MERCADOS y Negocios

45

ISSN-i: 1665 - 7039/ISSN-e: 2594 - 0163

REVISTA DE INVESTIGACIÓN Y ANÁLISIS ■ año 23 ■ número 45 enero-abril 2022

MERCADOS Y NEGOCIOS, año 23, número 45 (enero-abril 2022), es una revista de investigación, divulgación y análisis de publicación cuatrimestral editada por la Universidad de Guadalajara, a través del Departamento de Mercadotecnia y Negocios Internacionales del Centro Universitario de Ciencias Económico Administrativas (CUCEA), con domicilio en Periférico Norte 799, módulo G-306, núcleo Los Belenes, Zapopan, Jalisco, México, C.P. 45100. Tel.: 3770-3343, Tel./fax: 3770-3300 ext. 25607. Sitio web: http://mercadosynegocios.cucea.udg.mx/index.php/MYN/index E-mail: revistamercadosynegocios@cucea.udg.mx. Editor responsable: José Sánchez Gutiérrez, Reservas de Derechos al Uso Exclusivo del Título 04-2005-011212585100-102, ISSN 1665-7039 versión impresa, ISSN 2594-0163 versión electrónica, otorgados por el Instituto Nacional del Derecho de Autor, Certificado de Licitud de Título 12710, Certificado de Licitud de Contenido 10282, ambos otorgados por la Comisión Calificadora de Publicaciones y Revistas Ilustradas de la Secretaría de Gobernación. Este número se terminó de imprimir el 15 de enero de 2022 con un tiraje de 50 ejemplares. Las opiniones expresadas por los autores no necesariamente reflejan la postura del editor de la publicación. Mercados y Negocios aparece en el índice del catálogo Latindex 2.0; en la Matriz de Información para el análisis de revistas (MIAR), en DOAJ (Directory of Open Access Journals), en Dialnet, en tres bases de datos de EBSCO (Business Source Corporate Plus; Business Source Ultimate y Fuente Académica Plus), REDIB (Red Iberoamericana de Innovación y Conocimiento Científico) y en el Sistema de Información Científica REDALYC.

Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Editor's Letter

https://doi.org/10.32870/myn.vi45.7671.g6728

Starting from the publication of this issue *Mercados y Negocios* becomes a quarterly publication. We hope that this modification will help improve the editorial process to meet international quality requirements.

We are very happy to inform our readers that we have started the inclusion process in *Scielo-Mexico*. The task of editorial transformation has not been easy, and in this last stage, it has required modifying the flow of the editorial process. This transformation has been crowned with the opportunity to offer the reader the content of recent years in different formats through *Marcalyc*.

This issue contains four research articles and a bibliographic review, subjected to the peer-review process.

Collective Defined Contribution Schemes as an Alternative to Pension Plans, is the first article, written by Denise Gómez Hernández and Michael Demmler. It explores the financial and actuarial viability of a type of hybrid scheme known as a collective defined contribution (CDC), through the accumulation of a fund following the proposal of Aon (2020). The results show that this plan does achieve the replacement rate defined for all employees. In addition, through the same fund, profits and losses are financed so that this result prevails over time.

The second article was written by Yelly Yamparli Pardo Rozo, Octavio Hernández Castorena and Milton Cesar Andrade Adaime. Its title is *Key Factors of Competitiveness and Sustainability in Livestock Systems of The Andean-Amazonian Piedmont.* The objective was to identify factors of competitiveness and sustainability in livestock systems of The Andean-Amazonian Piedmont. In a sample of 60 farms in the area, a survey aimed at producers was run to identify internal and external factors for competitiveness and sustainability.

Data envelopment analysis was used to measure technical efficiency and an econometric model to identify the determinants of competitiveness and sustainability. The key factors of competitiveness were the profitability of the cattle and the forest extension within the farms. The main aspects related to sustainability were the reduction of environmental impacts of deforestation to increase carbon storage and the enhancement of ecosystem services. The increase of profitability and the establishment of sustainable systems of livestock production

are the rallying points to improve competitiveness and sustainability in livestock of the Amazonian foothills.

Motivation as a Driver of Customer Service: The Impact on Automobile Dealerships is the next article. Its authors are Roxana Dalila Escamilla, Adriana Segovia-Romo and Maria Mayela Terán Cázares. The objective of the research is to analyze the relationship of Motivation as a soft skill that drives Customer Service in car dealerships, specifically in sales area employees.

The survey was applied to a sample of 81 managers from the sales area of automotive agencies in the Monterrey metropolitan area. The proposed model was linear regression. The surveys were processed with SPSS Statistics. The hypothesis about the positive and significant relationship of the predictor variable and the dependent variable, in the employees of the sales area in the automobile agencies was confirmed. The suggestion is to analyze and build a complementary profile of the necessary soft skills of sales collaborators in car dealerships and other sectors.

María Angélica Cruz Reyes, Mary Xóchitl De Luna Bonilla and Vianey Chávez Ayecac wrote *Economic and social vulnerability because of Covid-19: poverty and food security,* which is the fourth article. The article's objective is to analyze food poverty and the effects in terms of vulnerability because of the Covid-19 pandemic in Mexico City from the capability approach. In the analysis stage, centrality, variability, and correlation parameters were used to identify the effects of the health crisis on food poverty.

The results corroborate that food poverty is a material and immaterial phenomenon, which impacts the economic, sociocultural, and environmental setting of the individual. The State must design strategies with different stakeholders in society for social and economic recovery, not only because of the implications of the pandemic but also because of the economic inequality among the population.

The Bibliographical Review, *Cooperate to compete successfully* was written by Renata Kubus. The content and development of the work contribute to the objective stated by the authors, that is, explaining to the reader the aspects of cooperation that substantially affect the competitiveness of companies. It is a book that condenses many aspects and leaves the reader with the interest of delving further into the details of the rational act of cooperating, its design as well as the contractual forms of cooperation.

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We thank our authors for their papers. We thank the readers for recommending and citing Mercados y Negocios, and our editorial team for not giving up in times of hard work. We want to demand more of ourselves every day and relentlessly aim for achieving more.

Tania Elena González Alvarado
Coeditor

Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Collective Defined Contribution Schemes as an Alternative to Pension Plans

Esquemas de Contribución Definida Colectivos como Alternativa de Planes de Pensiones

https://doi.org/10.32870/myn.vi45.7651.g6725

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Received: July 29, 2021
Accepted: August 22, 2021

ABSTRACT

Traditional pension plans, such as defined contribution and defined benefit, face several risks: being the most known, the increase of the life expectancy. To reduce this risk, many hybrid pensions plans have been proposed, to mitigate this risk. The objective of this study is to explore the financial and actuarial sustainability of a hybrid pension plan known as collective defined contribution (CDC) by accumulating a pension fund with the methodology found in Aon (2020). The results of the simulations in this study show that the replacement rate defined in the design of a CDC pension plan is reached by all the members in the plan. Moreover, that through the same pension fund, deficits and gains are financed by it.

Keywords: pensions; collective defined contribution; financial viability; actuarial viability.

Jel code: J08, J26.

RESUMEN

Los planes de pensiones tradicionales, como el de contribución definida y de beneficio definido, enfrentan varios retos; siendo el más conocido, el incremento de la esperanza de vida. Ante este reto, diversos planes de pensiones híbridos surgen para solucionar este problema. El objetivo de este trabajo es explorar la viabilidad financiera y actuarial de un tipo de esquema híbrido conocido como de contribución definida colectivo (CDC), mediante la acumulación de un fondo siguiendo la propuesta de Aon (2020). Los resultados muestran que este plan si logra alcanzar la tasa de reemplazo definida para todos los empleados. Además, que a través del mismo fondo se financian las pérdidas y ganancias para que este resultado prevalezca a lo largo del tiempo.

Palabras clave: pensiones; contribución definida colectiva; viabilidad financiera; viabilidad actuarial.

Código JEL: J08, J26.

INTRODUCTION

Pension plans can be classified into two large groups: defined benefit and defined contribution. This classification is given from how contributions are made to the pension plan and the benefit that will be obtained at the time of retirement. The main difference between these plans is the amount of benefit that the individual receives; since, on one hand in defined benefit plans, the member of the plan knows the amount of benefit that he or she will receive from the beginning because it is stipulated in the pension plan rules.

While, on the other hand in defined contribution plans, the amount of benefit received will be based on the value of the fund that the individual has accumulated throughout his working life. Another important difference is about who assumes the risk since in defined benefit schemes it is mainly the sponsor; while in defined contribution schemes, it is mainly absorbed by the individual (Gómez, 2015; Boelaars and Broeders, 2019; Van Meerten and Schmidt, 2018; Balter *et al*., 2018; Bennett and Van Meerten, 2019; Thurley and Davies, 2020).

It is important to point out that there is another type of plan called hybrid and that there is a transition from defined benefit plans to hybrid or defined contribution type; being the most frequent transition in the world, from defined benefit to defined contribution. This means that defined benefit plans are closing their funds to new members.

One of the reasons that have caused this change in pension systems is the increase in life expectancy since this complicates the sustainability of pension plans over time and has led to important reforms of pension systems in various countries. In this sense, the Organization for Economic Cooperation and Development (OECD) points out that pension systems must be balanced between the benefits offered and its financial sustainability. Thus, for different reasons, developed countries are the ones who have refined these pension plan systems, to face these different challenges (Gómez, 2015; Martínez-Aldama, 2013; Valero *et al*., 2011; Martínez *et al*., 2014; Alonso, 2014; Van der Zwan *et al*., 2019; OECD, 2009; Boelaars and Broeders, 2019; Bams *et al*., 2016; Balter *et al*., 2018; Thurley and Davies, 2020).

Each of the three pension plans (defined benefit, defined contribution, and hybrid) has certain advantages either for the worker, the employer, or for both. For example, employees opt for employer-sponsored pension plans because these types of plans contribute to reducing the risk of individual savings for retirement since they are developed to provide adequate resources for retirement, complemented by social security. In this way, the financial risk arising from individual retirement savings is eliminated when employer-sponsored plans invest workers' assets in a common fund, where administrative costs are also eliminated (Gómez, 2015; OECD, 2009; Wiman, 2019; Thurley and Davies, 2020).

Traditional pension plans such as defined contribution and defined benefit plans face several challenges, the best known being the increase in life expectancy. Consequently, several pension plans have been raised to solve these problems, which are classified as hybrid. Some of these are individual-defined contribution, collective individual defined contribution, and collective defined contribution schemes.

It should be noted that it has been pointed out that the collectivization of pension schemes allows to better face the challenges identified for traditional plans, compared to individual schemes. In this line, collective defined contribution pension plans have been proposed by several authors (Van Meerten and Schmidt, 2018; Wesbroom *et al*., 2013; Boelaars and Broeders, 2019; Gómez, 2015; Valero *et al*., 2011; Martínez- Aldama, 2013; Martínez *et al*., 2014; Van der Zwan *et al*., 2019; OECD, 2009; Boelaars and Broeders, 2019; Arends *et al.,* 2020; Wiman, 2019; Bams *et al*., 2016; Balter *et al*., 2018; Bennett and Van Meerten, 2019; Thurley and Davies, 2020).

The objective of this research study is to explore the financial and actuarial viability of the collective defined contribution schemes as an alternative pension plan for public or private institutions, through the accumulation of a fund with specific characteristics that are taken from finance and actuarial literature. Section 2 shows a review of the literature on the characteristics of collective defined contribution pension plans, as well as a review of an implemented plan. Section 3, shows the methodology that was used in this work to achieve the stated objective, showing the quantitative methods that exist to determine the financial and actuarial viability of these plans. Section 4 shows the results and section 5 shows the conclusions of that study.

LITERATURE REVIEW

The collective defined contribution pension plans are institutional agreements, where the contribution made by the members of the plan is an amount agreed from the beginning of the plan, as in the defined contribution plans. However, these contributions are assigned to a single fund or collective bag, which is invested collective to finance a pension amount for retirement.

Thus, unlike defined contribution plans, the fund is allocated collectively, rather than individually for each worker. Also, members of the plan are granted a pension upon retirement; which is not guaranteed and may vary depending on the performance of the fund (Wesbroom *et al.,* 2013; Boelaars and Broeders, 2019; Royal Mail Group, 2020; Department for Work and Pensions, 2019; Royal Mail Group and Communication Workers Union, 2018;

Arends *et al*., 2020; Wiman, 2019; Bams *et al.,* 2016; Bennett and Van Meerten, 2019; Thurley and Davies, 2020).

The main characteristics of collective defined contribution schemes are:

- The contributions of individuals are all brought together in a single collective fund
- The amount of the pension that the member of the plan receives at retirement is not guaranteed, long-term investments are allowed
- Several risks are shared, including longevity risk
- The plan member does not make investment decisions, which are left to the fund manager (who should be a professional)
- The pension that the subject receives will be mainly a function of the return obtained by the fund or the value of the assets
- The contributions made by the plan members and the sponsor are based on a fixed rate, which can be expressed as a fixed percentage of salary or a fixed amount.

It should be added that, although the benefits are not guaranteed, normally when they are going to decrease to meet the obligations (that is when a deficit occurs), they are adjusted based on rules which are stipulated in the contracts of the plan. Also, usually in CDC plans, the employer is not obliged to make contributions when there is a deficit in the pension plan, but it is financed collectively among its members (Boelaars and Broeders, 2019; Royal Mail Group, 2020; Department for Work and Pensions, 2019; Royal Mail Group and Communication Workers Union, 2018; Wesbroom *et al*., 2013; Arends *et al.,* 2020; Wiman, 2019; Bams *et al*., 2016; Bennett and Van Meerten, 2018, 2019; Thurley and Davies, 2020).

Some of the advantages of this type of plan, in general, are the following. These plans are simpler, since members of the plan are not involved in making investment decisions, but rather have a fund manager who is usually a professional. Due to the joint nature of the fund, it can opt in the last years of the workers' working life for investment strategies that are not so conservative, which allows it to potentially achieve higher returns. Longevity risk is shared, reducing the risk incurred by the plan sponsor.

Intergenerational risk is shared among plan members, thus allowing companies or plan sponsors to avoid significant liabilities. And, as there is a common fund, its size is greater; allowing to invest resources at a lower cost and in assets that generate higher returns. It is important to note that the fund, as it is managed by professionals, avoids the risk that unprepared individuals make investment decisions for the fund, as occurs in other types of pension schemes. In this way, incorrect decisions are avoided regarding how to save or invest the fund's assets. For these reasons, it has been noted that collective defined contribution (CDC) plans are more attractive to workers and sponsors (Boelaars and Broeders, 2019; Royal Mail Group, 2020; Department for Work and Pensions, 2019; Wesbroom *et al*., 2013;

Arends *et al.,* 2020; Bams *et al*., 2016; Bennett and Van Meerten, 2019; Thurley and Davies, 2020).

Other advantages of CDC plans are that the benefits are not purchased through annuities in the insurance market, but rather the benefits received by the members of the plan are financed from the same fund. This allows the fund to keep the assets for longer, being able to achieve higher than expected returns and save costs, such as the commission of the insurer when buying the annuity. In this way, CDC plans can provide higher pension benefits compared to other types of group schemes. It should also be noted that the combination of risks of the CDC plans allows the investment returns to be optimized in the long term, thus preventing decision-making from responding to short-term problems (Wesbroom *et al*., 2013; Thurley and Davies, 2020).

On the other hand, it has also been argued that CDC plans can provide greater benefits than an individual defined contribution plan. This is for several reasons which are mentioned below. The grouping of assets allows collective management that makes or even improves risk management. Moreover, there exists the possibility of making long-term investments at lower costs. Furthermore, CDC plans to promote less volatile benefits compared to individual defined-contribution plans (Arends *et al*., 2020; Wesbroom *et al*., 2013; Bams *et al*., 2016; Thurley and Davies, 2020). The above, indicated by Wesbroom et al. (2013), and Arends *et al.* (2020); found that CDC pension plans obtain higher benefits, are fairer, and are more stable compared to an individual defined contribution plan. Bams et al. (2016) also reached the same conclusions that Wesbroom *et al.* (2013) and Arends *et al.* (2020) but add that CDC plans are more stable and perform better in the long term than traditionally defined benefit schemes.

Also, it should be noted that longevity risk is better covered by the CDC plan than others, such as individual schemes. Since, for example, if the individual lives longer than projected, some schemes could not maintain the amount of the benefit or it would decrease; which in the CDC schemes does not occur (Arends *et al*., 2020; Bams *et al*., 2016; Thurley and Davies, 2020).

It should be added that, in the CDC schemes, benefits for employers have been identified, among which are the following. The reduction of pension costs and possible liabilities. These attract and keep workers longer in their jobs. It reduces the possibility of working beyond their retirement date and allows companies to help their workers obtain a pension that improves their quality of life. Also, it has been pointed out that the CDC schemes can help the economies of the countries since the funds can make long-term and large investments (because of the collective fund); something that other types of plans do not allow. Due to the aforementioned advantages, even unions such as the Royal Mail Group consider that these CDC plans have a better design than individual defined contribution (CDI) plans

(Department for Work and Pensions, 2019; Royal Mail Group, 2020; Wesbroom *et al*., 2013; Arends *et al*., 2020; Wiman, 2019; Bams *et al*., 2016; Bennett and Van Meerten, 2019, Thurley and Davies, 2020).

One of the disadvantages of CDC plans that should be pointed out is that different designs of collective pension plans arise. This is because the CDC name is used to designate several types of schemes that share certain common characteristics, which are described below. On one hand, the risks are shared. Also, the contribution is defined, and the benefit is not guaranteed. Likewise, there may be several types of CDC plan designs, although these must share certain characteristics such as those already mentioned, which makes their study and regulation a difficult task. However, it has been pointed out that this may not be a disadvantage and is a strength, since it shows the ability to adapt to multiple scenarios and under different circumstances (Arends *et al.,* 2020; Wesbroom *et al*., 2013).

Notably, some concerns and other issues have also been attributed to CDC plans, including the following. There are doubts about its long-term sustainability and under different circumstances such as a decrease in the number of members. Intergenerational rate may not be desirable and therefore, be confusing; since plan members may not know or understand certain concepts such as that their pension is not guaranteed, although this also is found in other types of pension schemes (Arends *et al*., 2020; Wesbroom *et al.,* 2013; Thurley and Davies, 2020).

As already mentioned, it has been pointed out that one of the concerns of the CDC schemes is that they require a continuous flow of new members. Although, plans which share this disadvantage are normally badly designed. In this sense, the models that have been used to study the CDC plans have found that these well-designed plans produce stable and fair pension benefits, even for a not continuous number of members of the plan. Also, in these models, it has been shown that a CDC plan works well upon a phase-out fund for retirees, without the need to include younger members in the plan (Arends *et al.,* 2020; Wesbroom et *al.,* 2013).

