.

9 https://www.20minutes.fr/economie/2848031-20200827-impots-intelligence-artificielle-permet-rendre-controles-fiscaux-plus-efficaces

10 The Graph theory is a branch of mathematics that studies how objects are connected to each other. If we imagine a map of points and lines; the points would take the name of nodes (or vertices) and represent things such as, for example: people, companies, etc.; and the lines that connect them are called edges or links and represent the relationships or connections between them, for example: friendship, routes, transactions, interests, etc. Graph theory serves to understand how things are connected and discover hidden patterns that provide us with important knowledge such as which is the most important node (parent house or decision maker), where there are groupings or circuits and what connections they are the most important or strong.

- Natural Language Processing (*Natural Language Processing*):
  - It is a subfield of AI that allows machines to understand and process human language, whether it is transmitted by voice or text. In the case of transfer pricing analysis, it could be used to extract data and analyze text in documents submitted by taxpayers about their transactions with related parties or their comparables.

- Analysis of "*benchmarking*" with AI:
  - Through the use of algorithms of "*clustering*" and semantic search such as: FAISS or Word2Vec automate search and validation of comparables.

- Robotic Process Automation (RPA):
  - This technology allows or helps the automation of repetitive tasks. Tools such as: UiPath, Automation Anywhere or Blue Prism, could allow, if applied in transfer pricing, in the download and consolidation of documentation of the taxpayer and / or their related companies, generate templates of preliminary reports, etc.

- Intelligent Visualization Platforms:
  - Technologies such as Power BI, Tableau or Qlik Sense make it possible to present AI model results in formats accessible to transfer pricing analysts. This could be used in the integration of data or information provided by CbCr documentation, for example.

- Data Infrastructure and Big Data:
  - It allows to unify and manage large amounts or volumes of information. For example, Apache Spark, Hadoop, Google Big Query, or Azure Data Lake could help simultaneously process millions of operation logs, statements, and reports that in turn feed into AI models.

- *Blockchain*:
  - It is a distributed or dispersed accounting system that could, in theory, guarantee the integrity of the records of intra-group transactions. In other words, if multinational companies recorded all transactions with their subsidiaries on a private *blockchain*, the authorities could obtain (with the necessary consents) an unalterable audit trail.

- Generative AI:
  - Models such as GPT-4 have demonstrated the ability to produce coherent text, code and analysis from indications. This technology could assist officials in the analysis and/or drafting of reports and/or documentation of transfer pricing such as the annual reports that multinational or comparable companies present.

As can be observed, a wide range of tools could be used to implement AI in the analysis or control of transfer prices. Generally, the use of these technologies always occurs in combination. For example, in some countries the treasury has combined *machine learning*, to classify risks and graph analysis, and to evaluate or identify evasion networks.

3. Theoretical Approach

3.1. Theoretical design

Theoretical approach of the use of AI in the development of tools for the analysis of transfer pricing.

The present study is designed with a combination of qualitative and quantitative analysis. In the case of qualitative analysis, this document focuses on the information collected from studies and research developed on AI by academic institutions of higher education, tax administrations, international organizations and other research entities.

As for the quantitative analysis; the present study focuses on specific technical exercises within the scope defined in this document and that seek to demonstrate with a practical or specific example the help that AI can provide in the application and/or control of transfer prices.

The study will focus on the analysis of the feasibility of developing, with the use of a combination of technologies related to AI, a tool that helps tax administration officials to process the annual reports of foreign companies and extract from them the economically relevant elements of the factors: characteristics of the goods or services and functions performed by these.

The revision of the annual reports of foreign companies exposes the officials of the tax administrations to allocate important resources, especially time, to read, analyze and extract economically relevant data and information that helps or supports the revisions, controls or reprocesses of their studies or transfer pricing reports submitted by taxpayers. This review can currently take days or even weeks for a tax administration official; especially because they also have to face the fact that these documents, the annual reports, are usually written in another language, especially in English.

The development of a tool, based on AI, to help the auditor in the review and subsequent extraction of data or information relevant to their audit can reduce time in the control processes and/or increase the scope, complexity or number of controls that could be covered in the same period of time with the same human resources available.

Next, the design of the architecture necessary for the development of this tool is presented. The specific AI technologies that are recommended to be used for the development of this architecture are listed:

- Natural Language Processing (NLP)
  - Through the use of this type of technologies, the sections of the annual report (10-K) could be segmented to process specific parts of the document and search in these phrases, words or related expressions with the factors of characteristics of the goods or services and functions performed that are economically most relevant.
  - The technologies that could be used for this purpose are the following:
    - spaCy or Stanza (robust NLP libraries in Python)
    - Transformers like BERT or RoBERTa, trained in financial language (FinBERT)
    - Hugging Face Transformers (for pre-trained and ready-to-use models)

- Entity Classification and Extraction (NER) Model
  - One of the important pieces in the comparability analysis, for example, is the identification of economically relevant characteristics that allow a reliable comparison to be made; in this sense, these models can help to automatically identify and label relevant elements within the documentation under review or analysis. For example, they can help us tag economically relevant functions that the company whose annual report is being reviewed may have reported.
  - Some recommended technologies are:
    - *Named Entity Recognition (NER)* customized with spaCy or Hugging Face,
    - *Rule-based NLP + ML* combination of rules and supervised training.