As previously noted, other concerns raised about these plans are that some concepts can be confusing to plan members; among them, that the pension is not guaranteed. Therefore, it has been said that it is important for the plan member to know that benefits are not guaranteed and that they may be less than expected. Faced with this type of risk, it has been suggested that, when designing a collective defined contribution plan, a mechanism can be implemented to help prevent high fluctuations in pensions.

This mechanism has been called a capital buffer or margin of prudence, which reduces the possibility that the pension plan will have to decrease the future pension benefit; but they could also limit the increase in the pension payment when this margin requires additional

capital. It is important to note that this mechanism is already used in the Netherlands (Thurley and Davies, 2020; Department for Work and Pensions, 2019; Royal Mail Group, 2020; Wesbroom *et al*., 2013; Bennett and Van Meerten, 2019).

The operation of this mechanism is as follows. This allows withdrawing a part of the additional benefits that would have to be granted, in such a way that once the indicated fund has been accumulated, there will no longer be a need to withdraw part of the additional benefits. Also, this may be appealing to some members, but others have noted that it can be difficult to handle. Another proposal to ensure the number of benefits of the pensioners is to buy a leveled annuity for the beneficiary with which a basic level is guaranteed; however, this comes with a fund reduction (Thurley and Davies, 2020; Department for Work and Pensions, 2019; Royal Mail Group, 2020; Wesbroom *et al*., 2013; Bennett and Van Meerten, 2019).

METHODOLOGY

To achieve the objective of the present study, which is to explore the financial and actuarial viability of a type of hybrid scheme known as collective defined contribution (CDC), through the accumulation of a fund with specific characteristics that are taken from the literature; it is proposed in the first place, a methodology for the accumulation of a pension fund of the CDC type. However, as mentioned in section 2; few authors address this issue.

According to Nederlandsche Bank (2019), these types of CDC plans must meet some of the characteristics mentioned as follows. First, there must be a set of assets with a market value at a given moment in time. Second, that for each worker there must be a level of benefit so that when this worker reaches retirement age, he or she receives a continuous benefit or pension payment. Thus, when the worker dies, the benefit payment is terminated.

For a certain period, the accumulated fund is used to determine the regulatory present value (actuarial liabilities), which is calculated by discounting all pension payments that must be made in the future, assuming that the aforementioned benefit levels are constant, assuming a discount rate similar to the real rate for a certain time.

Finally, there must be an adjustment rule which will describe how the benefit levels and the value of pensions will vary over time, and it is defined normally as the Consumer Price Index. Considering the concepts mentioned above, it can be said that a collective defined contribution scheme (CDC) is fair for all participants if the choice of the discount rate and the process of adjusting the benefits over time, implies that the value of assets is equal to the value of liabilities.

For the simulation of this type of CDC pensions, it is used the accumulation fund formula of a defined contribution pension defined in Booth *et al.* (2005) and shown in equation (1).

$$f(T) = f(0) * (1+i)^T + (1-e_1) * \sum_{t=1}^{T} c(t) * (1+i)^{T-t} \qquad (1)$$

Where:

- $f(T)$ the accumulated real value of the fund at period T
- $c(t)$ the real contribution at period t
- T the number of periods at retirement age
- i the real rate of return for each period
- e_1 the percentage of commissions on the value of the contributions

At the end of the accumulation period of a CD pension fund, this is converted into a pension, which corresponds to an annuity that determines the pension benefit corresponding to the individual or employee (Stewart and Gómez Hernández, 2008; Booth *et al*., 2005; OECD, 2017). Equation (2) shows the formula that will be used in this work to calculate the amount of the projected real pension (Booth *et al.,* 2005).

$$PRP = \frac{f(T)}{a_R * (1+e_2) * g(s)} \qquad (2)$$

Where:

- PRP is the amount of the projected real pension
- a_R is the projected annuity value at age R
- e_2 the percentage of the commission paid to the insurance company
- $g(s)$ a function that depends on the workers' salary, used to calculate the pension

According to OECD (2017), the replacement rate is normally expressed as the ratio between the projected real pension and the last salary of the worker just before retirement. Furthermore, these replacement rates are like those calculated under the assumption of a salaried career, as considered in $g(s)$, only if his or her wages are similar throughout his or her working life. On the contrary, if the worker's salary contains high variations during the working life, the pension benefit will depend on the average of these variations and not on the last salary.

To allow that the accumulation of the fund to be of the CDC type, these formulae will be adapted by assuming the characteristics proposed in Aon (2020) and which are summarized below:

- The worker will obtain a pension after working for 30 consecutive years in the company, this pension is independent of the worker's age.
- Plan contributions are 10% of the participant's salary and are paid by the employer.
- The plan's target benefit is based on 1% for each year worked and based on the participant's average salary. That is, the target replacement rate for all workers is 30% of their last salary.
- Retiree benefits are not purchased by an annuity provider but are obtained from the same pension plan fund.
- An investment policy of 60% of the assets invested in equity instruments and the remaining 40% in government bonds.

Taking these characteristics into account, the accumulated fund for each worker over the 30 years of service are calculated using equation (1). For each period, the replacement rate is calculated for those workers who meet the conditions for their retirement with equation (2); while for the remaining workers, a deferred annuity is calculated. The value of the deferred annuity is obtained from equation (3), indicated in Bowers (1984).

$${}_{n|}\ddot{a}_x = \sum_{k=n}^{\infty} v^k \, {}_kp_x \quad (3)$$

Where:

- ${}_{n|}\ddot{a}_x$ is the value of an n year deferred life annuity for a worker at age x
- v^k is the discount factor of a certain annuity and is defined as $(1+i)^{-k}$ with i the value of the annual interest rate
- ${}_kp_x$ is the probability of death of an individual at age x and taken from the mortality table EMSSA 09

At the end of each period, the subsequent process is followed to determine the value of the replacement rates calculated for everyone:

- If the replacement rates obtained are greater than 30%, then the surplus is distributed equitably among the members of the plan who have an anticipated replacement rate lower than this value; and this is where the collectivity of the fund characterizes these CDC plans. The surplus is added directly to the value of the fund of each of the workers in a proportional way, that is, the surpluses are added to each worker so that they reach the 30% stipulated in the rules of the plan. If there is a case in which the surplus is not enough for the other workers to reach the target value of 30%, this is added so that they all reach the same percentage.
- If the replacement rates obtained are not greater than 30%, the surplus of workers who are not in retirement conditions is distributed to those who are so that they reach the stipulated percentage of 30%. If there is a case in which there is no surplus or the

replacement rate does not reach 30%, then the workers will retire with their replacement rate obtained, even if it is lower than 30%.
- At the end of this process for each of the periods, the people who retire in that period stop accumulating funds, so they start their pay-off period and the process will be repeated until all participants in the plan retire.

Finally, the actuarial assumptions used to calculate the fund and the replacement rate are as follows:

- The initial value of the fund is $0, in other words, the worker begins to accumulate his fund with 0 Mexican Pesos.
- The total accumulation period of the fund is 30 years for all employees and this process is on an annual basis.
- The salary increase is determined through the value of inflation according to a forecast model based on a weighted moving average of three periods. The weighted moving average model is taken from Acosta López and Vega Castañeda (2021) and follows equation (4) shown by Wasserman (2006).

$$\hat{X}_t = W_1 X_{t-3} + W_2 X_{t-2} + W_3 X_{t-1} \quad (4)$$

Where W_i represents the weight in percentage that is applied to each of the periods and the value of each period is represented by X_i. For the application of this model, historical values from 1977 to 2019 are used.

- An annual interest rate of 2.5% (actual inflation in Mexico) to calculate the value of the life annuity.
- A rate of return is used as a vector of historical values in fixed income and equities, and, for future years, the weighted moving average model described in equation (4) is used.
- Any type of commission is not considered.

The following section shows the results of the methodology presented here. The first section shows the results of the value of the fund for each of the workers in the sample, as well as the value of the replacement rate and the year of retirement. The second section shows an actuarial analysis of the relationship between the replacement rate and age, as well as the replacement rate with salary.

RESULTS

Simulations of the fund value and replacement rates

To determine the value of the fund in equation (1) and the value of the replacement rate in equation (2) with the characteristics of a CDC pension plan mentioned in section 3, a sample of 5 workers from a database of a hypothetical institution, which will be mentioned in this work as a *Sample Institution* to maintain its anonymity. The sample of these 5 workers has the characteristics shown in table 1.

Table 1. Characteristics of the 5 workers on the sample

Number of workers	*Retirement year*	*Annual salary*
1	2023	$1,239,570
2	2025	$223,938
3	2029	$688,908
4	2031	$153,018
5	2033	$298,209

Source: Own elaboration.

16 Table 1 shows 5 plan members with very different salaries levels, as well as a 10-year difference for the first worker to retire in 2023, compared to the last one in 2033. This heterogeneity among plan members is desirable to obtain representative results. Annual salary data in the third column is shown in Mexican Pesos. As mentioned before, each year a value of the fund, replacement rate, and surpluses are calculated for each member of the plan. For each specific year, a member of the plan retires, and equation (2) is used. The difference between the value of PRP for a worker that retires that year and the worker who does not, relies on the value of a_R, as explained previously.

The results of the calculation of the fund value, the replacement rate, and the surpluses for the year 2023, are shown in table 2. Given that the first year in which there are retirements is 2023, the results show the replacement rate that is achieved by the worker who retires in that year. On the other hand, for the worker who does not retire in that year, the deferred replacement rate is shown. Thus, the first column shows the number of workers, ordered by year of retirement.

The second column shows the year in which each of them will retire, the third column shows the years of service that each of them has reached in 2023, the fourth column shows the replacement rate that each of them reaches in that specific year, the fifth column shows the surplus or deficit that each worker obtains in that year, the sixth column shows the value of the surplus in Mexican Pesos that is deducted from the worker who shows surplus (in this

caseworker 1), and that it is equitably distributed to to the other workers in an equitable way according to the rules of the plan. The last column of Table 2, shows the reevaluated replacement rate, considering the value of the reevaluated fund by adding the surplus to each of the worker's funds who presents a deficit.

It should be noted that the difference between the replacement rates in column 4 refers to the fact that for worker 1, this is the actual replacement rate with which this worker will retire, while the other 4 replacement rates refer to deferred annuities because workers 2 to 5 have not yet reached the years of service to retire.

Thus, worker 1 who retires in 2023 achieved an initial replacement rate of 39.18%, while the other replacement rates are 27.82% for the person who retires in 2025, 23.74% for those who retire in 2029, 16.91 % for those who do so in 2031 and 13% for the worker who retires in 2033.

The amount of $152,311.96 for each of the four participants who have not yet retired, is the calculation of 9.18% surplus, converted in Mexican Pesos to add it directly to the value of the accumulated fund for each worker in that specific year 2023 and start with the next calculation year 2024, to continue with the process of calculating the pension fund, replacement rate, etc.

Table 2. Simulation of the pension fund for a CDC pension plan corresponding to the year 2023.

Number of workers	*Retirement year*	*Years of service*	*Replacement rate*	*Surplus (%)*	*Surplus ($)*	*Reevaluated replacement rate*
1	2023	30	39.18%	9.18%	-	30%
2	2025	28	27.82%	-2.18%	$152,311.96	30.12%
3	2029	24	23.74%	-6.26%	$152,311.96	26.04%
4	2031	22	16.91%	-13.09%	$152,311.96	19.21%
5	2033	20	13%	-17%	$152,311.96	15.29%

Source: Own elaboration.

The results for the calculations corresponding to the years from 2024 to 2033, which is when the last worker retires, are shown in table 3. Only the results for the initial replacement rate and the surplus in Mexican Pesos from 2024 to 2026 are shown, from years 2027 to 2033 the reevaluated replacement rate is shown.

Table 3. Simulation of the pension fund for a CDC pension plan corresponding to the years from 2024 to 2033.

Number of workers	*Retirement year*	*Years of service*	*Replacement rate*	*Surplus (%)*	*Surplus ($)*	*Reevaluated replacement rate*
2024						
2	2025	29	38.71%	8.71%	-	30%
3	2029	25	28.24%	-1.76%	$83,277.09	34.06%
4	2031	23	32.94%	2.94%	-	30%
5	2033	21	20.10%	-9.90%	$83,277.09	25.92%
2025						
2	2025	30	32.51%	2.51%	-	30%
3	2029	26	29.60%	-0.40%	$55,337.22	36.30%
4	2031	24	40.90%	10.90%	-	30%
5	2033	22	24.60%	-5.36%	$55,337.22	31.34%
2026						
3	2029	27	33.17%	3.17%	-	30%
4	2031	25	34.24%	4.24%	-	30%
5	2033	23	28.23%	-1.77%	$184,219.67	35.63%
Number of workers	*Retirement year*	*Years of service*				*Reevaluated replacement rate*
2027						
3	2029	28				33.17%
4	2031	26				32.02%
5	2033	24				37.24%
2028						
3	2029	29				35.32%
4	2031	27				34.21%
5	2033	25				38.97%
2029						
3	2029	30				41.36%
4	2031	28				36.60%
5	2033	26				42.17%
2030						
4	2031	29				35.69%
5	2033	27				42.89%
2031						
4	2031	30				42.29%
5	2033	28				45.10%
2032						
5	2033	29				47.51%
2033						
5	2033	30				49.90%

Source: Own elaboration.

It can be seen from table 3 that compared to 2023 in table 2, every time more workers are reaching the target replacement rate of 30%. Another important aspect is that replacement rates eventually exceed their target value, resulting in workers obtaining a higher amount of pension. The highest replacement rate is found for worker 5, who retires with the highest amount of pension. This process seems to be logical, given that this worker is the one who receives the surpluses of the other workers and, as he or she is the last to retire in 2033, there are no more workers to distribute the surpluses left.

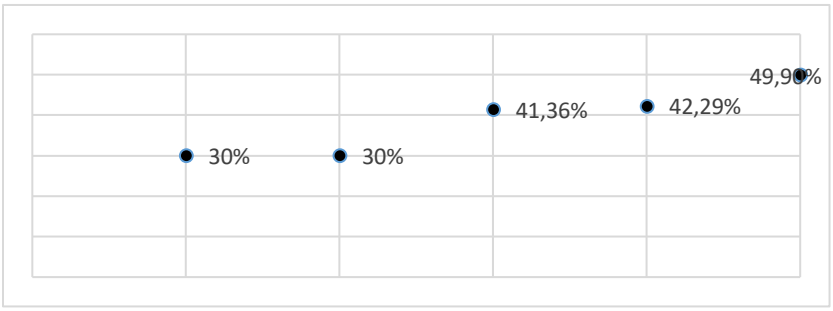
In the end, the 5 workers reach a replacement rate that is equal to or greater than 30%, which makes compliance with the rules of the plan and with the promise of a pension made to the workers. The replacement rates with which workers retire are 30%, 30%, 41.36%, 42.29%, and 49.90%; respectively, for workers 1 to 5. This result shows that the collectivity characteristic of CDC plans, is actuarially and financially sustainable; given that, with the same value of the fund without additional contributions, the target replacement rate is reached for all of them.

Actuarial analysis of the results of the replacement rate of the collective defined contribution plan (CDC)

When performing the analysis of the results obtained in the calculation of the replacement rate for a collective defined contribution pension, it can be observed that the replacement rates do not depend, at least linearly, on the age at which the worker enters the pension plan. Figure 1 shows that worker 5 who starts working at the age of 34, reached a replacement rate of 49.90%; while the two people who entered at age 40, reached replacement rates of 30% and 41.36%, respectively.

These results are obtained because the value of the fund depends entirely on the value of the rate of return assumed to simulate this value year after year. Furthermore, this is true since there are no commissions in this type of plan. That is why these replacement rates are so variable and do not depend on age. The main factor that affects the value of the replacement rate obtained is the performance of the rates of return for each year of service in which the worker contributes to the pension plan.

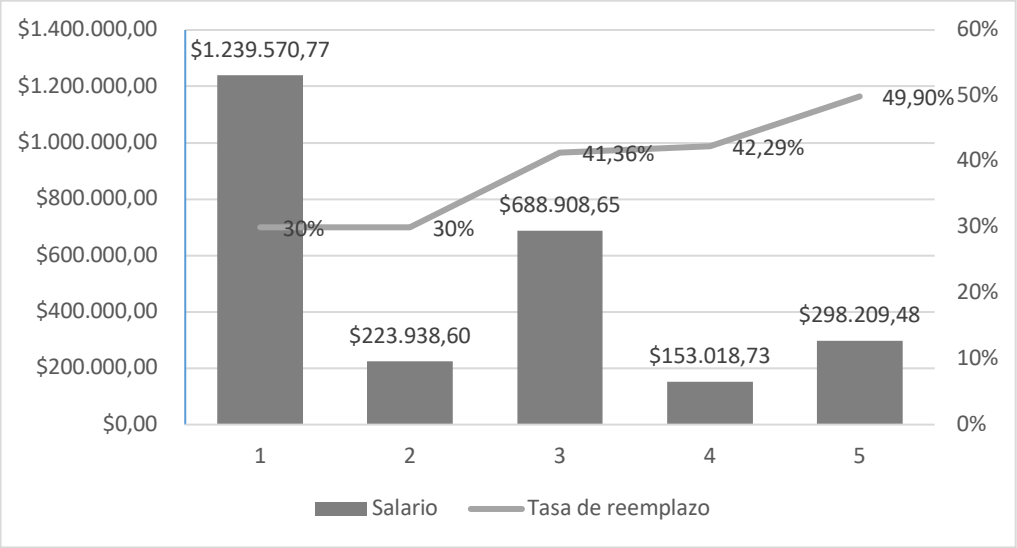
Figure 1. Final replacement rate at retirement ordered by each worker's entry age



Source: Own elaboration.

Figure 2 shows additionally the relationship between the worker's salary and the replacement rate obtained by each of them. The results show that not necessarily the higher the salary, the higher the replacement rate. This is due, again, to the rates of return obtained by each of the worker's funds during the years of contributions. Thus, worker 1 obtains lower rates of return than worker 4. In addition, worker 1 is the first to retire, so his or her earnings are distributed among the other workers; thus, the last worker is the one who obtains a higher replacement rate for having accumulated the earnings of the others and because there is no other worker to whom distribute surpluses. This model increases in the same line that the rates of return are also increasing. This makes that the simulation shown here is highly dependent on the model used to project rates of return over time.

Figure 2. Final salary vs Final replacement rate.



Source: Own elaboration.

With these results, those who have a higher replacement rate are the ones who will obtain a greater amount of money as a pension, and it would not be fair for the participants of the plan. However, the crucial element to determine this amount of money is the final salary of the workers since; for example, one of the workers who reached the lowest replacement rate (30%) gets a pension of $ 1,990,280 while the person who reached the highest replacement rate (49.90%) earns a pension of $ 1,097,826. This means that a difference of 19.9 percentage points translates into a difference of $892,453; this is by the salary difference and the difference between the ages.