- Summary and Automated Extraction,
  - It is necessary to have a summary of the key points contained in the analyzed annual reports. In this sense, it is necessary to consider technologies that help in the extraction of paragraphs of text that contain the key support of the characteristics of the goods or services, of the economically relevant functions identified within the analyzed annual report.
  - Some recommended technologies for these tasks are:
    - T5, GPT-4, BART oriented to the generation of summaries,
    - LangChain, for the generation of agents[11] have them read and process long documents.

- Semantic Search and *Embeddings*[12]
  - This tool will allow us to compare relevant texts, phrases or words between annual reports of different companies and detect similarities. This implies that phrase comparisons could be made between reports from different potentially comparable companies. This can help the auditor reduce the time it currently takes to review and process economically relevant facts on a 10-K.
  - The recommended technologies for this activity are:
    - Sentence-BERT (SBERT)
    - OpenAI Embeddings,
    - FAISS (*Facebook AI Similarity Search)* to index and search for similar texts.

- OCR and PDF Processing
  - These technologies allow converting PDF documents to text. Sometimes the documentation used for analysis consists of files that have not been properly digitized. Consequently, it is necessary to transform your original presentation into digital text.

11 In the context of LangChain and other generative Artificial Intelligence frameworks, an agent is an autonomous or semi-autonomous entity based on a language model (such as GPT or RoBERTa) that can reason, make decisions and execute actions to achieve a specific goal.

12 AI doesn't directly understand human language like we do. So, in order to process words or phrases, they must be converted into numbers. An *embedding* it is a way of transforming words or texts into vectors of real numbers in a way that captures their semantic meaning. For example, the word "cat" would be represented something like this: [0.24, −0.20, 0.59, ..., 0.10]

In conclusion, through the implementation and use of these technologies, it is proposed to develop tools to support the work of transfer pricing supervisors in their control tasks related to comparability analysis.

3.2. Sources of information and data

Internal data of the tax administrations (database of declarations, financial statements, local reports, country-by-country reports, etc.). External data (databases of comparables, financial information of third parties, sectoral economic reports, etc.).

One of the main challenges is that the implementation of the arm's length principle and the control of transfer prices has to do with the availability of information; either this is due to its scarcity or the existence of this but its difficulty at the time of reading, understanding or processing it. For example, the absence of qualitative information in annual reports of potentially comparable companies or the existence of annual reports in languages other than Spanish or English, as in the case of Japanese or Chinese companies. The fact that the information is presented in a language very different from those usually used in Latin America and the Caribbean within the analysis of transfer prices can complicate the availability of comparables or even though these can be used to make the comparison and finally the determination of compliance or not with local tax regulations.

It is precisely in the face of the aforementioned problem that the development of tools based on artificial intelligence can be of important help to audit teams in the field of transfer pricing of tax administrations. Training tax administration officials in languages other than Spanish can mean additional time and resources to those available. It is in this scenario that a tool based on technologies related to artificial intelligence would help to translate and present documentation to be used by auditors.

The development of the tool can use the information available to the internal of the tax administration. One of the valuable resources that the Institution has is access to a large amount of organized and processed data (*Big Data*) that taxpayers report on their tax returns and financial statements. Information on statements and financial statements could provide the input to detect typical and atypical patterns or structures. In a more advanced scenario, a historical compilation of audit approaches and results could help identify and resolve control processes, cover a larger group of taxpayers or economic sectors with risky potential. In addition, all the information that a tax administration possesses, considering its access to electronic invoices, can provide a great source of information for the identification of usual as well as new risks.

Some of the information sources that tax administrations could use for the design and implementation of an artificial intelligence-based tool are:

- Virtual invoicing system (electronic invoicing),
- National registry of taxpayers,
- Tax returns,
- Previous audits (conventional and transfer pricing),

- Financial statements presented,
- Buying and selling books,
- Registration of final beneficiaries or shareholders, etc.

External sources can also be added to these sources for some administrations and that require their obtaining through information exchange agreements; such as, for example:

- Customs, foreign trade,
- Public registry,
- Intendencies of companies or companies,
- The financial system, etc.

On the other hand, an important source of information corresponds to those that are international, for example, freely accessible databases or information shared with other tax administrations in the region or the world. In this sense, it is very useful for countries to be able to participate in spaces and mechanisms for the exchange of information at the international level. For example, one of those spaces is the CbC MAAC (*Multilateral Competent Authority Agreement on the Exchange of Country-by-Country Reports*).

3.3. Data processing and selection

Data cleaning and standardization techniques. Selection of relevant variables (profitability margins, financial ratios, cost structure, functions and risks of the entity, etc.). Validation and quality assurance of the sample.

When using bases of comparable companies such as, for example: Capital IQ, Royalty Range, Orbis, Super of Companies (in some countries) or from internal sources, we will not find the information in different formats, currencies or using different fiscal periods. The first thing that must be done is to eliminate empty or duplicate records; to do this, AI models usually use different approaches to identify data that does not follow a certain or expected pattern. Techniques such as *Mahalanobis*, a distance measure that considers the correlations between variables, or *Isolation Forests,* an algorithm based on decision trees that isolates points more quickly than other normal ones. Then comes the imputation of missing values with self-coding neural networks, a methodology that preserves the statistical structure without inventing data lacking logical support.

For monetary standardization, a Python pipeline can be used that extracts historical exchange rates using an API and documents each conversion applied.

Once the dataset has been cleaned, we can move on to determining which ratios truly capture value creation among related parties. Algorithms of *feature importance* (random forests, *gradient boosting*) classify dozens of indicators and highlight those that explain the greatest variance in EBIT or ROA. It should be noted that the final decision on the selection of the best indicators will always remain with the analyst; the AI will propose however the expert will decide.

The next thing will be to check the consistency with local regulations. AI may suggest discarding the use of gross margin, but if the valuation method based on segregated gross profit is legally appropriate, it will need to be considered; regulations should take precedence.

With the sample of pre-selected comparables, robustness tests would be performed: *k-fold cross-validation* (cross-validation technique that divides the data into k parts, trains and tests the model multiple times to ensure that it works well on different subsets of data) to verify range stability, influence analysis to discover lever observations and *bootstrapping* to estimate confidence intervals. The AI runs thousands of iterations in a very short time, but it is the expert who will interpret whether the atypical observations reflect a valid economic reality or a reporting error.

Traceability is another very important issue. Tools of *data lineage* record each transformation from the original CSV file to the final table that feeds the adjustment sheet. This process will allow those involved with the tool to know the origin of the data and results by providing a detailed record of their processing.

AI should not replace the expertise and experience of the transfer pricing expert; however, it should spare you the heavy lifting and help you by revealing invisible patterns. Cleaning and standardizing data with robust algorithms, selecting variables using important techniques and validating the sample with automatic tests would allow delivering technically accurate and, above all, better supported reports to the tax administration.

3.4. Technical analysis

Predictive and classification models: Identify transactions with a high probability of default or risk. Outlier detection: Use of clustering algorithms or statistical methods to find outliers in profit margins or cost structures. NLP: For the extraction of relevant clauses in contracts of related parties, identification of terms that could indicate a tax risk. Rules-based expert systems: To support decision-making according to local regulations and OECD guidelines.

In the case of transfer pricing, tools based on technologies involving artificial intelligence have a significant impact opportunity. For example, the use of NLP would allow the processing of documents, annual reports, extensive and on which one of the key parts of the application of the arm's length principle depends, such as the comparability analysis. In addition, this technology would be used to analyze contracts or corporate documents in which there may be relevant data and information to identify the conditions agreed or imposed between the related parties and that are the subject of fiscal control.

The NLP technology (*Natural Language Processing*) is a specialized branch of artificial intelligence aimed at intertwining human communication with machines' understanding of that communication. That is, it focuses on helping computers interpret, process and respond to human language through algorithms and computational models. This field breaks down language into structured components – such as syntax, grammar and semantics – to interpret its meaning and context. As a result, natural language processing (NLP) powers applications such as automated customer service systems, text analysis tools and speech recognition technologies.

A transfer pricing audit can mean reviewing more than a dozen documents with extensions exceeding 50 or 60 pages in Spanish or English. The review of this documentation can take between one to several weeks of the auditor's work. The use of NLP in a tool will allow the analysis of this documentation in much less time than the one mentioned above.

3.5. Technological tools

Platforms and libraries (Python, R, Apache Spark, etc.). Selection criteria (scalability, support, cost, compatibility with existing infrastructures).

Transfer pricing control in tax administrations requires intensive analysis of financial, operational and commercial data. In this context, artificial intelligence-based technologies offer an unprecedented opportunity to improve the efficiency and accuracy of analysis, especially in developing countries, where human and technological resources are often limited. The adoption of AI tools can facilitate the automation of processes, the detection of risks and the identification of hidden patterns in operations between related parties.

Among the most relevant platforms and libraries for the implementation of AI in transfer pricing, open-source tools such as Python, R and Apache Spark stand out, due to their wide adoption, active community, low cost and compatibility with information technology infrastructures.

Python is currently the most widely used programming language in data science and artificial intelligence. It has a very robust ecosystem of specialized bookstores, such as *scikit-learn* for algorithms of *machine learning*, pandas for structured data manipulation, Transformers and Sentence Transformers for natural language models, and TensorFlow or PyTorch for deep neural networks. These tools allow to build models that analyze texts of transfer pricing documentation, compare functional descriptions or detect anomalous behavior in financial margins.

Meanwhile, R is a powerful tool for advanced statistical analysis and visualization. Although it has a lower focus on deep learning models compared to Python, it is still useful in academic or institutional environments with a statistical tradition. Libraries such as caret, randomForest or tidymodels are suitable for creating supervised and unsupervised models, which can be useful in the segmentation of groups of companies or the evaluation of comparables.

Apache Spark stands out for its distributed processing capacity of large volumes of data. It is particularly relevant in contexts where the analysis of large databases of transactions, information statements or financial information requires scalability and speed. Its MLlib module allows to apply machine learning techniques in Big Data. In addition, Spark supports both Python and R through APIs such as PySpark or SparkR.

As for the selection criteria for these technologies, it is crucial to consider the degree of scalability of the solution, especially if the tax administration foresees a growth in the volume and diversity of data to be analyzed. Also, community and technical support is vital to solve errors and keep the models updated. Both Python and Spark have active global communities and abundant online documentation, making it easy to implement even with small teams.