CONCLUSIONS

Since traditional pension plans, such as defined contribution (CD) and defined benefit (BD), face several challenges; collective defined contribution pension plans (CDC) have been proposed as a hybrid or mixed pension plan that can function as an alternative to existing plans. However, these plans have not been fully explored, in some countries, these are already used as a novel plan design, but it has not been financially or actuarially proven. This is because in the countries where they are being explored, their plans are relatively new, and it has not been possible to verify that plan members receive an adequate replacement rate.

Then, the present study explored the financial and actuarial viability of these schemes as an alternative pension plan for public or private institutions. It was analyzed whether these types of plans manage, through the collectivity that characterizes them, to solve the heterogeneity in the replacement rates received by the members of the plan at the time of their retirement. Therefore, we sought to build a methodology like the traditional methodology of accumulating defined contribution plans (CD), adapting it to the characteristics of collective defined contribution plans (CDC) found in the literature. This exposed methodology is considered novel, since no explicit quantitative formula, equation, or method was found in this literature to model this type of plan; so, this study built from scratch the methodology as a proposed to model CDC plans.

The results found, after performing the simulation exercise with 5 hypothetical workers, that the target replacement rates of 30% were achieved by all the members who participated in the sample. This result shows that the collectivity characteristic of the plan is actuarially and financially sustainable; given that, with the same value of the fund and no additional contributions, the target replacement rate is reached for all of them. This result is relevant, although it has its limitations, mainly due to the number of employees. This limitation will be explored in subsequent work to determine if, with a greater number of plan members, this continues to reach financial and actuarial sustainability.

Another conclusion found in the study was that, when performing the analysis of the results obtained in the calculation of the replacement rate, it can be observed that these rates do not depend linearly on the age at which the employee enters work or the salary of each member of the plan. This is because the replacement rate depends on the rates of return that everyone obtained in the value of the fund for the years in which they contributed (years of service), so the model largely depends on the behavior of the historical and future rates of return. This is a powerful conclusion because equity among the members is guaranteed, as well as the fulfillment of the objective of these plans, which is the collectivity, even in adverse situations in the prices of market instruments.

The simulations carried out in this study present, among others, the limitation that the exercise was carried out with a pension plan closed to new members, which we wish to explore in a later study; to determine if actuarial and financial viability remains in a group open to new members. For now, it can also be concluded that, as we have reviewed in the literature, the CDC plans are indeed a feasible alternative for many vulnerable groups of workers who now do not have a retirement savings plan and that, thanks to the collectivity of these plans, members of the plan can have access to a pension at retirement.

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Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Key Factors of Competitiveness and Sustainability in Livestock Systems of The Andean-Amazonian Piedmont

Factores clave de competitividad y sostenibilidad en los sistemas ganaderos de Piedemonte Amazónico Colombiano

https://doi.org/10.32870/myn.vi45.7663.g6722

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Received: August 9, 2021
Accepted: December 17, 2021

ABSTRACT

The objective was to identify factors of competitiveness and sustainability in livestock systems of The Andean-Amazonian Piedmont. In a sample of 60 farms in the area, a survey aimed at producers was implemented to identify internal and external factors for competitiveness and sustainability. Data envelopment analysis was used to measure technical efficiency and an econometric model to identify the determinants of competitiveness and sustainability. The key factors towards competitiveness were the profitability of the cattle and the forest extension within the farms. The key factors towards sustainability were the reduction of environmental impacts of deforestation to increase carbon storage and the enhancement of ecosystem services. The increase of profitability and the establishment of sustainable systems of livestock production are the rallying points to improve competitiveness and sustainability in livestock of the Amazonian foothills.

Keywords: *Carbon capture, Ecosystem service, Comparative advantage.*
Jel code: Q01, Q13

RESUMEN

El objetivo fue identificar los factores tanto de la competitividad como de la sostenibilidad en los sistemas ganaderos del Piedemonte Amazónico Colombiano. En una muestra de 60 fincas de la zona, se aplicó una encuesta dirigida a los productores para identificar los factores. Se midió la eficiencia técnica y, mediante un modelo econométrico, se identificaron los determinantes de la competitividad y la sostenibilidad. Los factores clave para la competitividad fueron la rentabilidad del ganado y la extensión forestal dentro de las fincas. Los factores clave para la sostenibilidad fueron la reducción de los impactos ambientales de la deforestación para aumentar el almacenamiento de carbono y la mejora de los servicios de los ecosistemas. El aumento de la rentabilidad y el establecimiento de sistemas sostenibles de producción ganadera son el punto de encuentro para mejorar la competitividad y sostenibilidad de la ganadería del Piedemonte Amazónico.

Palabras clave: Captura de carbono, servicio del ecosistema, ventaja comparativa
Código JEL: Q01, Q13

INTRODUCTION

The livestock sector is important to the economy of Colombia and its Amazon region. It represents 1.4% of the national GDP and 21.8% of the GDP of the agricultural sector (DANE, 2021). It produces 6% of national employment and 19% of employment in the agricultural sector, and 7.9% of the head of cattle in Colombia is produced in the Amazon region (FEDEGAN, 2021). However, the livestock sector has not been competitive due to low levels of productivity and quality compared to other countries, and due to the predominance of extensive livestock models in the Amazon region (Ramírez and De Aguas, 2021). Their international markets take place with nearby countries with low-quality requirements (Pertuz-Martínez and Elías-Caro, 2019).

The Amazon region contributes about 0.9% of the country's GDP and 1.8% of the primary sector (DANE, 2021). The Amazon has fragile soils for the development of livestock (Martínez and Zink, 2004), but it has been an established economic activity since the 1950s (Arcila, 2011). Around 98% of the livestock systems in the Amazon foothills are considered traditional, 1.8% are in transition towards sustainable production models and 0.2% have some sustainable production model (agroforestry, silvopastoral, agro-silvopastoral) (Pardo- Rozo, Muñoz-Ramos and Velásquez-Restrepo, 2020).

The expansion of the agricultural frontier has caused deforestation, loss of biodiversity, species displacement, contamination of water bodies, soils, and changes in the dynamics of water and microclimatic regulation (Pardo *et al*., 2021). The emission of 26% of greenhouse gases in Colombia is attributed to the agricultural sector (Yáñez *et al*., 2020). The Colombian Amazon contains endogenous ecosystems and strategic environmental services, such as carbon capture and storage and regulation of the water cycle (Roucoux *et al*., 2017), which are important in mitigating climate change. Environmental services in the Amazon are considered a comparative advantage (Olaya, Dussan and Plazas, 2017). Therefore, the Amazon livestock systems have comparative advantages that must be harnessed to improve competitiveness.

This research aims to identify key factors of competitiveness and sustainability in livestock systems in the Amazon foothills. The research is part of the world policy of the Sustainable Development Goals (United Nations, 2015) and national, regional, and local development plans for rural development (ECLAC, FAO and IICA, 2020). The resulting information will allow the design of guidelines for decision-makers aimed at strengthening the Colombian agricultural policy.

THEORETICAL CONCEPTUAL FRAMEWORK

The concept of competitiveness. Competitiveness is a concept that, since the beginning of the millennium, has acquired greater complexity through different approaches and disciplines from the first approaches of Chandler (1962), Ansoff (1965), Krugman (1994), and Porter (1998). This last author defines competitiveness as being different or competitiveness as the survival capacity and positioning of an organization or company in the market with a performance above the average. The author mentions the creation of strategies to achieve competitiveness such as the cost leadership strategy, the differentiation strategy, and the focus strategy. Competitiveness can also be defined as a process of market integration between countries and the ability to develop the economy based on its operational productivity and the opening of markets, which improves the quality of life of the inhabitants (Porter, 2008).

For companies, sectors, or countries to become competitive, they must have operational and allocative efficiency. Among the concepts associated with competitiveness, we can find productivity, efficiency, globalization, the opening of markets, and in general the optimization of economic, technological, and economic processes. Although productivity is restricted to the optimization of a productive apparatus and does not incorporate the importance of insertion in local and international markets, a company must become competitive. Operational and administrative efficiency is also a key factor for competitiveness. Porter indicates that a country is competitive based on the performance of its industrial and business sectors.

In this sense, it is understood that the competitiveness of a country depends essentially on the development capacities of the industrial sector to achieve innovation and improvement. A competitive company optimizes its resources to achieve the maximization of productivity, economic and financial benefits and becomes innovative in the insertion of the market and lasts for an important period (Porter, 2021). Other important concepts are an absolute and comparative advantage as well as a competitive advantage. Porter (1998) differentiates these last two concepts, where he clarifies that comparative advantages are inherited, but competitive advantages are created.

There are four spheres of competitiveness: microeconomic, mesoeconomic, macroeconomic, and meta-economic levels (Ramirez and de Aguas, 2017). The microeconomic level refers to the creation of competitive advantages within the company through its management capacity, strategies, and innovation. The mesoeconomic level refers to the efficiency of the environment, the factor market, the physical and institutional infrastructure as well as the specific policies in science, technology, environment, and innovation. It is also known as

regional competitiveness. The macroeconomic level corresponds to the fiscal, monetary, commercial, exchange, and budgetary policy, which make it possible to strengthen the industrial apparatus. The fourth level, the meta-economic one, refers to the development-oriented political and economic structure, strategic views, and development plans following the international market (Gutiérrez-Rodríguez and Almanza-Junco, 2016).

Other important concepts about competitiveness and strategy are the forces of competition and the competitive diamond proposed by Porter, which later included the environmental component. In the case of Colombian, the latest reports on national competitiveness involve variables related to state efficiency, justice, corruption, infrastructure, transportation, energy logistics, digital economy, education, health, labor market, pensions, foreign trade, tax system, business finance, science, technology and innovation, green growth, and productivity (CPC, 2021).

Competitiveness variables in the livestock sector. García-García, Figueroa-Rodríguez and Mayett-Moreno (2015), identified key factors associated with competitiveness. Among these are production (productivity or performance), innovation (educational level, technology transfer, cluster), and social factors (quality of housing, politics, income, or phenomena associated with the seasonality of production). The main models and proposals to measure business and sector competitiveness consider the variables mentioned by Sarmiento-Reyes and Delgado-Fernández (2020), which are classified as financial, economic, market, technical, social, environmental.

Among the environmental variables associated with competitiveness is the existence of environmental policies, waste management, and environmental licenses. The key variables associated with competitiveness in the Colombian livestock sector between 1990 and 2010 according to Pertuz-Martínez and Elías-Caro (2019) were low prices in inputs and the dairy sector; supply in the domestic market, increased milk production; genetic crosses suitable for the environment, improved pure breeds, FMD-free meat, dual-purpose cattle, increased areas in the pasture, vertical integration of the meat chain, reduction of production costs, economic labor and incorporation of sustainable livestock production models. Some competitiveness factors, identified by Arredondo-Trapero, Vázquez-Parra and De la Garza (2016), in Latin American countries are innovation, quality of scientific institutions, business investment, academic relationships, business, and government, patents and availability of scientists and engineers.

Sustainability The concept of Sustainable Development SD was mentioned for the first time in the Brundtland Report and its subsequent institutionalization at the Rio Summit was consolidated as one of the philosophical foundations of world environmental policy. The translation of the term sustainable development for the United Nations in Our Common Future (1987), the Rio Declaration (1992), the Kyoto Protocol (1998), the Johannesburg

Summit (2002), the MDGs, and in different articles and citations made is the following: "that development that allows economic growth, increased quality of life and social well-being, without exhausting the base of natural resources, guaranteeing the satisfaction of socioeconomic and environmental needs for the current and future generation".

In environmental economics, Daly (1990) defined sustainable development as the scenario in which the capacity for human exploitation equals the capacity to sustain the environment. Pearce and Turner (1995) establish that the notion of SD could expand the concept of intertemporal efficiency, for a context where some natural resources or resources are not produced by the economic system. In this sense, SD would imply using natural resources in a way that maximizes current production without reducing its future production capacity or maximizing the net benefits of economic development subject to the conservation of natural resources over time.

Among the paradigms of sustainability, there is weak and strong sustainability. The first one establishes that economic well-being can be maintained by substituting natural capital for manufactured capital without exception (Solow, 1997). On the other hand, strong sustainability refers to the substitutability of natural capital, limited by ecological characteristics such as integrity, irreversibility, uncertainty, and the existence of critical components that make a unique contribution to the human being. These views are complementary, since in the first one there is no incompatibility between economic growth and the conservation of natural capital, under the assumption of technological evolution and innovation that allows it, which becomes an anthropocentric approach.

Measurement of sustainability in the rural sector in Latin America. Methods and techniques have emerged for measuring sustainability in the rural sector of Latin America according to López (2012). Some of them are capital analysis, life cycles, multi-criteria decisions, and partial sustainability indicators, among others. These last methods, due to the multidimensional nature of the concept of sustainability, use many qualitative and quantitative variables for their measurement and have been supported by the application of parametric and non-parametric quantitative methods.

Among the first experiences of the assessment of sustainability with indicators specifically directed to the agricultural sector in Latin America, it is possible to identify the document by De Camino and Müller (1993). The authors proposed the integration of variables, complex and dynamic functions involved with the definition of sustainability in an economic system integrated by technology, production and productivity, profitability, resources, population, and their social variables, needs, consumption, and time. Another tool developed for the agricultural sector was the Framework for the Evaluation of Natural Resource Management Systems Using Sustainability Indicators (MESMIS) that begins with a characterization of the

production system to determine the strengths and weaknesses, then strategic indicators are selected, implemented, analyzed, and evaluated to recommend improvement actions in the future (Quiroga, 2007).

Other authors such as Cherchye and Kuosmanen (2002) proposed the measurement of sustainable development by calculating the sustainability index through the construction of a frontier by analyzing the data envelopment in which several countries are compared and linked whose economic measurement variables were: the human development index, the poverty index, and a welfare indicator. The socio-political variables were the gender-related development index (GDI), the gender empowerment index (GEM). Similarly, the human well-being index and the environmental variables were the carbon footprint, the ecosystem welfare index, and the environmental sustainability index. This research used the criteria of methodological uniformity among the countries.

Variables associated with sustainability in agricultural systems. Rural productive units are social cells that mesh the dimensions of sustainability and define the development of a country in terms of its food security (Pardo *et al*., 2020). The pressure of these productive systems on natural resources is the high impact due to deforestation, changes in land use, and impacts on ecosystem services. Ecosystem services understood as the processes, raw materials, and energy that nature provides to satisfy the vital needs of living beings, are part of the inventories and potential values that the properties of the Amazonian context have (Constanza *et al*., 1997; Hartwick and Olewiler, 1998). These have been classified as support services, regulation, provisioning, and cultural services.

Supporting services are related to the functioning of ecosystem processes, which creates direct services such as photosynthesis, the formation and storage of organic matter, the cycling of nutrients, the creation and assimilation of the soil, and the neutralization of toxic wastes, among others. Provisioning ecosystem services serve as raw materials, inputs, or energy for direct consumption. Regulation services consist of water, climate, and energy cycles, carbon repositories or sinks, pollination, and oxygen production, among others. Finally, cultural ecosystem services are all those aesthetic, recreational, and cultural values that provide well-being to men, such as scenic beauty, rock pictographs, fossils, virgin forests, and natural landscapes to develop research (Reid, 2005).

In this regard, the ecosystem services immersed in rural production systems in the Amazon are related to natural and environmental resources such as forests, wetlands, surface and underground water bodies, and soil productivity, with all ecosystem products and services. that their interactions involve. Among them are water conservation, biodiversity, pest control, underground water retention, water production, medicinal banks, carbon sinks, erosion reduction, microclimate, environmental corridors, scenic beauty, historical and

ancestral values, oil reserves, aquifer recharge zone, species sightings, and soil conservation (Uribe *et al*., 2003; Toledo, Briceño and Ospina, 2018).

Variables associated with competitiveness and rural sustainability. Low agricultural productivity in Colombia limits competitiveness and actions are necessary to accelerate productivity improvements that promote rural development, production chains, sustainable practices, and internationalization (Parra-Peña, Puyana and Yepes-Chica, 2021). The authors mention the following variables for rural competitiveness and sustainability: research, development, and innovation, an environment for the adoption of technology (agricultural extension, education, and training), reforms to factor markets and employment growth non-agricultural in rural areas. Other variables used to measure competitiveness and sustainability in rural areas can be summarized into the following: development indices, quality of life index, index of unsatisfied basic needs (INBI), indicators of governance, index of concentration of income and territory (GINI); efficiency indicators, profitability indicators, ecological footprint, CO2 emissions, biodiversity index, carbon storage levels. These variables are economic, social, political, environmental, and technological.

METHODOLOGY

The study area was the rural area of Belén de Los Andaquíes, Caquetá, located in the Amazon foothills in southern Colombia. The methodological design of this research is quantitative due to the use of statistical techniques (descriptive and inferential) and linear programming and diagnostic tools since the information will be the baseline for the development of other orientations in a practical and theoretical sense (Hernández-Sampieri and Mendoza, 2018). From a population of 300 livestock systems in the study area, a sample of 60 producers was taken using simple random sampling, extracted from the database of the study by Pardo-Rozo (2020), with the values of the variables in Table 1.

Table 1. Description of the product and input variables used in the data envelopment analysis (DEA) to obtain the efficiency frontier of the cattle farms

VARIABLES OF COMPETITIVENESS AND SUSTAINABILITY OF LIVESTOCK FARMS	
***RBC*:**	The variable represents the annual benefit/cost ratio per farm, calculated from the relationship between the present value of income and operating costs for livestock.
***NBS*:**	The variable that represents the number of basic needs satisfied which takes values between 1 and 5, where 5 is a better position than 1.
***CA*:**	Continuous environmental variable, which represents the tons of carbon stored in aerial biomass of the total hectares of forest cover that the farm has.
***NE*:**	The educational level of the entrepreneur or owner. If it does not have any educational level, it takes the value of 1, with the primary level it takes the value of 2, high school 3, technical 4, university 5, and postgraduate 6.
***% BOSQ*:**	Percentage of forest cover present on the farm.
***COSTS*:**	Annual production costs within the farm are measured in Colombian pesos for the year 2021.
***% PTIVO*:**	The relative percentage of productive coverage on the property, the sum of the hectares in Pastures for livestock

Source: Own elaboration.

The methodology presented in Medeiros, Gonçalves-Godoi and Camargo-Teixeira (2019) was used, which used a comparative and econometric analysis of competitiveness, and its determinants are indicated. The data enveloping analysis methodology was used to generate operational efficiency measures associated with competitiveness and sustainability. Then the determinants of competitiveness and sustainability were obtained by using a Tobit model.

Proposal for the construction of an efficiency indicator to determine competitiveness and sustainability. The efficiency frontier (competitiveness and sustainability) was calculated using the DEA with the variables presented in Table 1, where RBC, NBS, and CA act as outputs and the educational level, the percentage of productive soils, forests, and operating costs act as inputs. The indices were calculated according to Coll and Blasco (2006), using the Frontier Analyst program, version 4.4, which yielded efficiency indices between 0 and 1 for each farm. In this research, those farms with a score equal to 1, and with potential towards

competitiveness and sustainability when it was less than 1 (inefficient) were considered sustainable, competitive, and sustainable.

The data require a descriptive and inferential analysis according to Gujarati and Porter (2010). The Limdep version 7.0 software was used as a technological tool for statistical analysis. For the determination of competitive and sustainable farms, the Data Envelopment Analysis was used, a linear programming technique that allows the construction of synthetic efficiency indicators from variables with different units. As a linear programming technological tool, the 2018 version Frontier Analyst software will be used. In addition, an econometric model has been presented that attempts to identify the determining factors of sustainability and competitiveness of livestock systems (Gujarati and Porter, 2010).

Mathematical model. Ina similar trend to Pardo-Rozo (2020), the model seeks to solve the problem of maximization of a product and the simultaneous minimization of inputs, through the construction of an optimal production frontier that allows each observation unit to be compared against the estimated optimum. N farms used a certain number of inputs (I) to produce products (P) in a certain period (t). For the i-th farm, the X matrix of order inputs (I x 1) and a Y matrix of order products (P x 1) were taken, both made up of the data observed from the agricultural farms assuming constant returns to scale.

The technical efficiency of a given farm can be estimated through the following linear program, which is expressed in the primal model as Objective function: MaxU, V (Xi, Yi), subject to i) VXi = 1, ii) UYi - VXi ≤ 0, with i = 1,2, … N and U, V ≤ 0; where Xi: represents the inputs of the i-th evaluated cattle farm. Yi represents the products of the i-th evaluated livestock farm. U is a vector of P x 1 optimal products that must be found (the weight of the output). V is a vector of I x 1 the optimal combination of inputs to be found (the weight of the input). The problem is solved by linear programming, by finding the values of U and V that optimize the measure of efficiency (competitive and sustainable for this case) subject to values equal to or less than a unit.

DEA models can be oriented towards supplies (input) or production (output), depending on the existence of constant returns to scale (CCR model) or variable returns (BCC). It should be considered that variable returns can be increasing or decreasing and that it must also be considered whether the inputs can be controlled or not. One of the limitations of the method is that the program can assign a null or scarce weighting to a factor that, from the theory, can be of great importance in the relative efficiency of the productive units (Coll and Blasco, 2006).

Efficiency can be technical, price (or allocative), or global (or economic). It should be taken into account that the DEA provides relative efficiency measures (only concerning its

reference set, that is, between the farms in the sample), but does not offer an absolute efficiency measure because it does not compare the DMU against a theoretical maximum, which is to say that the efficiency frontier will be built from the scores of the farms that are closest to meeting the sustainability criteria (economically, politically, socially and environmentally) without be these necessarily sustainable. The inclusion of a new farm with its conditions of inputs and outputs can change all the efficiency scores, defined here as a score towards sustainability.

Tobit model to find the determinants of sustainability. In addition to estimating the sustainability score, a regression model was used to observe the factors on which it depends. The model parameters were obtained from the maximum likelihood estimation method, according to the econometric methodology of Gujarati and Porter (2010), using the Limdep version 7.0 program. The Tobit econometric model was used to observe if the potential for improvement towards sustainability and competitiveness was related to the socio-economic, political, and environmental variables studied. The Tobit model was the most indicated because both the regressive variable and the explanatory variables have censored data (Gujarati and Porter 2010). The Tobit model used was (Equation 1):

$$Not\ efficient = \beta 0 + \beta 1 * Ing + \beta 2 * Bosq + \beta 3 * Past + \beta 4 * Cult + \beta 5 * Bov + \beta 6 * Agri + \beta 7 * Forest + \varepsilon \quad (1).$$

The dependent variable was Not Efficient: it represents the inefficiency indicator according to the coefficients found by the DEA method. This original variable is modified as follows (Gamarra 2004): *Not Efficient* = [1-*Efficient*] / [*Efficient*] information provided by the DEA 1- [$\theta CCR / \theta BCC$], where θ is the score of efficiency with constant returns (CCR) and variable returns (BCC) provided by the DEA model.

The independent variables were: Ing: continuous variable that represents the annual income of the family in Colombian pesos for the year 2020. Bosq: continuous variable that expresses the hectares of forest cover on the farm. Past: continuous variable that expresses the hectares of pasture for livestock that the farm has. Cult: continuous variable that expresses the hectares destined to crops on the farm. Bov: dichotomous variable that takes the value of 1 when the farm develops the economic activity of cattle ranching, otherwise it takes the value of 0. Agri: dichotomous variable that takes the value of 1 when the farm develops commercial agricultural activity, otherwise it takes the value of 0. Forest: dichotomous variable that takes the value of 1 when the farm has rubber or palm crops and develops this economic activity,

RESULTS

Variables of livestock farms associated with competitiveness and sustainability. The variables of competitiveness according to the level of importance given by the producers were grouped into productive capacity, technological capacity, financial capacity, and human talent capacity as internal factors. As external factors, the variables were grouped into access to markets and the perspective of producers in the face of political support for farm productivity, the perception of producers about the support of regional banks to strengthen investment, the conditions of public order, and technology transfer carried out by scientific and academic institutions, which for the region are the el Instituto Amazónico de Investigaciones Científicas SINCHI and the Universidad de la Amazonia respectively.

The internal sustainability variables were grouped into the deforestation carried out on the farm, the importance that livestock producers gave to the potential of the ecosystem services immersed in the properties, land use, and the adoption of sustainable production models or practices. The external factors of sustainability include levels of poverty and the support of the administration and scientific and academic institutions. Table 2 presents the results found for each of these determining variables and associated with competitiveness and sustainability within livestock farms.

Table 2. Variables associated with competitiveness and sustainability in the sample farms

COMPETITIVENESS	UNIT	SUSTAINABILITY	UNIT
INTERNAL FACTORS	(Average)	Internal factors	(value and / or measure)
PRODUCTIVE CAPACITY	4 liters cow day. 24 ha on average per farm	Internal deforestation	58% of farms (0.4 ha yr-1)
FINANCIAL CAPABILITY	$ 15 million annually, with an average cost-benefit ratio of 1.8	Valuation of the ecosystem services of the farm	Null 3%, low 23%, medium 36%, high 38%
TECHNOLOGICAL CAPACITY	5% high, 25% medium, 70% low	Change in land use in 10 years	Null 10%, low 40%, medium 25%, high 25%
HUMAN TALENT CAPACITY	Education level 10% null, 40% primary, 25% high school,	Incorporation of sustainable production models	Null 66%, low 25%, medium 7.8, high 0.2%
		Forest conservation	42% of the farms, 488 trees ha-1.
EXTERNAL FACTORS	(value and / or measure)	External factors	(value and / or measure)
MARKET ACCESS (ROAD VALUATION)	Terrible 34%; Bad 38%; Acceptable 25%, Good 3%	Perception of support in technology transfer for the establishment of sustainable models	Null 43%, low 50%, acceptable 7%
PERCEPTION OF POLITICAL SUPPORT	Null 43%, Very low 52%, Low 5%		

PERCEPTION OF THE FINANCIAL SECTOR	Null 52%, Very low 38%, Low 16% Acceptable 4%	Housing conditions, overcrowding, educational, income level Poverty with more than two UBN unsatisfied basic needs	For the study area, 90% are poor and 10% are in extreme poverty.
PERCEPTION OF PUBLIC ORDER	Acceptable 85%, Good 13%, Excellent 3%		
PERCEPTION OF TECHNOLOGY TRANSFER	Null 43%, Very low 52%, Low 5%		

Source: Own elaboration.

The average monthly income of the households on the farms was considered low because it was less than 1.01 smmlv in 2021. The average value of the CBR for the farms was 1.8, which indicates that each peso disbursed as cost, generated 1.8 pesos of income (maximum value 5 and a minimum of 0.19). The area is characterized by low educational levels for producers. 100% of them have poverty problems associated with low productivity, low income, and access to school for children between 6 and 12 years old. In general, the results indicate the low possibilities of these farms towards competitiveness, since there is no support from the government, the financial sector, and low technological and productive levels are observed, regarding the national production.

In environmental aspects, changes in land use are given from 50% of the productive systems, where 58% carry out deforestation activities. This situation aggravates the conditions to develop a sustainable livestock model since the impact on resources is high. The establishment of sustainable production practices and models is minimal. However, there is a high valuation of the ecosystem services that may be immersed in agricultural properties.

Determination of the efficiency score (Competitiveness and Sustainability). Efficiency scores were found with the variables of competitiveness and sustainability (Table 3).

Table 3. Distribution of efficiency scores (in competitiveness and sustainability) for farms based on product-oriented models with constant-scale yield (CCR) and variable-scale (BCC)

SCORE	EE CCR	%	EE BCC	%
0.4 TO 0.5	1	1.4	1	1.4
0.5 TO 0.6	6	8.5	3	4.2
0.61 TO 0.7	8	11.4	16	22.8
0.71 TO 0.80	31	44.2	25	35.7
0.81 TO 0.9	18	25.7	17	24.2
0.91 TO 0.99	3	4.2	4	5.6
1.00	4	5.6	4	5.6

Source: Own elaboration.

From both approaches (CCR and BCC), it was found that most of the farms of this research obtained an average score between 0.71 to 0.8, followed by a group of farms with scores between 0.81 to 0.9, and only four farms (5.7%) obtained a score of 1 in the four dimensions of sustainability, that is, they generate the sustainability frontier.

Comparison of competitive and sustainable vs. non-efficient farms. The comparison of the competitiveness variables for efficient and inefficient farms is presented below (Table 4). As expected, the competitive and sustainable farms presented higher average values in the variables Carbon stored CA, Ratio Benefit-Cost RBC, Basic Needs Satisfied NBS, Government support AG, and tree density compared to the average of non-competitive and unsustainable farms. For example, the average CA in the sustainable farms was 83.6 t ha-1 compared to the average of 76.4 t ha-1 for the remaining 56 farms.

Table 4. Average values of efficient farms compared to the general average

VARIABLE	4 EFFICIENT FARMS		56 NON-EFFICIENT FARMS	
	Half	**Min - Max**	**Half**	**Min - Max**
RBC	5.0	2.5 - 12.0	4.8	0.2 - 12.8
NBS	4.0	3.0 - 4.0	3.0	2.0 - 4.0
CAT *T HA^{-1}*	178.0	166.3 - 293.9	162.47	45.5 - 272.76
PRODUCTIVE LAND (%)	53.0	13 - 91	72.4	0.2 - 98.0
FOREST COVER (%)	13.0	2 - 75	16.9	3.0 - 75.0

Source: Own elaboration.

The percentage of productive land is lower efficient farms than in other farms, a situation that is due to the optimization relationship between the use of land as a factor of production (pastures, crops, and forests). Although the farms that make up the border have technical efficiency scores equal to 1, it does not necessarily indicate that these farms will be competitive and sustainable, but they do stand out from the 60 livestock farms in the study. They were efficient in obtaining carbon, in profitability, with greater basic needs satisfied and the best perception of the support of the government and its policies versus their production costs and productive coverage which is consistent with the criteria of sustainable development: to guarantee economic growth, quality of life, social welfare, and without depleting the natural capital current and future generations.

Identification of key factors associated with the competitiveness and sustainability of livestock farms. A Tobit econometric model was developed in addition to the non-parametric

DEA analysis, which allowed us to analyze the determining variables of the scale efficiency scores. The variables related to the main coverage of the property and the use of the soil in livestock activities (pastures, crops, and forest) were chosen. It was found that the variables that determine the sustainability score were income, hectares in forest, and bovine livestock activity (Table 5). The negative sign of the variable Forest indicates how increasing the hectares in this cover would increase the probability of obtaining a higher score towards efficiency. The opposite case occurred with the variable Income and the variable of livestock activity (cattle), because when income increases, the probability for the Farm to obtain a score towards efficiency decrease. Likewise, livestock farms have a lower probability of efficiency compared to other farms with different economic activities. The information above indicates that livestock activity is not competitive or sustainable, perhaps it is related to the establishment of extensive traditional models that have left low productivity and profitability.

Table 5. Determinants of the efficiency (competitiveness and sustainability) of livestock farms through the Tobit model.

VARIABLE	COEFFICIENT	STANDARD ERROR	P-VALUE	HALF
CONSTANT	-1.17700	0.4720	0.0126	
ENTRY**	0.00038	30.0000	0.0870	763.55
FOREST*	-0.10440	0.0450	0.0120	4.35
PASTURES	-0.00020	0.0050	0.9560	25.00
CROPS	0.04080	0.0360	0.2590	2.81
CATTLE ***	0.64250	0.3935	0.1020	0.72
AGRICULTURAL	-0.07980	0.3045	0.7930	0.23
FOREST	0.09550	0.2943	0.7450	0.43

Source: Own elaboration.

The only statistically significant variable was Forests, which confirms the importance of the Carbon storage ecosystem service for sustainability. In terms of economic activity, only cattle ranching was relevant in the model; the negative sense suggests that the livestock activity is not practiced efficiently.

CONCLUSION

The variables associated with the sectoral competitiveness and sustainability of the cattle farms in the Amazonian foothills were the profitability of the cattle activity, the soils used for this activity, the costs and technological levels of production, the poverty condition of the

producers, and the conservation of forests on farms for carbon storage as an important environmental factor against climate change. The variables identified as key factors to study competitiveness in the livestock sector and sustainability were consistent with those proposed in García-García et al. (2015) as well as Pertuz-Martínez and Elías-Caro (2019) which were: the annual income of the farm, the livestock activity, and the forest cover of the farm.

Due to its low profitability, livestock activity is negatively related to competitiveness and sustainability, while the conservation of wooded areas within the farm is positively related to competitiveness and sustainability. This aspect is questionable because this is one of the main culturally introduced socio-economic activities in the region but, due to the fragility of the Amazonian soils, livestock does not correspond to the aptitude for land use. These results, seen from the weak sustainability, allow us to suppose that livestock in the region is negatively affecting the natural and economic resources because all the externalities it causes (deforestation, reduction of carbon sinks, among others) are not compensated by the economic or social system, as shown by the 100% NBI and the assessment of government support and the RBC indicator and the low levels of current production (compared to the national average). Rather, these livestock practices reveal that, in political and institutional terms, an intervention is needed in the economic, productive, and social system, which creates changes in the forms of production and stops the high impacts on the environment and resources, which is more of an approach towards competitiveness.

It was found that the livestock systems in the Colombian Amazonian foothills, in general, are not competitive or sustainable (93%, 56 of the 60 farms). These findings are like the study carried out by Pertuz-Martínez and Elías-Caro (2019) which confirms the last places in competitiveness registered by the departments of the Amazon region in the competitiveness ranking presented by the Consejo Privado de Competitividad (Private Competitiveness Council) in 2020 (26 out of 32). These results are consistent with experiences on the assessment of sustainability and competitiveness in Colombia, including the investigations carried out by Figueroa and Artemio (2016), whose main findings were the dependence of sustainability with economic, ecological, and sociocultural variables. In these studies, the importance of the conservation of ecosystem services in cattle farms in Colombia was highlighted.

Therefore, the measurement of competitiveness and sustainability is multidimensional, and its monitoring allows to foresee factors that determine it and what the efforts should be at the political level. Competitiveness and sustainability are limited by the levels of poverty shown by low education, low technology, and, consequently, low productivity and profitability, minimal possibilities of a family transition to an entrepreneurial class as well as scenarios of ineffective government support to the sector. All these situations decrease the probability of establishing a policy towards sustainable development for the rural sector, despite the

comparative advantages that the Amazon foothills have in terms of natural resources, ecosystem services, biodiversity, and food security (Ávila-Foucat, 2017).

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Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Motivation as a Driver of Customer Service: The Impact on Automobile Dealerships

La motivación como impulsora del servicio al cliente: Impacto en las concesionarias de automóviles

https://doi.org/10.32870/myn.vi45.7656.g6723

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Received: October 27, 2021
Accepted: December 22, 2021

ABSTRACT

The objective of the research is to analyze the relationship of Motivation as a soft skill that drives Customer Service in car dealerships, specifically in sales area employees. The survey was applied to a sample of 81 managers from the sales area of automotive agencies in the Monterrey metropolitan area. The proposed model was linear regression. The surveys were processed with SPSS Statistics. The hypothesis was confirmed, about the positive and significant relationship of the predictor variable and the dependent variable, in the employees of the sales area in the automobile agencies. It is suggested to analyze and build a complementary profile of the necessary soft skills of sales collaborators in car dealerships and other sectors.

Keywords: soft skills, motivation, customer service

Jel code: M12.

RESUMEN

El objetivo de la investigación es analizar la relación de la Motivación como una habilidad blanda que impulsa el Servicio al Cliente en las concesionarias de automóviles, específicamente en los empleados del área de ventas. La encuesta se aplicó a una muestra de 81 gerentes del área de ventas de agencias automotrices en el área metropolitana de Monterrey. El modelo propuesto fue de regresión lineal. Las encuestas fueron procesadas con SPSS Statistics a través de sucesivos pasos para obtener los resultados. Se confirmó la hipótesis sobre la relación positiva y significativa de la variable predictora y la variable dependiente en los empleados del área de ventas de las agencias automotrices. Se sugiere analizar y construir un perfil complementario de las habilidades blandas necesarias de los colaboradores comerciales en las concesionarias de automóviles y otros sectores. Esto mejorará el reclutamiento, la selección y la capacitación.

Palabras clave: habilidades blandas, motivación, servicio al cliente.

Código JEL: M12.

INTRODUCTION

Customer service is a differentiator in a highly competitive market, and the human factor is responsible for putting this service into practice (Solnet et al., 2019). Employees have a series of soft skills that allow them to: generate experiences that the customer wants, thereby increasing sales and fostering loyalty towards the organization (Heskett et al., 2008). The service approach in the organization has the essence of satisfying the needs presented by the client (Vega, Olivero and Gastelbondo, 2020). Service is also the fundamental experience where the contact between the organization and the client occurs, this set of experiences is known as moments of truth (Carlzon, 1991). The retention or loss of a potential client or a client already in shape depends on these interactions (Vazquez, 2014). So, organizations must view customer service as the essential and differentiating element which can determine their existence and/or permanence in the market (Montoya et al., 2013).