Cost is another determining factor. Open-source solutions offer a significant advantage over proprietary platforms, as they allow to build analytical capabilities without commercial licenses. This is especially relevant for developing countries, where the public budget is limited. However, it is also important to consider the training and technical maintenance costs of the personnel who will use and maintain these tools.

Finally, compatibility with existing infrastructures should be carefully evaluated. Solutions that run on desktops, on-premises servers, or low-cost virtualized environments (such as public cloud virtual machines) allow for faster and cheaper deployment. Python and Spark, for example, can run in modest environments, and scale as resources allow.

In conclusion, the use of technological tools based on artificial intelligence such as Python, R and Apache Spark offers a viable, scalable and accessible solution to improve transfer pricing control in tax administrations of developing countries. The appropriate selection should consider not only the technical power of the tool, but its operational sustainability within the institutional and budgetary context of the country.

4. Legal and Ethical Framework

The use of tools based on technologies related to artificial intelligence must consider at the same time the legal and ethical implications of using a large amount of data from sources whose privileged access can only be had by a tax administration. That is, it is also necessary to address the issue of the use of artificial intelligence from a legal and ethical point of view, for example, taxpayer data in their tax returns for the creation of AI models or algorithms, risk control and/or decision-making.

4.1. Data protection and confidentiality

Local and international regulations on confidential data. Access requirements and policies.

The implementation of technological tools based on artificial intelligence (AI) to support the analysis of transfer prices represents a strategic opportunity for tax administrations in developing countries. However, this digital transformation must be accompanied by robust policies and practices that guarantee data protection and the confidentiality of the tax, financial and commercial information that companies provide to the tax authority.

Transfer pricing analysis involves the processing of sensitive information about transactions between related parties, including functional descriptions, financial margins, business strategies, intra-group contracts and country-by-country reports. This information is not only of a confidential nature due to its economic and strategic content, but is also subject to legal confidentiality rules, both nationally and internationally, including provisions established in the OECD Guidelines on Transfer Pricing and Information Exchange Agreements between tax administrations.

In this context, the use of AI tools such as natural language models, machine learning algorithms and massive data processing platforms requires the adoption of specific measures to prevent leaks, unauthorized access and misuse of information. These measures must be aligned with principles such as data minimization, purpose limitation, transparency of processing and system security.

One of the main challenges for tax administrations in developing countries is to ensure that technological solutions are implemented under secure schemes, even when using open-source tools or cloud services. It is essential to ensure that the analyzed data does not leave the jurisdiction without the appropriate controls, and that the development, test and production environments have anonymization mechanisms[13], encryption and access control.

Likewise, if generative AI or advanced models such as GPT are used, it is necessary to confirm that the processing is carried out locally or on platforms that respect the confidentiality of the data in accordance with national laws and the

13 Anonymization is a data processing technique that deletes or modifies identifiable personal data to obtain anonymous data that cannot be associated with any individual.

confidentiality agreements signed. Many commercial AI services require sending data to external servers for analysis, which could be incompatible with the protection of tax data unless there are appropriate contractual clauses and robust technical controls.

On the other hand, it is advisable to establish audit and traceability protocols that allow documenting how the data is processed, who accesses them and for what purposes. This not only strengthens institutional security but also reinforces taxpayers' confidence that the information they provide will be used exclusively for legitimate tax purposes and will not be disclosed or shared without authorization.

In parallel, the human resource that operates these tools must be trained not only in technical aspects, but also in the legal and ethical obligations related to data protection. Security is not just a matter of software, but of organizational culture.

In conclusion, data protection and information confidentiality are fundamental pillars in the application of artificial intelligence in the analysis of transfer prices. For developing countries, where technological modernization coexists with budgetary constraints, it is essential to adopt a prudent and structured approach that ensures that the use of AI is maintained within a legal, ethical and safe framework. Only in this way will it be possible to take advantage of the potential of these tools without putting the integrity of the tax system or public trust at risk.

4.2. Biases in AI and Responsibility

Risk of bias (p. biases in sample selection) and how to mitigate them (data quality review, fairness approaches in AI). Accountability and transparency in algorithm-assisted decision-making.

The use of artificial intelligence (AI) tools in tax administration offers great advantages to optimize complex processes such as transfer pricing analysis. However, it also introduces risks related to algorithmic biases and responsibility in automated decision-making, especially relevant in the context of developing countries, where technical and regulatory resources may be limited.

Biases in AI can arise at different stages of a system's development cycle: from the collection and preparation of the data to the design of the algorithms and their practical implementation. In transfer pricing analysis, these biases can affect the selection of comparables, functional analysis or margin assessment, which could lead to unfair, inconsistent or even discriminatory results against certain types of companies, sectors or jurisdictions.

A common example is the bias in the selection of the data sample. If the data used to train AI models comes mostly from multinational companies in developed countries, the learned patterns might not reflect the reality of business operations in emerging economies. Similarly, if the financial reports used as input contain errors or are biased by specific accounting practices, these defects can be replicated and amplified in predictive models.

To mitigate these risks, it is essential to establish solid data assessment and cleaning practices. This includes reviewing the representativeness of the samples, eliminating anomalous records, balancing classes in supervised models and

applying imputation or anonymization methods that do not distort the information. In addition, it is recommended to use approaches that ensure that AI-based systems do not systematically favor or discriminate against individuals or groups and that make it possible to identify and correct unwanted inequalities in the model's results. These approaches may include techniques such as data reweighting, cross-validation with ethical criteria or the use of equity metrics (*fairness metrics*) in the performance evaluation.