Customer service should also be considered in the auto dealership industry. Just to mention some data on this sector, the ADANL (2019) in the years 2017-2019 reported sales in Nuevo León that oscillated in 9,209, 9,382, and 9660 units respectively. The above data are indicators of the attention that should be paid to this important sector in all matters, in particular customer service. In this sector, customer service is key to influencing the purchase decision. Car dealerships offer similarities for each segment in various attributes such as products, technology, safety, comfort, and prices. What makes the difference is the customer service. In addition to influencing the sale, customer service also generates loyalty towards the employee, the brand, and the dealer (Hennig-Thurau, 2004). Through good service, it is possible to get the customer to return for the maintenance of the car or a buyback (Díaz, Muñoz and Duque, 2021).

Given the above, the collaborators are the ones who represent the organization in the experiences that the client lives. They are the ones who can provoke an emotional connection, a unique bond of warmth and trust (Albrecht, 1990). When employees achieve the human touch in the service experience, a competitive advantage of the business is guaranteed (Bowen, 2016; Mody, Suess and Letho, 2019). This is how soft skills in employees who are in direct contact with clients require special attention (Faizal, Annual and Rashidi, 2019). Heckman and Kautz (2012) mention soft skills as qualities that do not depend on the knowledge acquired and are of relevant value in some positions. Soft skills are made up of common sense, the ability to deal with people, a positive attitude, and flexibility. They are the intangible and specific skills of the personality that determine the strengths of the leaders, facilitators, mediators, or negotiators of an organization (Robles, 2012; Faizal et al., 2019). In some universities and researchers, they have carried out studies to find out what are the

important soft skills in the labor market, within them, motivation is mentioned (Robles, 2012; Singh and Jaykumar, 2019).

This article aims to analyze in a particular way the soft ability of motivation as a driver of Customer Service. This study was applied to the automotive distribution sector, specifically to employees in the new car sales area in the Monterrey Metropolitan area. Several aspects are framed in the process: First, the statement of the hypothesis, the design of an instrument, data collection, and statistical calculations for the verification or rejection of the hypothesis. Later the importance of the innovation of the subject in the sector of automobile distribution. And finally, by having the human factor as the center of research.

THEORETICAL FRAMEWORK

This section presents some definitions and theories of customer service and motivation that were the basis for constructing the definitions and models of both variables for the study. The definitions of the variables were the reference for the elaboration of the instrument that was applied in the part of the research methodology.

Customer Service (CS)

Carlzon (1991) establishes the moments of truth in his theory of customer service. These are the experiences that collaborators generate for clients and determine their warmth, attention, treatment, the service they offer, etc.

Within the analyzed definitions of customer service that gave the guideline for the development of the dependent construct are the following: Customer service is a set of basic individual predispositions and an inclination to provide what the customer needs, it involves being courteous and attentive when dealing with clients, associates, or collaborators (Alge et al., 2002).

Machorro et al. (2009), mention that the service is to offer honest attention, follow-up, and resolution of problems in such a way that the client is satisfied with the good or service acquired (Marinova, Singh and Singh, 2018). On the other hand, customer service is linked to the perception and expectations about the quality and satisfaction it generates, understanding the service as a courtesy, credibility, responsiveness, understanding of the customer, reliability, communication, security, and accessibility (Susskind, Kacmar and Borchgrevink, 2003; Fornieles et al., 2014).

According to Gonzalez et al. (2016) quality customer service can be seen from reliability; that is, the ability to perform the promised service reliably and carefully. Responsiveness: willingness and willingness of employees to help the customer and provide what is expected

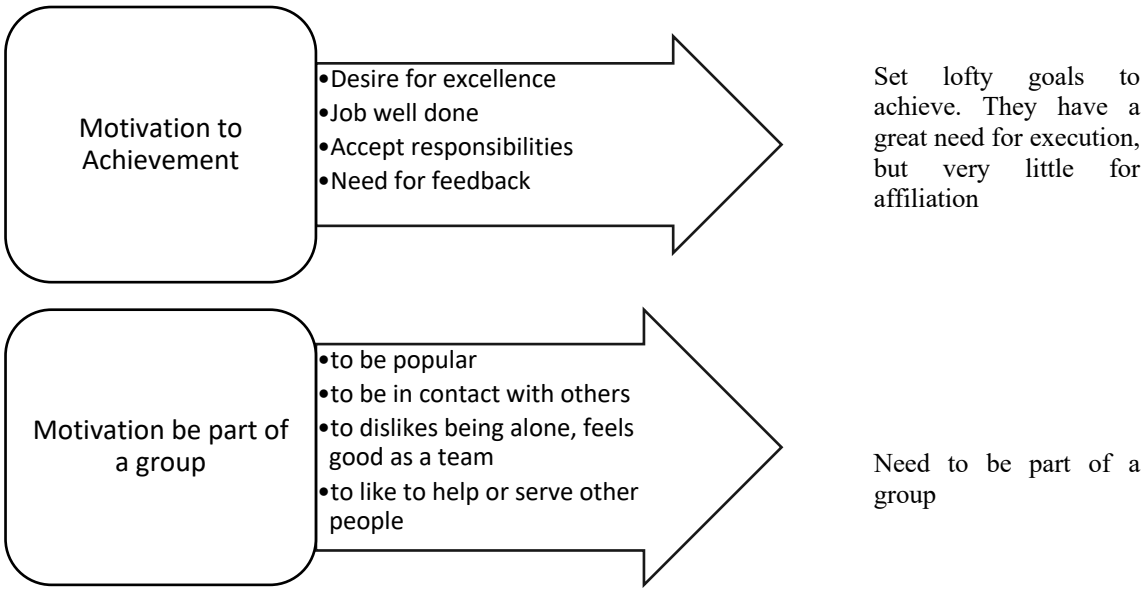
of the service. The security, knowledge, and attention shown by employees coupled with their skills inspire credibility and trust (Dehghanpouri, Soltani and Rostamzadeh, 2020). In addition to the empathy and individualized attention that must be offered to clients (Gil et al., 2007).

The operational definition of customer service for this study is good treatment, understanding, willingness, and willingness to support the customer. Transmitting security, credibility, and trust at the time of interaction (Leppard, Molyneux and Santapau, 1998; González et al., 2016). The understanding of what the client expects, in such a way that, when receiving the service, it is of quality and therefore is satisfied with the reception of it (Montoya et al., 2013). It includes unique interactions for the client, with high differentiation and generating memorable experiences (Coste et al., 2017; Colón, 2017; Vega et al., 2020).

Motivation (MT)

For the skill of motivation, the theories presented by Haque, Haque and Islam (2014) and Marulanda, Montoya and Vélez (2014) that mention the motivation to achieve, and affiliation were taken as a basis, in them, they explain that the collaborator extrinsically or intrinsically desires excellence, a job well done where he accepts the assigned responsibility. In addition to the above, it is suggested that they like to contact others, help, and serve other people (Najul, 2011). In the analysis of this study, the intrinsic motivation present in both is taken: achievement and affiliation. For reference is the following graphic model adapted from the authors as shown in Figure 1.

Figure 1. Motivation Model



Source: Own elaboration (Haque M.F. et al., 2014; Marulanda et al., 2014).

Some found definitions of motivation that will help to build the construct for this study are the following: Motivation is a way of creating high levels of enthusiasm to achieve the organization's objectives, this situation results when collaborators want to satisfy some individual need in Their work shows commitment and dedication, benefiting the internal or external client (Abu-ELSamen et al., 2011). Motivation refers to the achievement of organizational objectives by satisfying the needs or demands of individual employees (Haque et al., 2014).

Motivation is a set of cognitive processes through which the individual determines the amount of time and effort that will be invested in the search to satisfy specific needs and objectives. Depending on their origins, motivational processes can be intrinsic, that is, inherent to the collaborator or extrinsic, external to him. Employees who feel the desire to enjoy performing a task have an intrinsic motivation, this results in high levels of autonomy, perception of self-efficacy, commitment, satisfaction, and fulfillment in job performance, impacting their leadership (Hernández et al., 2009).

Intrinsic motivation is considered to be one of the main explanatory variables related to self-direction mechanisms, especially strategies focused on behavior and natural reward, from this definition terms such as self-efficiency, autonomy and job satisfaction are rescued, own leadership, to determine and fulfill the proposed objectives (Curral and Marques, 2009). In these mentioned objectives, the collaborator will know how much energy and effort he will need to invest to achieve them, considering that organizationally the final benefit of this effort is reflected in the client (Mohd et al., 2012).

Navarro et al. (2011) define motivation in organizations as the degree of effort that people are willing to exert in their work to satisfy their needs. This is based on the assumption that employees have a set of needs that lead them to behave in a certain way to satisfy them. Such needs are individual dispositions of varying degrees that guide behavior toward the goal of achieving satisfaction and reducing the stress of unmet needs. Needs represent the source of energy that drives motivating employee behavior.

García and Forero (2014) mention employee motivation as an emotional state that is generated as a result of the influence exerted by certain motives. The reasons can be satisfaction, visualization of achievement, commitment and work interest, task orientation, and success orientation. This specifies that the reasons for the employee's behavior can be intrinsic, such as achievement, success, job interest, satisfaction, or extrinsic, such as homework, etc.

One motivation was analyzed from different points of view, the operational definition for this study is the degree of effort, enthusiasm, and commitment that collaborators are willing to exert in their work to satisfy their needs and those of clients (Navarro et al., 2011; Haque

et al., 2014). It is the desire to achieve the task or goal in favor of the client (Navarro et al., 2011; García and Forero, 2014; Marulanda et al., 2014). It is the good spirit to provide a quality service that satisfies the client (García and Forero, 2014).

Empirical relations between Customer Service (CS) and Motivation (MT)

Within the literature review, some studies were found in which a relationship between customer service and motivation was observed. Such is the case of an investigation on the development and implementation of software in Portugal, in which 108 collaborators were surveyed. The relationship between CS and MT was positive and significant ($\beta = .25$, $p < .05$). Concluding that promoting motivation in employees, reflected in their leadership and innovation in their work, results in better customer service (Curral and Marques, 2009).

In another investigation in Hannover, Germany. They found a positive and significant relationship of motivation with satisfaction, customer service, and customer retention. The results were as follows: a $\beta = .76$ for customer motivation, service, and satisfaction. A $\beta = .08$ for customer motivation and retention. Both relationships with the significance of $p < 0.05$. The questionnaire to obtain the data was applied to a sample of 989 retail consumers of books / CDs / DVD and travel agencies. That is 408 from travel agencies and 581 from media (DVD and CD) (Hennig-Thurau, 2004).

Swanson, Davis and Zhao (2007) investigated a theater to know the motivation for achievement and its relationship with service and customer satisfaction. The sample was 442 audience members. The result of the structural equations model was a path coefficient of 0.19 and a significance of $p < 0.05$, mentioning that motivation positively influences general satisfaction.

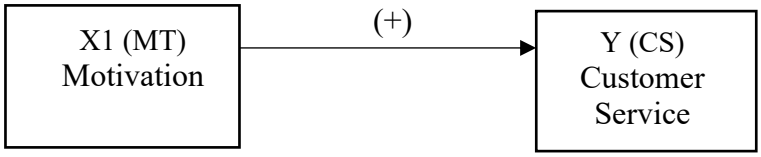
In the investigation that was carried out in Zhejiang city of China. In the tourism industry. We wanted to see the impact of employee motivation (proactive personality) and customer service. It was using the application of a survey 1.- to 145 first-line collaborators of clients who had to wait time to be served and 2.- to 39 supervisors of said collaborators to evaluate their performance in customer service. The data were calculated through structural equations and the result was β .536 $p < .01$. They concluded that good customer service begins with the people, with the collaborators. That is, front-line collaborators by focusing their attention on the customer's points of view and being proactively motivated, helps in providing good service and that the customer is satisfied with the treatment received. When the employee has confidence in her abilities to participate in a broader set of roles to serve customers, it results in better customer service (Huo et al., 2019).

In Korea Japan, a study was carried out in electronic banking to find out the relationship between the employee's motivation expressed in the commitment they have towards the client and a good service experience and satisfaction when receiving said service. A questionnaire

was sent electronically to 247 clients and they were processed using structural equations, having the following result, a $\beta = .08$, and a $p < .05$ proving that the commitment that the employee feels and/or must satisfy the customer generates a positive influence on the service experience provided (Shin, 2021).

Once the theoretical framework was explored, the graphic model and the hypothesis were raised as shown in figure 2. Subsequently, the development of the measurement instrument, its application, and the calculations to obtain the results.

Figure 2. Graphic Model



Source: Own elaboration.

From the graphic model the hypothesis of the study was established:
H_1: MT has a positive relationship with customer service.

RESEARCH METHODOLOGY

After establishing the models and definitions of the constructs of the investigation, the instrument was developed and applied. The items that made up the instrument were selected and adapted from the empirical studies found in the literature review. Among these instruments analyzed were SERVQUAL and SERVPERF (Parasuraman, Zeithaml and Berry, 1988), all of them validated with acceptable Cronbach's Alpha. Upon having the first version of the instrument, the content validity was performed with expert Doctors in Methodology and Human Capital. Before developing the instrument in Google Forms for its application, statistical adjustments and expert suggestions were made. Table 1 shows how the instrument was constituted with the Cronbach's Alpha values of each construct.

Tabla 1. Constitution and Reliability of the Instrument

Variable	Cronbach Alpha
CS	.939
MT	.884
Total items with demographics	11

Source: Own elaboration (SPSS Statistics).

At the time of elaborated the instrument, the population and the sample were determined. The population of commercial automotive distribution agencies in the Monterrey metropolitan area was 96 (AMDA, 2019), automotive agencies are classified as SMEs, considering the number of collaborators (INEGI, 2009). The agencies studied vary between

8 and 60 collaborators. The statistical formula (equation 1) was applied for a simple random sampling with finite population *n* = Nz2 (1-p) / (N-1) e2 + z2p (1-p) where, N = 96, Z = 1.96, p = .5, 1-p = .1, e = .05. Resulting in an *n* of 77 respondents.

The study subjects of the research were established as the Sales Managers or Coordinators of the automotive distribution agencies of the Monterrey metropolitan area. They are the ones who are closely involved in the operation of the business and determine the sales strategies of the agencies. They are also the ones who know, constantly treat, and observe customers. The instrument was sent to all study subjects of the population and thus to be able to receive the largest number of questionnaires to cover the sample. Eighty-one questionnaires were received, all of which were accepted for processing, and since the sample of 77 was covered, the calculations were carried out in SPSS statistics.

Regarding the demographic data of the sample, they were obtained through four items that refer to gender, age, education, and geographical area. Table 2 shows the results. In it, it is observed that the number of men and women is similar, slightly inclined towards men with 54%. Employees with an age equal to or greater than 36 years represent 50%. A small number of employees have a maximum high school education (16%). Regarding the demographic of the geographical area, they were segmented into two groups, area A, which is where the largest number of automotive agencies are located.

The area is made up of Monterrey and San Pedro, which are municipalities with high purchasing power, and are in the center of the Monterrey metropolitan area. In Zone B were the municipalities of Cadereyta, San Nicolás, and Santa Catarina, which are further from the central zone. The percentages of groups A and B are those expected according to the concentration of agencies by zone, 57% are in the group of zone A, that is, in the periphery and central municipalities.

Table 2. General demographic data

Demographics	**Gender**		**Age**		**Schooling**		**Area**	
Groups	**Men**	**Women**	**<36**	**≥36**	**≤ High School**	**≥ Bachelor´s Degree**	**A**	**B**
	81		81		81		81	
N	44	37	31	50	13	68	57	24
%	54%	46%	38%	62%	16%	84%	70%	30%

Source: Own elaboration.

RESULTS

The statistical model proposed for the investigation, according to the hypothesis was SC = β0 + β1 (MT) + u. Linear regression with successive steps. The result is shown in table 3.

Table 3. Model and Method

Model	Incoming Independent Constructs	Statistics	Result	β	T	Condition Index	Sig.
Linear Regression CS= β0+β1(MT)+u.	MT= MT1, MT3, MT6	R^2 .746 F 98.839 Durbin Watson 1.075	MT accepted	MT .743	MT 9.942	1	MT <.001

Source: Own elaboration.

Talking of the results of the model, a coefficient of determination R2 of .746 and a Durbin Watson test of 1.075 are observed. Regarding the relationship between the predictor and the dependent variable, a β of .743 was obtained, with a statistical significance lower than .001, an estimation error of .075, a Condition Index of 1 and Fisher's test of 98.839.

Next, Table 4 shows the hypothesis and the degree of impact of the variable towards CS.

Table 4. Status of the specific hypotheses according to the results of the model

Independent variables: Soft Skill Motivation	β	Significance	Result
H_5: MT has a positive impact on customer service.	.743	(+) <0.001	Accepted

Source: Own elaboration.

The appreciation of the results of this study shows that motivation has a driving relationship concerning customer service in direct sales collaborators in new car dealerships.

CONCLUSIONS AND IMPLICATIONS

Theoretical implications

According to the methodological contribution, the process of developing the instrument and the results obtained through a quantitative method to obtain the relationship of the variables are highlighted. In turn, it is possible to compare empirical studies found in different sectors and how the behavior in this automotive sector of the relationship of motivation towards customer service is above the study carried out in software and entertainment (theater) and slightly lower than that applied to book / CD / DVD retailers and travel agencies. Table 5 presents the authors of said empirical studies found and the result of the linear regression of

this study to contribute to the relationship of the variables proposed for the automotive sales sector.

Table 5. Relations between Motivation (MT) the dependent variable (CS) and this study

Authors	β	Significance
(Curral & Marques, 2009)	.25	<0.05
(Hennig-Thurau, 2004)	.76	<0.05
(Swanson, Davis & Zhao, 2007)	.19	<0.05
(Huo et al., 2019)	.53	<0.01
(Shin, 2021)	.08	<0.05
This Research	.74	<.001

Source: Own elaboration.

Regarding the data of each demographic group, regressions of each group and category were processed in SPSS Statistics. Each iteration included the independent variable Motivation (MT) with the dependent Customer Service (CS). In addition, the calculation of a mean difference or t-test was performed to validate in which category the impact of motivation towards customer service was greater. Table 6 shows the assumptions based on the regression of each category and the result of the calculations. The relationship between TM and CS was stronger in women than in men, in those under 35 than in those over this age, higher in undergraduate students than in high school or a lower grade, and finally, there is a higher degree of relationship of motivation towards customer service in the collaborators who are in the agencies of zone B, which are the agencies that are in fewer conurbation areas and with less purchasing power vs zone A.

Table 6. Hypothesis tests on Motivation´s relationships in the different groups

Demographic	Group	n	β	Typical Error	Assumptions	T-test
Gender	M	44	.722	.092	$MT_W > MTM$	3.59
	W	37	.805	.131		
Age	<36	31	.771	.099	MT<36 > MT≥36	2.16
	≥36	50	.721	.105		
Schooling	≤ Highs	16	.380	0.164	MT≥Bach >MT≤Highs	9.25
	≥ Bachelor	65	.789	.080		
Area	A	57	.677	.101	MTB > MTA	7.68
	B	24	.867	.102		

Source: Own elaboration.

Management implications

Within the practical contribution it is concluded that, in the automobile dealer sector, customer service is key to influencing the purchase decision. Car dealers offer similarity in each segment in several domains: products, technology, safety, comfort, and prices. What makes the difference is the treatment of the client (Gómez, 2011). In addition to influencing the completion of the sale, customer service also generates loyalty towards the collaborator, the brand, and the concessionaire (Causado-Rodriguez, Charris and Guerrero, 2019). By offering good customer service, you can get the customer back for car maintenance or a buyback. Loyalty is generated when clients feel trust with the sales consultant (Shoemaker and Lewis, 1999). The advisors must offer a warm treatment during the sales process (Wagner et al., 2019). Making them feel unique and important (Tesone and Ricci, 2006). Showing empathy and above all, listening carefully to interpret their needs and tastes (Da Silva and Leite, 2010). These last actions occur when the collaborator has certain soft skills.

By confirming the relationship of the soft ability of Motivation (MT) with Customer Service (SC), a latent reality in the automotive agencies sector is clarified and established that had not been found in the literature review previously. With this study, the importance of Motivation of the collaborator who is in front of the client is perceived. By having this ability, the collaborator has a drive and taste to achieve their goals and carry out their activities, in such a way that they lead them to achieve their objectives and satisfy their achievement needs within the organization and consequently, good service is provided to the client (Tampubolon, Murniarti and Sidabutar, 2021).

The statement of the hypothesis on the relationship of motivation and customer service in direct sales collaborators in car dealerships was accepted, so the practical contribution for this sector is valuable and has the purpose of gradually developing a profile of the soft skills of these collaborators, especially at the time of hiring and training.

Future lines of work and limitations

It is suggested to study this skill at the leadership or managerial level and expand it to the other areas of the automotive agencies. On the other hand, to complement this study, it is proposed to continue deepening in other soft skills such as flexibility, self-confidence, sense of urgency, and proactivity in the collaborators of the automotive dealership sales area. It is also suggested to extend the research to other locations, hoping to see the behavior of the data for this variable. Finally, it is proposed to take these studies to more retail sectors to analyze the relationship of motivation and customer service in employees who are direct with the customer, as well as the level of momentum compared to other sectors.

Situational moment of the Investigation. It should be noted that this study was carried out exactly at the beginning of COVID-19 in Nuevo León, which was at a significant moment in

car dealerships. This affected not only individual and collective behavior in the sales process and customer service. But also, before the process of the investigation itself. 44% of the surveys were applied and received before the pandemic, during this period the response and reception process was complicated, the estimated time was 3 to 4 weeks. As the home office was presented and more collaborators were online, filling out and receiving questionnaires was easier. The remaining 55% were shipped and received in a response time of 1-2 weeks.

According to the sales process before the pandemic, it was 90% face-to-face, that is, in person. This allowed the collaborator's skills to be put into practice naturally or visually. However, when the surveys were applied, that 90% of employees were making a significant effort to sell remotely and/or digitally. So, the skills had to be accentuated. They made them come true through calls or video calls, contact with the client had to be closer and warmer, taking care not to overwhelm him (Bullemore-Campbell and Cristóbal-Fransi, 2021).

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Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Economic and social vulnerability because of Covid-19: poverty and food security

Vulnerabilidad económica y social por causa del Covid-19: pobreza y seguridad alimentaria

https://doi.org/10.32870/myn.vi45.7660.g6724

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Received: August 9, 2021
Accepted: December 13, 2021

ABSTRACT

The objective is to analyze food poverty and the effects in terms of vulnerability because of the Covid-19 pandemic in Mexico City from the capability approach. In the analysis stage, centrality, variability, and correlation parameters were used to identify the effects of the health crisis on food poverty. The results corroborate that food poverty is a material and immaterial phenomenon, which impacts the economic, sociocultural, and environmental setting of the individual. The State must design strategies with different stakeholders in society for social and economic recovery, not only because of the implications of the pandemic but also because of the economic inequality among the population.

Keywords: Capability theory, poverty and food insecurity, economic inequality, sustainable management.

Jel code: I320, M14

RESUMEN

El objetivo es analizar la pobreza alimentaria y los efectos en términos de vulnerabilidad como consecuencia de la pandemia Covid-19 en la Ciudad de México desde el enfoque de capacidades. En la etapa de análisis se utilizaron parámetros de centralidad, variabilidad y correlación para identificar los efectos de la crisis de salud con la pobreza alimentaria. Los resultados corroboran que la pobreza alimentaria es un fenómeno material e inmaterial, que impacta el escenario económico, sociocultural y ambiental del individuo. Es necesario que el Estado diseñe estrategias con diferentes actores de la sociedad para la recuperación social y económica, no solo por las implicaciones de la pandemia sino también por la desigualdad económica entre la población.

Palabras clave: Teoría de las capacidades, pobreza e inseguridad alimentaria, desigualdad económica, gestión sostenible.

Código JEL: I320, M14

INTRODUCTION

The paper offers a conception of economic inequality and food poverty tacit in Amartya Kumar Sen's capability theory. To distinguish the nature and causes of poverty and inequality requires in-depth analysis beyond income distribution, to build a strong society whose characteristics are empathy and freedom. Among the strategies to minimize this, it is also necessary to review social policies and impartially address the fundamental shortcomings of the population.

For more than 20 years, new proposals have emerged that explain that poverty should not only refer to income but the deprivation of basic capability. Thus, Sen's theory addresses the issue based on the capability theory, where his proposals are about the importance of moving towards the juncture of concepts, metrics, and policies, with the understanding that government intervention will be more effective if it prioritizes being and doing, rather than having, and thus achieve a multidimensional approach. The objective of the research is to analyze food poverty and the effects in terms of vulnerability due to the Covid-19 pandemic in Mexico City from the capability approach, with a sustainable administration perspective.

Mexico is the most unequal country in Latin America, although not the poorest. In terms of sustainability (whose basic concerns are the minimization of poverty and the effects of climate change), therefore the management must put into action the principles of effectiveness, but with care in the social, environmental, and economic impacts. In such a context, sustainable administration must consider changes in such a way that the objectives of increasing the quality of life of the interested parties prevail, as well as preserving ecosystems without losing sight of the performance of the organizations. Manage resources in such a way that with ethics and transparency it is possible to minimize poverty, contribute to the objective of "zero hunger", close gaps of inequality and opportunities.

This research presents the conceptual aspects of inequality and poverty, dimensions, and indicators, describing the work of Sen, the capability theory, and the influence it had on the conception of poverty from the multidimensional approach, specifically the case of Mexico City. By having a methodology with these characteristics, it can be conceived that the best practices in the field are recovered, thereby explaining food poverty and its relationship with economic inequality. The research analysis focused on four boroughs: Iztapalapa, Tláhuac, Iztacalco and Gustavo A. Madero. It ends with the presentation of the impact of the Covid-19 pandemic on poverty in general.

DEVELOPMENT

Atkinson (2019) presented several studies on measuring poverty around the world; his way of reviewing the methodologies for such a case enabled the observation that there are measurements on income, as is done in Latin American and Caribbean countries, or on consumption, as shown in countries in Africa. In general terms, poverty is measured in monetary terms, and the comparative points reviewed included the following: consumption vs income, people vs households, short vs long term. There were also questions, such as what dimensions or indicators were used? What is the sample size? Was everyone considered? What are the resemblances or similarities in the methodologies? In this sense, it is important to understand the nature and causes of poverty.

INEQUALITY, POVERTY, AND OTHER RELEVANT TERMS

The International Glossary on Poverty and that of the National Council for the Evaluation of Social Development Policy (Spanish acronym CONEVAL) reflect an important work in compiling a series of definitions to enable an understanding of poverty, with emphasis on food poverty and inequality (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

Poverty and inequality have been the main topics of different studies and forums around the world, in which goals have been set for their eradication, such as those described in the United Nations (UN) Sustainable Development Goals. Some of these definitions are presented below:

1. *Economic distance*. Involves the population that does not have control over resources and is significantly different from others in society. “There is an inevitable connection between poverty and inequality: some degree or dimension of inequality [...] will lead people to fall below the minimum acceptable levels in that society. This aspect of economic distance is what constitutes poverty” (O’Higgins and Jenkins, 1990). The term was introduced in the Luxembourg Income Study to describe the situation of people whose income is below 50% of the median income (Smeeding et al., 1990; Spicker and Álvarez, 2009, p102).
2. *Impoverishment.* In some cases, this results from the degradation of productive resources (land, pasture, or fisheries); falling prices for commodities (such as crops, livestock, fish, labor); lack of work; deprivation of livelihoods such as land and water; and weakening of social solidarity networks. Famine and mass impoverishment are also associated with reduced or absent entitlements (Sen, 1981).

3. *Equality*. Generally used to demonstrate that quantitative information about social problems does not represent simple facts, but rather ways of organizing data that would otherwise be complex and unreliable. Indices. An index consists of a set of indicators that are combined to produce a composite measure (Spicker and Álvarez, 2009, p155).
4. For the United Nations Development Programme (UNDP), poverty means "the denial of the most fundamental opportunities and choices for human development: to live a long, healthy and creative life and to enjoy a decent standard of living, freedom, dignity, self-respect, and respect for others". In other words, "poverty represents the absence of certain basic capabilities" (UNDP, 2011).
5. *Multidimensional poverty.* A person is in a situation of multidimensional poverty when he/she is not guaranteed the exercise of at least one of his/her rights for social development, and his/her income is insufficient to acquire the goods and services required to satisfy his/her needs (CONEVAL, 2018).
6. *Poverty*. A person is in a situation of poverty when he/she has at least one social deprivation (in the six indicators of lack of education, access to health services, access to social security, housing quality and spaces, basic housing services, and access to food) and his/her income is insufficient to acquire the goods and services required to satisfy his/her food and non-food needs (CONEVAL, 2020b).
7. *Extreme poverty.* People in such a situation have such low income that, even if they were to spend all of it on buying food, they would not be able to obtain the necessary nutrients to have a healthy life (CONEVAL, 2020b).
8. *Vulnerability*. This is defined by harm, not risk. (Chambers, 1989, as cited in Spicker and Alvarez, 2009) He argues that, in general, policies aimed at alleviating poverty have not taken into consideration the vulnerability of the poor. Policies have focused on income or consumption levels, not on the factors that exacerbate poverty or expose individuals, households, and communities to the risk of impoverishment (Spicker and Álvarez, 2009).
9. *Vulnerable due to social deprivation.* Non-poor population with one or more social deprivations but whose income is higher than the income poverty line (CONEVAL, 2020b).
10. *Vulnerable due to income*. Non-poor population with no social deprivations but whose income is lower than or equal to the income poverty line (CONEVAL, 2020b).

For this research, the above list implies specifying the differences between poverty, inequality, poverty, and food insecurity.

SEN AND THE CAPABILITY THEORY

In 1973, the Organization of Ibero-American States for Education, Science and Culture (Spanish acronym OEI) identified inequality as a significant variable in different parts of the income distribution, mentioning that no assessment of poverty is 100% relative, since absolute income effects in quantitative terms the population living in poverty in a particular society. Thus, the study of poverty cannot be seen only as a study of inequality (Sen, 1997).

Since 1976, Sen has worked to integrate the two concerns: poverty and inequality, which have been extensively researched by several authors. As is well known, Sen also questioned this conception of analyzing "income poverty" because it was considered that it conceals some fundamental aspects of economic deprivation (Sen, 1997).

According to Sen (2000), poverty is "capability deprivation, focusing on analysing the limitations of basic capabilities that people have to function, and not just as a low income". The author pointed out that these capabilities are basic for the exercise of freedom, so this condition limits freedoms, causing in turn "premature mortality, a significant degree of malnutrition, a high level of illiteracy, among other deficiencies". Sen's capability theory, therefore, focuses on people, not on institutions, and its purpose is to provide more precise guidance to governments concerning the bases on which it is relevant to support the design of public policies aimed at effectively meeting the demands of equity and social justice, beyond the mere obsession with improving national economic production and income distribution.

Therefore, the lack of such freedoms represents an obstacle for an individual in society since he/she cannot obtain that which is of value to him/her; the lack of resources and income distance them from a sustainable life or free of deficiencies that are fundamental for his/her economic, social, and cultural development. The measurement of poverty based on capability is done with the Sen Poverty Index, which is an alternative to the incidence index and the poverty gap, which aims to consider the intensity of both poverty and inequality (Spicker and Álvarez, 2009).

It is necessary to reflect that, when it comes to studying poverty, one necessarily resorts to counting the number of poor people. Sen's proposal is aimed at evaluating it. Once the poor population of a community is identified, we proceed to characterize them and evaluate the level of poverty in that place, using variables such as income, which is just one of many factors that influence the real opportunities that people have. These opportunities are influenced by variations in individual circumstances, such as age, disability, exposure to

disease, talents and skills, sex, maternity, and by environmental and social contexts such as epidemics, pollution, crime, local social insecurity.

In concrete terms and referring to Bracamontes and Camberos (2011), who analyzed the methods of poverty measurement, they described that Sen proposed a hybrid measurement by combining the overall poverty index (H) and poverty intensity (I), as follows: $P = HI$, where the values of H are represented by: $0 \leq H \leq 1$.

Furthermore, about the principle of difference, Rawls (1971 as cited in Sen 1997) pointed out that priority should be given not necessarily to the less happy individual, but to the less privileged. This premise is based on the lower rate of value of primary goods. understood as those "general-purpose resources that help anyone to further their purposes and include rights, freedoms and opportunities, income and wealth, and the social foundations of self-respect". He also explained that even though one person may have the same basket of primary goods as another (or even higher), one may be less happy than the other because of the use he/she makes of his/her income.

Sen's position is that capabilities provide a more attractive benchmark for comparison, whereas others argue that the priority of welfare maximization, such as satisfaction, or resource maximization, which describes income and wealth, are inescapable for measuring equality. Each one defends their proposal to carry out such measurement and Sen has an interest in offering a notion of basic justice (Table 1).

Table 1. From the principle of difference to satisfaction for justice

Income and Wealth	***Satisfaction***	***Basic Justice***
Resource Maximisation	Welfare Maximisation	Health, education, political participation, non-discrimination, comparative use of capabilities

Note: Sen made a critique of John Rawls' "Theory of primary goods", as it states that primary goods are one more element of a highly complex general theory and consider that a country is better for its citizens the more resources it has if it divides them equally (or equally enough) among all its inhabitants (Nussbaum, 2018).
Source: Nussbaum (2018).

As a result of the analysis made by Sen, regarding poverty, he explained that income is only important to lead an adequate life" since it is also a lack of capability, such as the minimum capacities to avoid hunger, malnutrition, or weight loss (Sen, 1981). For the same author, capabilities are substantial freedoms, a set of opportunities (usually interrelated) to choose and to act; in a person, these are the alternative combinations of functionings that are feasible to achieve. It does not consider only the abilities that lie inside a person but includes the freedoms or opportunities created by the combination between those personal faculties and the political as well as the social and economic environment (Nussbaum, 2018).

The philosophical influence of the capability theory has an extensive list of thinkers, from the ideas of Aristotle and Socrates to Nobel Prize for Literature winner Rabindranath Tagore to Mahatma Gandhi. Another theory with its ancestry that considers Sen's criteria is the thought of Marxism, in the same way, the conceptions of freedom and self-development were studied by Stuart Mill. Finally, in this synthesis of authors of economic science, literature, and politics we find Adam Smith and his writing on moral sentiments.

The impact of Sen's proposals is understood, since according to Vergara (2016), Sen was accurate when from an ethical approach he pointed out that there is no justification for separating the study of economics from that of ethics and philosophy and that to this subject two fundamental issues arise for economics: ethics and social achievements.

According to Nussbaum (2018), when poverty is analyzed as a lack of capability, the focus is only on how well or badly each person is doing. In addition, such a study highlights the possible distributive inequalities within the family itself; in this sense, one of the points to highlight in this theory is the value of unpaid domestic work at the time of evaluating a disadvantaged situation. In the capability theory, the visibility of famine has put nations on alert not only because it highlights the scarcity of food, but also because it responds to the lack of opportunities for those who suffer from it to obtain what they need (due to lack of employment), i.e., it takes up the importance of poverty and food security. The following represents the interrelationship of capabilities.

Table 2. Interrelationship of capabilities

Functioning	***Capability***	***Agency***
Freedom of the individual to live a lifestyle	Combinations of functionings (being and doing) a person can achieve	Freedom that the person has in doing or being the things that he/she values

Note: The distance between economics and ethical behavior weakens the scope of welfare. It is emphasized in this sense that the Pareto optimality criterion limits the valuation of social achievements.
Source: Nussbaum (2018).

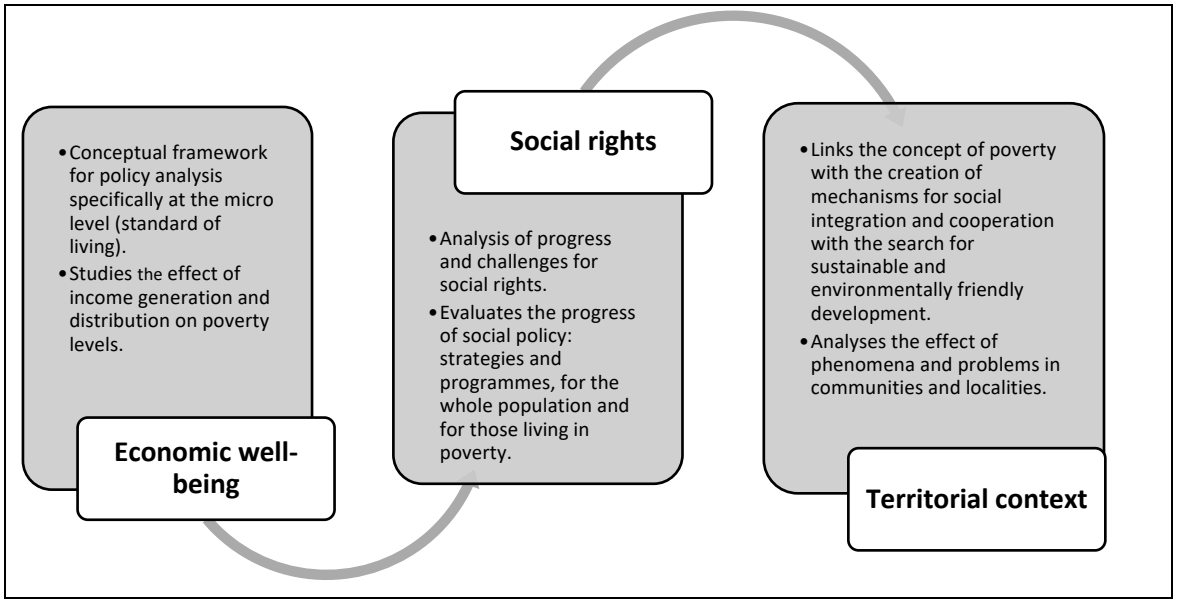
ECONOMIC INEQUALITY AND FOOD POVERTY IN MEXICO CITY

The classification between developed and undeveloped countries, between rich and poor, has been an element of study in different sciences such as economics. Some authors such as Gutiérrez and González (2010) justify the theories of economic development in the sense that they propose assumptions to study the conditions, causes and factors of economic inequality between those who have more and those who have less; these assumptions are focused on the person or groups, as well as on monetary terms, or capabilities or multifactor. Also, Castillo (2016) has argued that poverty, lack of capability, and non-equality are a form of violence and lack of human rights.