Accountability and transparency in the use of algorithms are equally crucial. When AI tools are used to support decisions regarding control, adjustments or transfer pricing audits, it is necessary to ensure that the responsible officials understand how and why the system reached certain conclusions. This involves not only documenting the model design, but also implementing algorithmic explainability mechanisms (*explainable AI*) that allow to interpret the predictions or classifications generated.

Institutional responsibility must be established from the design of the system. Although an AI tool can offer useful recommendations, the final decision should rest with a properly trained official, who can exercise professional judgment, validate the results and be accountable for the actions taken. In this way, the blind delegation of authority to opaque systems is avoided and the legitimacy of fiscal action is reinforced.

In the case of tax administrations in developing countries, where legal and ethical frameworks on AI may still be under construction, it is advisable to adopt guiding principles from the beginning: fairness, non-discrimination, auditability, security and meaningful human control. These principles should be integrated into institutional protocols and guide both the internal development of tools and the acquisition of external technological solutions.

In conclusion, although artificial intelligence can be a powerful ally for the analysis of transfer pricing, its use must be accompanied by measures to prevent bias and ensure responsibility in decision-making. Only with an ethical, transparent and equity-focused approach will it be possible to achieve a fair and effective technological transformation in the tax field.

5. Pilot Program or Application Example

5.1. Objectives of the pilot plan or example of application

Validate the technical feasibility. To measure the impact and efficiency in specific cases of transfer pricing control.

The objective of this pilot or application example is to show the feasibility of the creation, use and impact of tools based on artificial intelligence in the analysis of transfer prices.

5.2. Description of the pilot or application example

Description of the tool developed based on AI to assist in the documentary analysis related to transfer pricing.

The development of this pilot or example of application of AI-based technologies for the analysis of transfer prices focuses on the use of Natural Language Processing (NLP) to identify specific text within a document; basing this search on instructions given to the model previously.

This tool seeks to help the transfer pricing analyst in the review and processing of extensive documents used in transfer pricing such as annual corporate reports. More specifically, analyze documents submitted by companies listed on any of the stock exchanges in the United States of America to the Securities Agency (SEC) of that country. These documents are called 10-K or Annual Reports and have a defined structure.

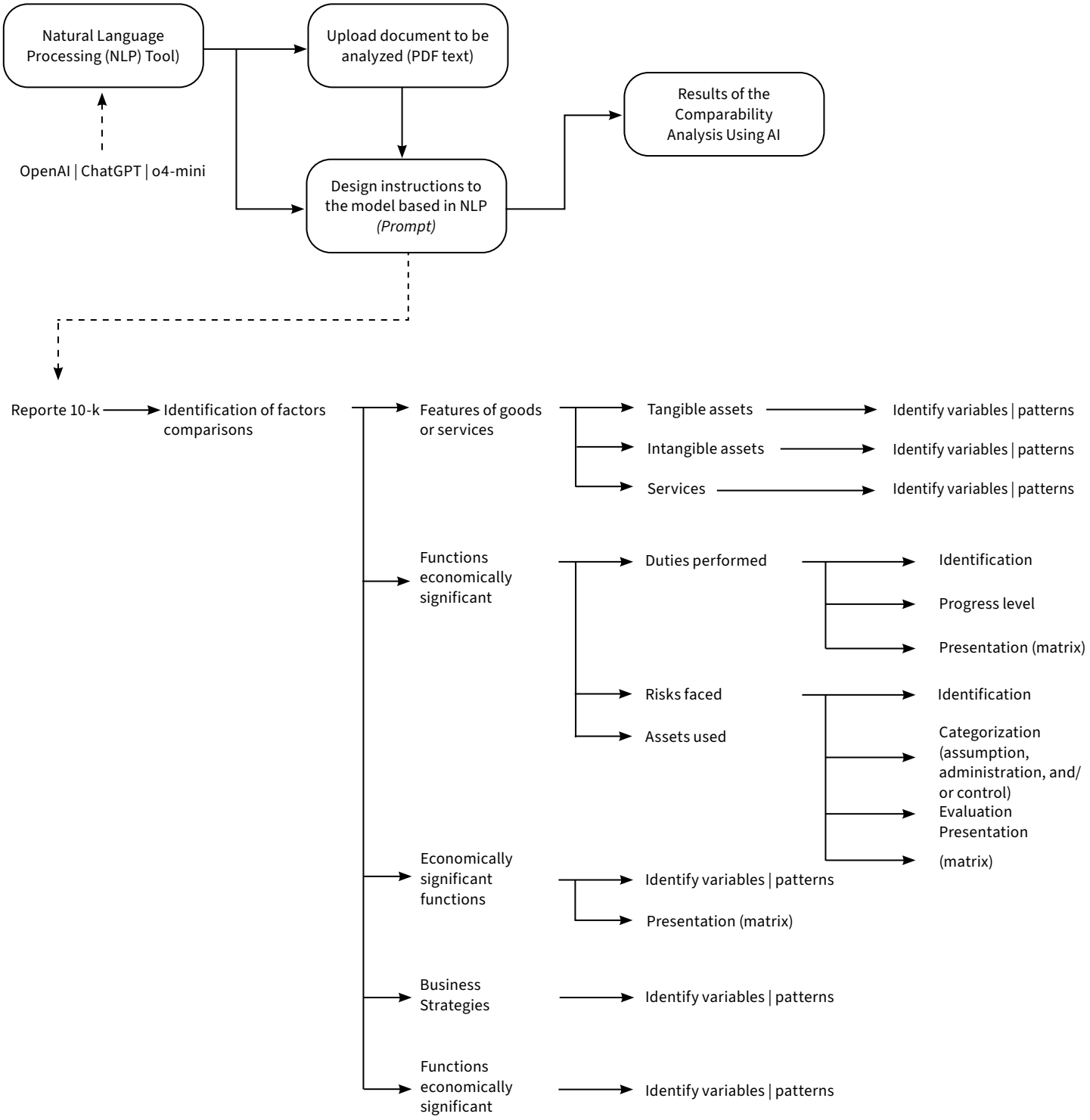
These documents will be used for processing given their standardized structure. This factor will allow the model and instruction design (*prompt*) to be applied in the most effective manner.