It should be noted that in most of the references considered in this paper, the words "poverty and inequality" are found together, but they are different meanings and Casas and Barichello (2015) made a distinction where they explained that the two terms are a measure of welfare, but for poverty this is absolute and the second is relative.

According to Núñez (2006), the first studies on economic inequality are based on the proposals of analysis through Lorenz curves in 1905. The Organisation for Economic Co-operation and Development defines it as the difference in how assets, welfare, or income are distributed among the population that is, it is the dispersion that exists in the distribution of income, consumption, or some other welfare indicator (Litchfield 1999, as cited in Galindo and Ríos, 2015).

Figure 1. Multidimensional elements of poverty according to CONEVAL



Note: The measurement of food poverty and economic inequality requires a criterion allowing the population to be classified into different groups concerning their poverty circumstances.
Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2021a).

It is important to clarify that poverty should not be confused with inequality; the latter refers to the variation in living standards of the population, regardless of whether the population is in poverty (McKay 2002, as cited in Galindo 2015).

In the case of Mexico, the National Council for the Evaluation of Social Development Policy (CONEVAL) is the official agency, whose objectives include measuring inequality, where the methodology it uses is based on income per household, also using the Gini coefficient (economic inequality is measured based on the income distribution of the population in each period). Monetary approaches also allow for subclassification into:

1. Food poverty
2. Capability poverty
3. Property poverty

The elements of the multidimensional methodology are shown below (Figure 1), focusing on three main elements: economic welfare, social rights, and territorial context. With this, it can be said that it shares some parts of Sen's theory. Also, to identify the different indices used to measure poverty and which of them consider the issue of economic inequality or food poverty, a comparative table of indices for measuring poverty was prepared (Table 3).

Table 3. Different indices measuring poverty, inequality, and food security.

INDEX	AGENCY/ENTITY/ PROGRAM	COMPONENTS AND/OR ELEMENTS AND/OR VARIABLES AND/OR CATEGORIES
LAEKEN INDICATORS FOR POVERTY AND SOCIAL INCLUSION	European Council National Action Plans for Social Inclusion (NAP/incl)	***Primary and secondary indicators****: rates of quantitative and qualitative information such as:* - Income and income distribution (including Gini Coefficient) - Unemployment - Population - School dropout and health
POVERTY GAP INDEX (PGI) **PROPORTIONAL POVERTY GAP**		-Poverty incidence and intensity
FOSTER, GREER, AND THORBECKE POVERTY INDEX (FGT) **ALSO KNOWN AS *PA* INDICATOR, IT SHOWS EVIDENCE OF INEQUALITIES AMONG THE POOR**		Elements: - Population, number of poor, poverty line and income *per capita*
POVERTY INCIDENCE RATE		W of individuals, households, or families that fall below the poverty line
HUMAN POVERTY INDEX (HPI)	UNDP Human Development Report	Based on Sen's proposal - Incidence and inequality gap
SEN INDEX (SI) **ALTERNATIVE POVERTY MEASURE**		Poverty intensity - Incidence rate - Poverty gap (intensity) - Gini Coefficient
HUMAN DEVELOPMENT INDEX (HDI) **INSTRUMENT COMBINING PEOPLE'S LONGEVITY, EDUCATION, AND INCOME FOR A DIGNIFIED LIFE**	UNDP Human Development Report	- **Health index** - **Education index** - Income index
FOOD SECURITY INDEX (FSI)	United Nations System World Bank and UNDP	Combination of variables between food production and consumption
INTEGRATED POVERTY INDEX (IPI)		The index that combines the poverty incidence rate with income gap rates, income distribution below the *per capita* growth line

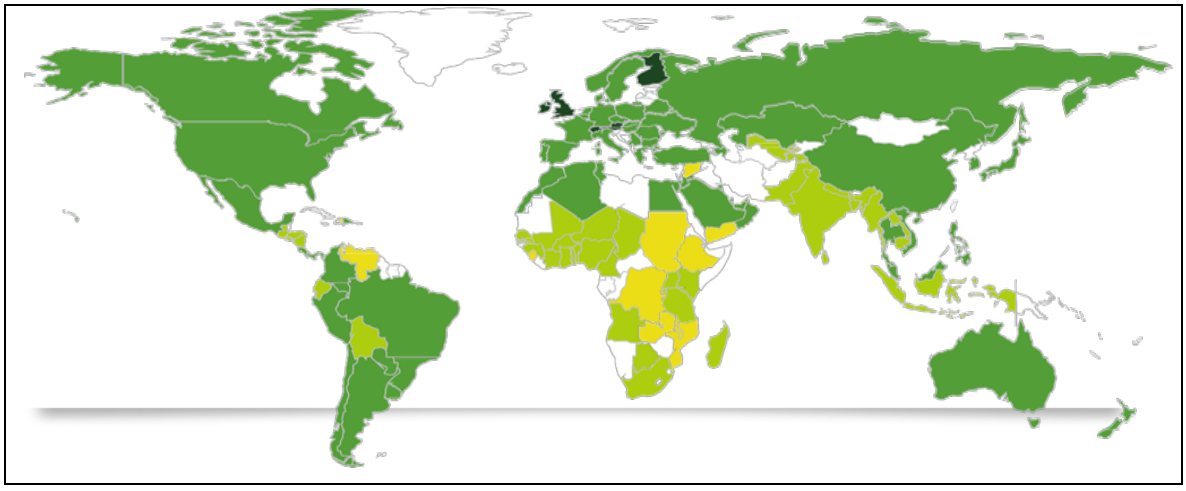
BASIC NEEDS INDEX (BNI)	International Fund for Agricultural Development (IFAD) Indices designed to measure rural poverty and deprivation	Index composed of education and health
RELATIVE WELLNESS INDEX (RWI)		Median of FSI, IPI, BNI

Source: Own elaboration (Spicker and Álvarez, 2009).

As claimed by Spicker and Álvarez (2009), "poverty has no single meaning. It contains a series of meanings related through a series of similarities" (p.292). Considering this thought, the table above was made, where it is observed that only the International Fund for Agricultural Development (IFAD) has a specific metric to measure food security, and although the rest do not have this explicitly, it is likely that, when considering the income variable, they measure it. It is significant to note that one of the first techniques for measuring poverty was based on the food variable proposed by Watts in 1967.

Moreover, the Global Food Security Index (GFSI) was created in 2011 to provide information on the development of the Sustainable Development Goals (SDGs). Next, the world heat map (Figure 2) is presented to represent the position of countries about food security, which has four dimensions: affordability, availability, quality and safety, and natural resources and resilience (Economist Impact, 2021).

Figure 2. Representation of the Global Food Security Index



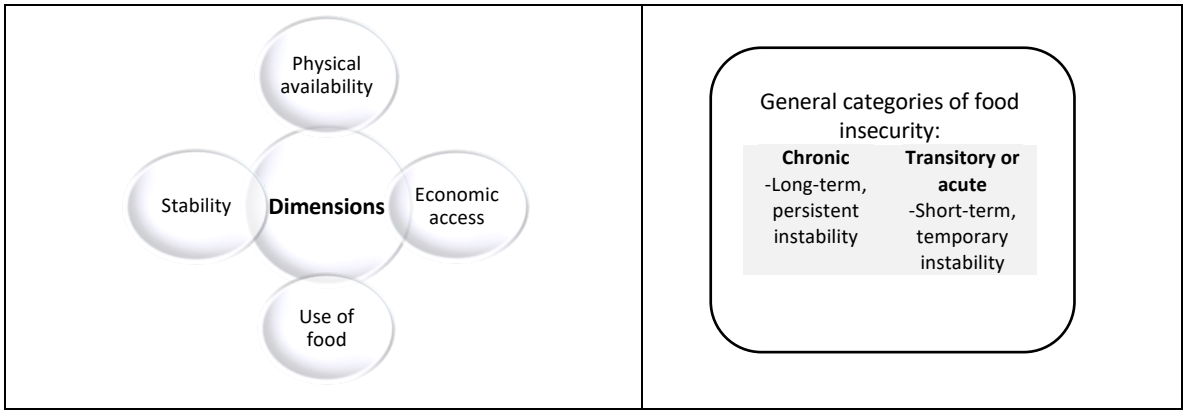
Note: The darker the color, the better the performance, so according to the Corteva Agriscience methodology, Mexico is a country of good performance in 46th place out of 113 countries; Ireland is the top-ranking country, followed by Austria and the United Kingdom, respectively.
Source: Global Food Security Index (2021)

Describing food poverty implies addressing food insecurity, which, according to the World Food Summit (FAO, 2011), exists when all people, always, have physical, social, and economic access to sufficient, safe, quality food that meets their requirements for a life of

quality and health. Food insecurity is defined as little or no access to adequate nutritional food for human development.

Furthermore, (CONEVAL, 2020a; 2020b) presents four dimensions of food security (figure 3) and it establishes that for food security goals to be met they must be achieved simultaneously, when an individual, household, or population lacks any of them - even for a short period - then the individual, household or population will be in a state of food insecurity.

Figure 3. Dimensions and categories of food security



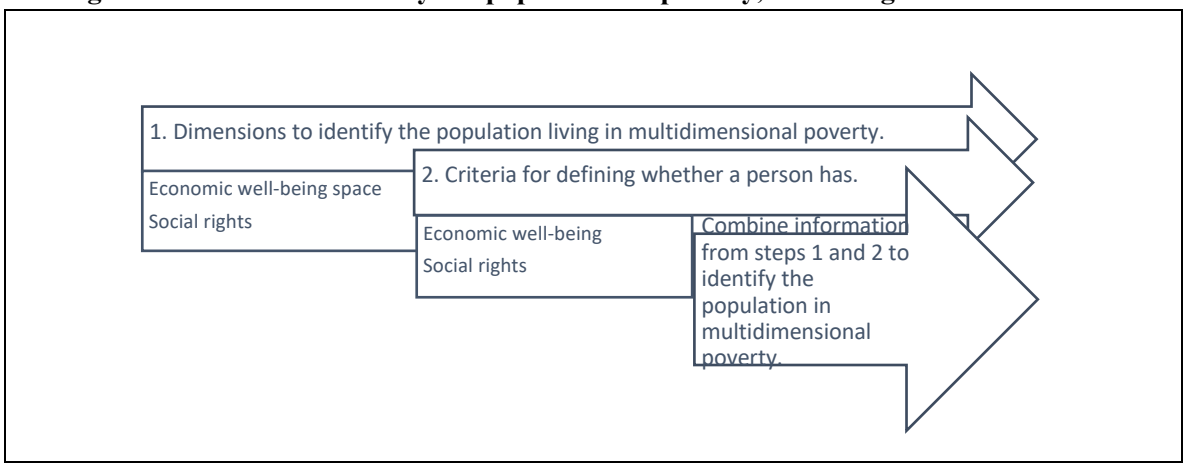
Note: Classification in terms of intensity of food insecurity was proposed in two categories: chronic and transitory, as shown in Figure 4.

Source: Own elaboration (Spicker and Álvarez, 2009; FAO, 2011).

When food security is not achieved, then the following types of insecurity arise 1. Moderate, 2. Acute, 3. Chronic and 4. Severe. The latter is when people are likely to have run out of food, go hungry and, in the most extreme case, go days without food, putting their health and well-being at serious risk (FAO, IFAD, WHO, WFP and UNICEF, 2019).

Considering the above, it can be said that food poverty, being closely linked to food insecurity, has indicators that can help with the gradual assessment of food insecurity, such as the variables level of household income and level of poverty. It should be noted that CONEVAL considers the following elements to identify the population in conditions of vulnerability due to poverty (Figure 4).

Figure 4. Elements to identify the population in poverty, according to the CONEVAL



Source: Own elaboration.

In the context of methodologies to measure poverty, Godinot (2021), of the Multidimensional Poverty Peer Network of the University of Oxford, has observed that there are five dimensions of poverty that are not studied. He has proposed a series of instruments to collect aspects of formal and legal work, physical security, social relations (connectivity), psychological well-being and happiness, and people's empowerment, through questionnaires with a Likert scale.

IMPACT OF THE COVID-19 PANDEMIC ON POVERTY

The World Bank (2021) predicts that global extreme poverty will increase not only because of the impact caused by the Covid-19 (coronavirus) pandemic but also by the forces of conflict and climate change. Many of the people who had barely escaped extreme poverty may fall back into it; it is estimated that because of the health crisis there will be more than 115 million people in extreme poverty.

The history taken up by the World Bank is from 2018, showing that, out of every five people below the international poverty line, four lived in rural areas. Children and women will be more vulnerable to a lack of skills and opportunities for a better quality of life.

Specifically, with economic information, more than 67% of the poor will live in poor countries affected by war and violence; those economies represent 10% of the world's population. In addition, more than 120 million poor people live in areas at risk of flooding due to climate change. The figures are alarming: in addition to this, and due to changes in land use, poverty will increase in urban areas, and formal jobs will be insufficient.

The latest research suggests that there is little chance of meeting the Sustainable Development Goals, and some of them are set to regress. According to the BBC News editorial report (May 2021), the projections made by the Economic Commission for Latin America and the Caribbean (ECLAC), in Latin America poverty reached its highest level in the last 12 years, affecting 33.7% of the population, that is, one in three Latin Americans is in hardship. Extreme poverty in Mexico soared from 10.6% to 18.3%.

In Latin America, the situation is serious, with poverty increasing from 20% to 26.1% in Honduras and from 7.6% to 12.8% in Ecuador. The only countries with low levels of poverty are Brazil and Panama. The closure of economic activities, the fall in employment, and the reduction of commercial and investment activities are only a reflection of inequality and poverty, which are not the result of the pandemic, but of previous crises: but financial, economic, real estate, and food crises.

METHOD AND RESULTS

To achieve the objective, an analysis is required of food poverty and the effects in terms of vulnerability in Mexico City from the capability approach. After the analysis of the poverty variable from the capability approach, the conceptual differences of inequality and poverty, the dimensions of the multidimensional metric, Mexico's food poverty situation was approached from the primary sources yielded by the results of the latest studies carried out by CONEVAL.

CONEVAL's methodology (Coneval, 2019) considers two units of analysis: economic well-being (based on per capita income) and social rights (six variables according to Mexican Social legislation: education, health services, social security, housing quality, spaces, and services).

For this study, the analysis focused on three aspects that are considered focal to observe the phenomenon of poverty and food insecurity: vulnerability due to social deprivation, income, and scarcity due to access to food.

The research is limited to four boroughs in Mexico City, two of which are because they reflect a greater number of poor people, as well as the two boroughs that are adjacent to the one with the highest number of poor. According to the selected criteria, the boundaries are as follows: Iztapalapa, Tláhuac, Iztacalco, and Gustavo A. Madero.

In the first part and with the delimitation according to the 2010-2015 measurement made by CONEVAL, it is presented through graphs that show the frequency as to the number of people, as well as the frequency of poor people living in Mexico City by borough.

Figure 5 shows the total population per borough and the number of poor people per borough. Iztapalapa, Gustavo A. Madero, Álvaro Obregón and Tlalpan have the highest population and highest rate of poverty.

Figure 5. Mexico City: 16 boroughs

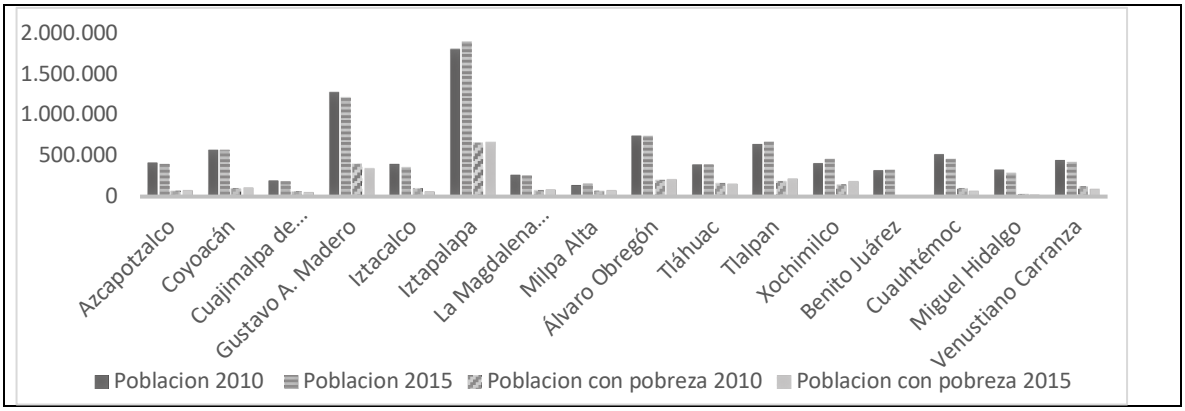
Mexico City	2,457,084	8,846,359
Azcapotzalco	77,859	400,254
Coyoacán	113,337	572,991
Cuajimalpa de Morelos	55,995	185,835
Gustavo A. Madero	344,966	1,215,014
Iztacalco	61,122	358,195
Iztapalapa	665,408	1,903,552
La Magdalena Contreras	85,716	263,139
Milpa Alta	76,765	156,147
Álvaro Obregón	208,689	748,509
Tláhuac	154,855	395,414
Tlalpan	217,122	677,137
Xochimilco	187,111	462,380
Benito Juarez	16,424	330,457
Cuauhtémoc	74,685	465,420
Miguel Hidalgo	20,367	287,260
Venustiano Carranza	96,663	424,655

Note: the image of the political division of Mexico City was taken from Mapa-de-alcadías-de-la-cdmx-para-imprimir.gif (946×731) (paraimprimir.org)

Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

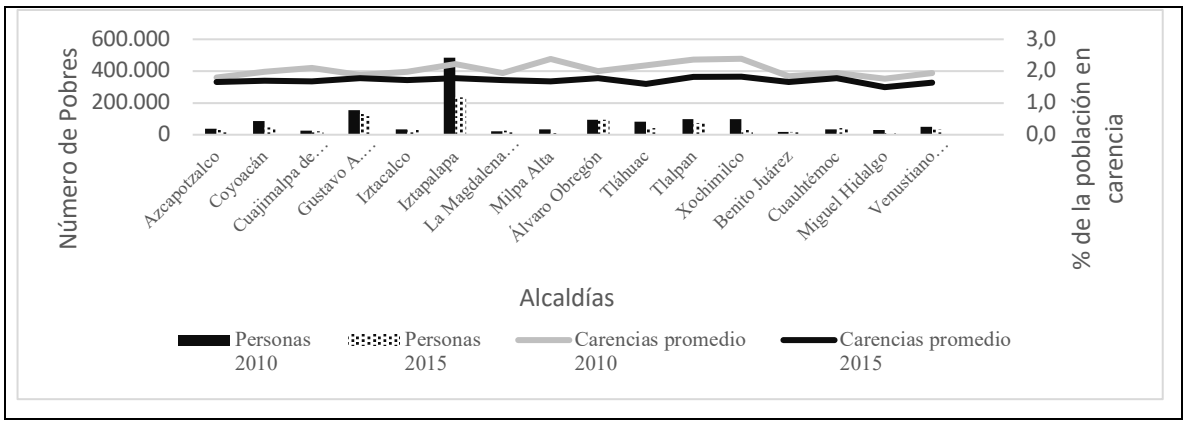
After identifying the areas with the poorest people by political division, the information was stratified to represent the four selected boroughs by population and poverty (Graph 1), and Graph 2 shows a comparison of the population in extreme poverty.