This technological tool is based on Natural Language Processing (NLP). A commercial platform is used; that is, a paid or subscription AI service to access the most advanced NLP models. The service selected to be used in this example is the ChatGPT tool from the company OpenAI; specifically, the o4-mini model. This project was developed using the option offered by the subscription version of this service to access the creation of custom models.

The creation of the custom model implies the possibility of uploading a document, in this case it will be the 10-K document of a selected company, and that this is analyzed based on the specific instructions given in another document uploaded to the custom model. The instructions with which the model is programmed to analyze the 10-K document based on these are attached in an attached TXT document.

The following diagram shows the design of this tool (Appendix No. 1):

Illustration 2. Design outline for an AI-powered 10-K document analysis tool



Source: *Created by: Jairo A. Godoy G.*

Three proof documents were used; that is, 10-K annual reports of companies commonly used in transfer pricing analyses. On average, each document had more than 146 pages with qualitative and quantitative data, written in English language. The analysis of one of these documents and the identification of key information to develop the analysis of the five comparison factors that are part of the comparability analysis according to the OECD technical guidelines and what is indicated in the local regulations of many tax administrations in the Region can take a tax administration official between two and three days on average. However, when using this tool, the analysis and identification time of the relevant information for each comparability factor plus the corresponding translation into Spanish was less than 15 seconds on average.

In the following images you can see fragments of the results that the model showed based on the instructions loaded in it to analyze the 10-K annual report of the company Cardinal Health Inc. Illustration #3 shows the result that the model presents after following the instructions to identify the main tangible goods based on a series of variables that allow cataloging the identified as economically relevant.

Illustration 3. Results of the AI analysis of the "Characteristics of Goods and Services" section of Cardinal Health Inc.'s 10-K.

1. Tangible assets						
Characteristic:	**Generics**	**Branded**	**Specialty**	**OTC (CPC 346)**	**Medical: Products CH**	**Medical: Brand**
economically significant	**(Cod. CPC 35424)**	**(Cod. CPC 35421)**	**(CPC 35425)**		**Brand (CPC 4214)**	**National (CPC 4214)**
Nature of the good	Generic drugs	Patented drugs	Niche drugs	Over the counter drugs	Gloves, bags of incontinence, sutures, etc.	Third-party equipment and supplies
Grupo/subgroup	Generics by molecule	Branded by molecule	Oncological, immunological	Analgesics, vitamins	CH Brand: examination, hospital, patient	Brand Products (BD, Medline...)
Service life / caducity	1–3 years	2–5 years	6–24 months	2–4 years	2–3 years	2–5 years
Regulatory requirements	FDA 503A/B, DEA licenses	FDA NDA/ANDA	FDA BLA/Section 505(b)(2)	FDA OTC Monograph	FDA 510(k) / PMA By product	FDA 510(k) / PMA by product
Level of service (fill rate)	≥ 98 %	≥ 99 %	≥ 95 %	≥ 98 %	≥ 99 %	≥ 98 %
Gross margin (€)	2–6 %	8–12 %	15–25 %	10–15 %	20–35 %	5–15 %
Price sensitivity	Alta	Medium-high	Very high	Media	Medium high	Alta

Source: "Pharmaceutical segment distributes branded and generic pharmaceutical, specialty pharmaceutical and over-the-counter healthcare and consumer products" 10k2024_CardinalHealth

"Medical segment manufactures, sources and distributes Cardinal Health branded medical, surgical and laboratory products..." 10k2024_CardinalHealth

Source: Result NLP ChatGPT o4 Model-mini–Comparability Analysis designed by Jairo A. Godoy G.

The following illustration shows the results of the analysis of the aforementioned document for the identification of Cardinal Health Inc.'s economically relevant intangible assets and services.

Illustration 4. Results of the AI analysis of the "Characteristics of Goods and Services" section of the 10-K for Cardinal Health Inc.

2. Intangible assets					
Intangible asset	**Who develops?**	**Who's doing better??**	**Who maintains it?**	**Who protects?**	**Who exploits?**
Marca "Cardinal Health"	Equipo de Branding Corporativo	Marketing & I+D internal	Legal & Compliance internal	Legal department, USPTO	All departments
Software Wavemark *(CPC 8312)*	IT team and developers	IT Team and developers	IT internal	SW Patents and licenses	División Medical (clients)
Red Oak Sourcing JV	Legal & Financial from CH y CVS	(CH/CVS) Alliance team	Red Oak Operations	JV agreements, external attorneys	CH y CVS Health
Know-how radiopharma	Nuclear & Precision Division	Internal research	Internal Nuclear Division	NDAs and compound patents	Nuclear pharmacies & clinics

Source: "Business" sections in Form 10-K 10k2024_CardinalHealth

3. Services						
Category of service	**Classification (NAICS)**	**Personalization**	**Asset intensity**	**Frequency**	**Contract duration**	**Oper. Margin**
Distribution pharmaceutical	424210	Baja	Logistics & Warehousing	Continuous	Ren. annual	1–3 %
Repacking and lot-chargeback	541380	Media	Repackaging plants	Continuous	Long contract	4–7 %
Pharmacy services hospitals	621510	Alta	Pharmaceutics, IT	Continuous	3–5 years	6–10 %

Source: NLP ChatGPT Model Output o4-mini comparability analysis designed by Jairo A. Godoy G.

Illustration #5, on the other hand, shows the result delivered by the AI model on the identification and evaluation of execution of the economically relevant functions of Cardinal Health Inc., and additionally, the reference text (original) that allows to identify inside the 10-K the support that justifies the presented result. This allows the analyst to search for this text in the annual report and personally evaluate whether the model result adheres to what is technically required by both the local transfer pricing regulations and the technical guidelines on the subject embodied in the OECD Guidelines.

Illustration 5. Results of the AI-based analysis of the functional analysis section of Cardinal Health Inc.'s 10-K.

5. Functions performed					
Function	**Completely**	**Mostly**	**Partially**	**Nothing**	**Evidence**
Purchases/ Procurement	X				"The Pharmaceutical Segment generic program includes... generic pharmaceutical contract manufacturing and sourcing costs" 10k2024_CardinalHealth
Fabrication/ Manufacturing	X				"Our Medical segment manufacturing sources and distributes Cardinal I branded medical... products" 10k2024_CardinalHealth
Distribution/ Logistics	X				"Through its Pharmaceutical Distribution division, distributes... pharmaceutical and over-the-counter healthcare and consumer 10k2024_CardinalHealth
Marketing and sales		X			"We connect patients, providers, I pharmacists and manufacturers fc integrated care coordination" 10k2024_CardinalHealth
Regulatory and Compliance		X			"This segment also operates under regulations issued by DEA, FDA, and state boards of pharmacy" 10k2024_CardinalHealth
Finances Administration	X				MD&A Presentation, Financial Statements, Active Liquidity Management
1+D/Product Development			X		There is no evidence of internal pharmaceutical research; the company focuses 10k2024_CardinalHealth
Customer service and support	X				"Provides consulting, patient support and other services for specialty pharmaceutical products"

Source: *Result NLP ChatGPT o4 Model-mini comparability analysis designed by Jairo A. Godoy G.*

A task that is usually very demanding of time and attention to detail, in addition to English language proficiency, corresponds to the identification of economically relevant contracts mentioned in the annual reports by companies. These contracts may contain relevant information for the analysis of comparability in transfer prices since they may contain data related to the operations of tangible, intangible goods and/ or services analyzed. The following illustration shows the result that the AI-based tool provides and helps to identify. In addition, it provides selected data previously configured in the instructions given to the NLP model; in addition to revealing the response translated into Spanish.

Illustration 6. Results of the AI-based analysis of contract clause analysis of the 10-K from Cardinal Health Inc.

8. Analysis of Contractual Clauses					
Contract	**Object/goal**	**Parties/Roles**	**Term**	**Amount/Engagement**	**Form of payment**
Red Oak Sourcing, LLC	Generic sourcing at large scale	Cardinal Health y CVS Health (co-venturers)	Until June 2029	Not disclosed publicly	Based on rates of service
National cooperation Agreement on opioids	Solve most of state and local lawsuits over opioids	CH, 51 states and the Cherokee Nation	18 years (until 2038)	Up to $6.3 billion	Staggered
Line of credit and commercial role	Provide liquidity and support commercial paper program	CH and a banking union	Credit until 2028; open paper	$2 billion each	Based on daily use
Repurchase agreement Of shares	Allow CH to repurchase own actions for return to shareholders	CH and shareholders	Through December 31, 2027	$3.5 billion authorized	Open market
Cooperation Agreement with Elliott	Strategic and corporate governance review	CH y Elliott Associates	Until July 15, 2024	$0 direct, costs of assessment	Expenses according to rates

***Source*:** Result NLP ChatGPT o4 Model-mini comparability analysis designed by Jairo A. Godoy G.

Finally, a contribution that can significantly help reduce the time spent analyzing an extensive document such as a company's 10-K is the identification of economically relevant elements about the economic circumstances surrounding the operation of the company reporting the document. Illustration #7 shows the result that the model delivered.

Illustration 7. Result AI analysis of the factor 10-K economic circumstances analysis of Cardinal Health Inc.

10. Material Economic Circumstances		
Circumstance	**Economic Significance**	**Ubicación en Documento**
Inflation and supply chain costs	Increase in transportation, raw materials and labor Pressure on margins in Medical sector	"Medical segment profit was adversely impacted... net inflationary impacts" 10k2024_CardinalHealth
Consolidation in the health sector	Greater negotiating power of large chains and GPOs; risk of loss of contracts	"Our two largest GPO relationships... accounted for 16% of our revenue in fiscal 2023" 10k2024_CardinalHealth
Regulation traceability and serialization	Implementation of the DQSA and CE Mark under MDR; increase compliance costs and complexity of chain	"Title 2 of the DQSA... tracing pharmaceutical products..." 10k2024_CardinalHealth
Interest rate environment	Increments in cost of financing and in performance Required by investors	"A 50-basis-point increase... interest expense of $6 million" 10k2024_CardinalHealth
Currency volatility	Impact financial statements and results of locations in international subsidiaries	"The potential maximum loss in earnings... $5 million... transactional exposure" 10k2024_CardinalHealth

Source: Result NLP ChatGPT o4 Model-mini–Comparability Analysis designed by Jairo A. Godoy G.

In this way, it is demonstrated how an AI tool based on the use of Natural Language Processing (NLP) with the proper instructions can help process and analyze extensive documents that are used in transfer pricing over the comparable ones used to demonstrate compliance with the arm's length principle with them. This also shows that the use of AI in transfer pricing can help reduce the time that supervisors must allocate for this work, as well as make their work more effective and technical.

6. Conclusions and Recommendations

6.1. Main findings

This study points out that transfer pricing represents a significant problem for both multinational companies and tax administrations due to its inherent complexity, its subjectivity in determining and the considerable volume of information required to document intra-group transactions.

An important finding is the recognition that traditional tax audit tools, although effective to some extent, are increasingly insufficient in the face of the increasing volume and complexity of intra-group operations in the global economy. The difficulty of tax administrations to review, process and validate extensive documentation in different languages is highlighted, a task that traditionally consumes a lot of time and significant human and technological resources.

In response to this challenge, this study shows the potential that artificial intelligence (AI) can have, particularly through technologies such as *Machine Learning*, Natural Language Processing (NLP), *Deep Learning*, graph analysis and *Big Data*. International reference experiences, such as those from the United States, the United Kingdom, France and Austria, show that these tools can significantly increase the efficiency, accuracy and scope of tax audit work.

Finally, it was shown through a specific pilot that the use of NLP-based tools, such as ChatGPT, allows analyzing extensive financial documentation in seconds, a task that would typically take days or weeks. Automation using AI not only significantly reduces the time required for the audit but also improves the quality and consistency of the analyses, decreasing the subjectivity in the interpretations.

6.2. Policy and strategy recommendations

Based on the aforementioned findings, a number of specific policies are recommended for the effective implementation of AI in tax administrations:

- Development of Technological Infrastructure: It is recommended to invest in robust data processing platforms, ensuring scalability and compatibility with existing systems to handle large volumes of data efficiently.
- Adoption of NLP Models: It is suggested to implement Natural Language Processing technologies for the analysis of extensive documents, which will significantly reduce operational times and optimize human resources for auditing. Specific tools such as spaCy, Hugging Face Transformers and specialized models such as FinBERT should be considered a priority.
- Specialized Technical Training: Staff should be trained in the practical and ethical use of AI tools. This training should cover not only technical aspects, but also legal and ethical considerations related to data protection.

- Data Protection and Confidentiality: It is recommended to implement strict security and privacy protocols that ensure the protection and confidentiality of the tax data processed. It is essential that access policies are clear, restrictive and in accordance with international data protection regulations.
- Ethical Approach and Transparency: To mitigate biases in AI, it is recommended to use cross-validation techniques, equity metrics and explainable approaches in the models used. Transparency in algorithmic processes should be mandatory to ensure confidence in the results.
- International Cooperation: It is essential to strengthen international cooperation through the exchange of information and practices on the effective use of AI in tax control. Participating in global platforms such as the CbC MAAC will allow access to best practices and more advanced technologies

6.3. Future lines of research

This paper also identifies some key areas for future research that would help to further strengthen the use of AI in transfer pricing:

- Advanced Predictive Models: It is recommended to investigate in depth the development and adjustment of specific predictive models for early detection of transactions with a high risk of tax evasion or manipulation. This would allow for proactivity rather than reactivity in monitoring.
- AI Integration with Blockchain: Exploring how the combined use of AI and blockchain technologies could ensure the integrity and inalterability of intra-group transaction records, providing an additional powerful tool for auditing and control.
- Robotic Process Automation (RPA): Deepen the study on how to effectively implement RPA for repetitive tasks related to the collection and consolidation of documentation, which would allow supervisors to concentrate on more complex analysis tasks.
- Adaptation of AI Models to Local Contexts: Investigate how to adapt successful international AI models to specific local contexts, especially in developing countries, adjusting them to particular economic, cultural and technological realities.
- Ethical and Social Impact Assessment: To deepen studies on the ethical and social implications of the widespread use of AI in control processes, particularly on public trust and the perception of tax justice.

6.4. Conclusions

In summary, the application of artificial intelligence in tax administrations offers a promising path towards a more efficient, accurate and fair control of transfer prices. Effective implementation requires strategic investment in technology, staff training, and rigorous safety and ethics protocols. In addition, continuing research will make it possible to further optimize these tools and adapt them better to specific needs, thus ensuring a more transparent and equitable future in global tax management.

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