Graph 1. Population and poverty in Mexico City



Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

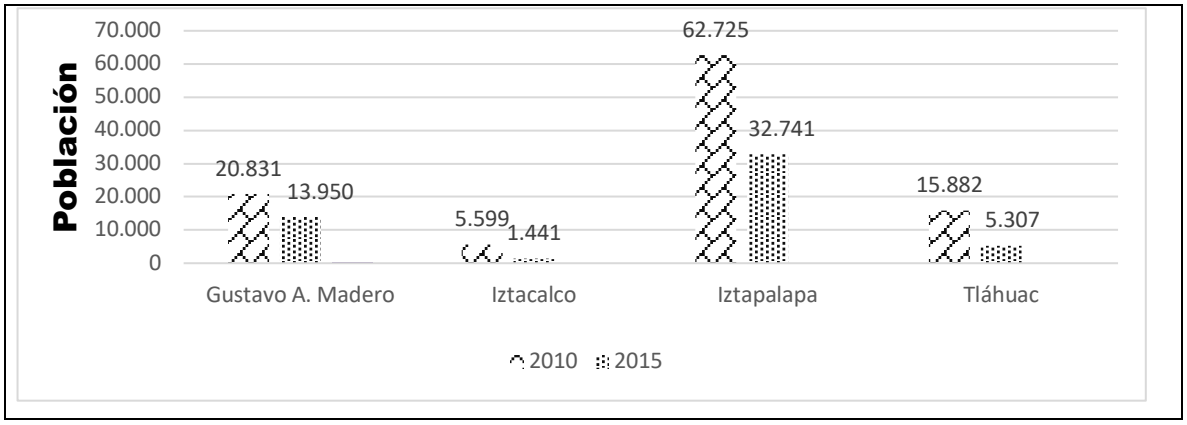
Graph 2. Population living in poverty and percentage with the total of Mexico City 2010-2015



Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

According to the results of the measurement of extreme poverty in 2010, the borough with the highest poverty was Tláhuac with 4.1%, while Iztacalco had the lowest extreme poverty with 1.4%, but in 2015 Iztapalapa reached 1.7% of extreme poverty and Iztacalco experienced its lowest level with 0.4%. Meanwhile, in 2010 Gustavo A. Madero saw 1.6% of its population living in extreme poverty and had a 1.1% decrease of this in 2015 (Graph 3).

Graph 3. Population living in extreme poverty 2010-2015

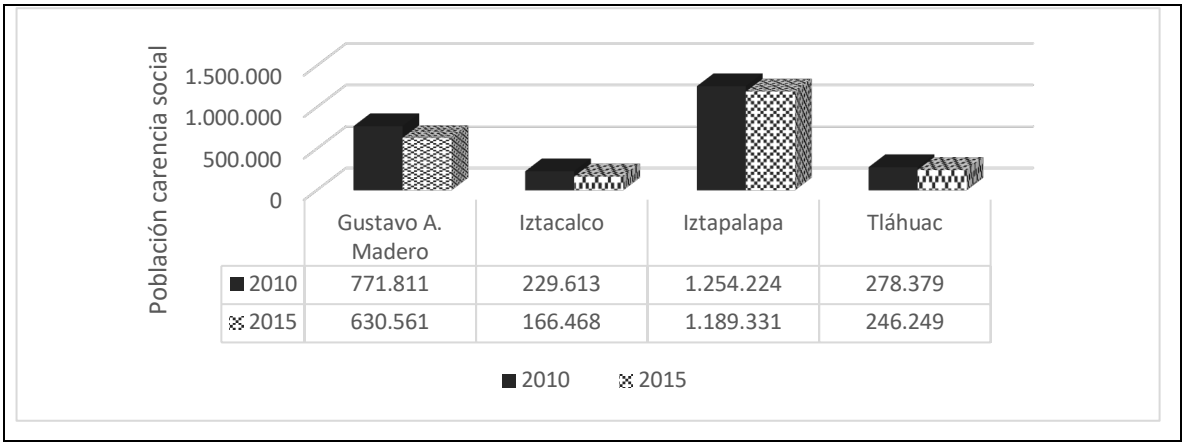


Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

Graph 4 shows the number of people in fragile situations due to social deprivation for 2010 and 2015 for the four boroughs. Social deprivation in 2010 shows that Iztapalapa had 33.0%, followed by Iztacalco with 31.8%. The lowest level was obtained by Tláhuac with 28.7%, while Gustavo A. Madero reached 28.8%. For 2015 Iztacalco decreased its vulnerability by reaching 29.4% but was the highest of the year, and Tláhuac was once again the lowest with

23.1%. Iztapalapa fell to 27.5% and Gustavo A. Madero has 23.5% of its population affected by this deprivation.

Graph 4. Number of people by lack of opportunities due to social deprivation 2010-2015



Note: Evolution of social deprivation in Gustavo A. Madero, Iztacalco, Iztapalapa and Tláhuac boroughs of Mexico City, 2010-2015.

Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

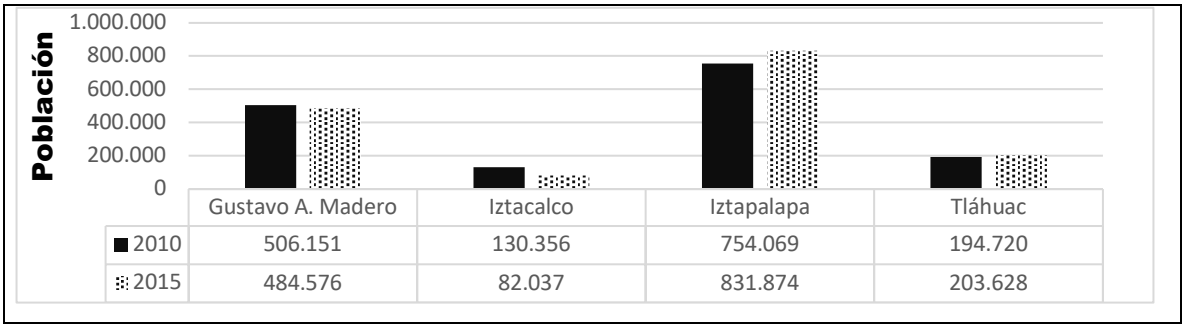
The variability in terms of the different vulnerabilities was obtained through K, variability index, where "n" is the number of populations:

$$K = \frac{n_{2015} - n_{2010}}{n_{2010}}$$

Concerning variability by social deprivation, it was observed that Iztapalapa was the one that decreased vulnerability due to social deprivation the least, since it only decreased by 0.0573, followed by Tláhuac with 0.1154, Gustavo A. Madero with 0.1830, and Iztacalco with 0.2750.

Regarding the monetary value of a basic food basket per person per month and the extreme poverty line by income, formerly the minimum welfare line, it was obtained that for 2010 the percentage of the population with lower income in the four boroughs have the following behavior: Gustavo A. Madero has 8.2% of the vulnerable population by income, in second place is Tláhuac with 7.3%, followed by Iztacalco with 6.9% and lastly Iztapalapa with 5.3%. For 2015 this increased in three boroughs: in the first place, Tláhuac with 12.3%, followed by Gustavo A. Madero with 11.5%, and Iztapalapa with 8.7%. Iztacalco presents a decrease of 5.8%. These percentages shown are the population that does not reach the level of income to acquire the basic food basket (Graph 5).

Graph 5. Vulnerable by income - income below the welfare line - 2010-2015

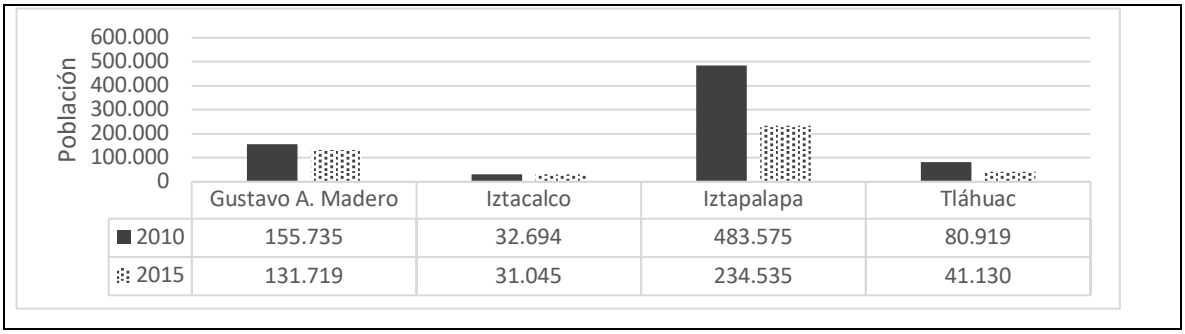


Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

It was observed that Iztapalapa increased the number of people when considering income on the welfare line in 2015, so the figure was 0.1031 more than in 2010, followed by Tláhuac with 0.0457. Iztacalco saw a decrease in the vulnerable population with 0.3706 and Gustavo A. Madero with 0.0426. The indicator on lack of access to food shows the population with moderate or severe limitations in always having access to sufficient food to lead a healthy and active life.

Graph 6 shows the indicator of food deprivation in the four boroughs of Mexico City. It is observed that the population of Iztapalapa has food deprivation of 26.8% in 2010, and by 2015 this had fallen drastically to 12.3%. Tláhuac's food deprivation had fallen from 20.7% in 2010 to 10.4% in 2015, Gustavo A. Madero from 12.1% to 10.8%, and Iztacalco from 8.2% to 8.7%. In 2018, the percentage of the population with food deprivation in Mexico City was 6.5% lower than the national average. Mexico City ranked 29th among the 32 states in terms of deprivation levels.

Graph 6. Food deprivation 2010-2015

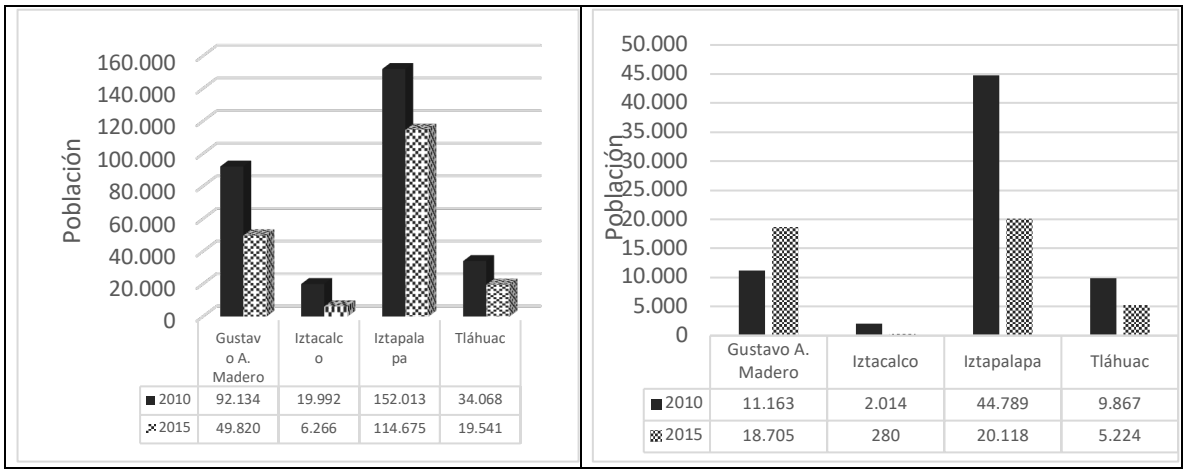


Note that in 2010 Iztapalapa has 3.1 times more people experiencing food deprivation than Gustavo A. Madero, suggestive of having income to pay for food; in 2015 the same borough has 1.78 times more.
Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

According to the information in Graph 4, in the four boroughs, the number of people at risk of food deprivation decreased by 0.1542, 0.0504, 0.5159, and 0.4917 in Gustavo A. Madero,

Iztacalco, Iztapalapa and Tláhuac, respectively, the latter two seeing significant decreases. It can be said that Iztacalco showed a greater decrease in poverty, with a difference of 8.8% between 2010 and 2015. On the other hand, Iztapalapa, and Tláhuac are the boroughs with the highest number of people in this condition. It is worth noting that, of these four boroughs in both 2010 and 2015, Iztapalapa is the one with the highest poverty index in the different indicators analyzed. The boroughs with the highest number of people lacking access to food in 2015 were Iztapalapa and Gustavo A. Madero. Graphs for housing variables are presented below (Graph 7).

Graph 7. Deprivation due to housing quality and space and basic services 2010-2015.



Note: in synthesis and according to the demographic dimension of the year 2015 CONEVAL methodology results, Iztapalapa has 1.164 million inhabitants, of which 28.39% are poor; Iztacalco amounts to 390,340 inhabitants, of which 17.06% are poor; Iztapalapa now has 1.828 million inhabitants, of which 34.96% are poor; and Tláhuac has 361,590 inhabitants, of which 39.16% are poor.
Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

Subsequently, data from the portal of the National Council of Science and Technology (CONACYT, 2021) were used regarding general information of Covid-19 of Mexico City, specifically for the four boroughs (Table 4).

Table 4. General information on Covid-19, Mexico City (CDMX)

	Covid-19 cases	*Percentage of total Covid-19*	*Total population 2021*	*Covid-19 incidence rate*
CDMX	977,533			
Gustavo A. Madero	110,776	11.33%	1,176,967	9.41%
Iztacalco	39,137	4.00%	393,821	9.93%
Iztapalapa	154,207	15.77%	1,815,551	8.49%
Tláhuac	50,886	5.20%	366,586	13.88%

Note: The incidence rate was determined as follows: Number of cases / Total population
To identify if the relationship between the variables of food deprivation and the number of Covid-19 cases, we proceeded to make the association of the variables between multidimensional poverty and Covid-19 cases.
Source: Own elaboration (Conacyt, 2021).

$$\text{Correl (X,Y)}=\frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2}\,\sum(y-\bar{y})^2}$$

Table 5. Association of variables: multidimensional poverty and Covid-19 cases

	Economic well-being	*Food deprivation*	*Gap in education*	*Health access*	*Social security access*	*Housing quality and spaces*	*Access to basic housing services*	*Covid cases*
Economic well-being	1.0000							
Food deprivation	0.9489	1.0000						
Gap in education	0.9490	0.9986	1.0000					
Health access	0.9235	0.9964	0.9922	1.0000				
Social security access	0.9185	0.9945	0.9963	0.9932	1.0000			
Housing quality and spaces	0.9115	0.9899	0.9939	0.9870	0.9990	1.0000		
Access to basic housing services	0.9943	0.9098	0.9108	0.8774	0.8722	0.8649	1.0000	
Covid-19 cases	0.9817	0.9916	0.9906	0.9792	0.9756	0.9698	0.9558	1.0000

Note: The significance of the relationship between food deprivation and vulnerability to the Covid-19 health crisis was performed using the F-test.

Source: Own elaboration (CONEVAL, 2014, 2018, 2019, 2020a, 2020b, 2021a, 2021b, 2021c, 2021d).

Finally, the relationship is strong and positive so it can be said that the greater the food poverty, the greater the vulnerability to Covid-19 (Tables 5 and 6).

Table 6. F-test for two-sample variances

	Food deprivation	*Covid cases*
Median	109607.25	88751.5
Variance	8985677700	2888298594
F	3.111062589	
P(F<=f) (one-tailed)	0.188087822	
Critical value for F (one-tailed)	9.276628153	

Where: Hi = Food poverty led to increased vulnerability to the Covid-19 crisis.

Source: Own elaboration.

CONCLUSION

The impact of poverty on the economic, political, sociocultural, and environmental setting is multifaceted and multidimensional. When talking about human development, Sen did so base on a vision that focuses not only on the products or goods a person owns; he does not consider only the material, but the model of life people has, how long they live, the type of health they have, education, the human being's ability to prefer what type of society they want to live in;

all these aspects have more weight than income. In terms of the methodology used in Mexico by CONEVAL, these are multidimensions.

Indeed, the monetary factor does not cease to be relevant, as we see that the public policies of the Mexican State, despite the investments and design of social programs that it has implemented at different times, have not been able to reverse the population's poverty figures, including food poverty. Mexico can produce food, but, among other circumstances, such as the distribution and waste of food for the population, this should be analyzed as there is food insecurity. However, it must be said that according to the global food security index it is ranked within the average. The fight against food insecurity represents a major challenge for the State, as it must design strategies with different stakeholders in society for social and economic recovery. In addition to the problems that the State may have, we must now add the effects of the pandemic that directly impacts the economic inequality among the population and the consequences of the planetary limits such as climate change, loss of biosphere, nitrogen, and phosphorus cycles, among others.

The work finds its main contribution in the identification of the direct and positive relationship that exists between the lack of food and people's vulnerability to the health crisis; although it is a predictable relationship, the result is interesting since the characterization took place based on historical data from 2010 and 2015, which were related to accumulated information of numbers of Covid-19 cases to November 2021. It was also observed that the Iztapalapa borough, despite having a greater number of poor people and Covid-19 cases in absolute numbers, was not the most vulnerable, but Tláhuac, which had an incidence of 13.88% vs 8.49%., which can be explained by the fact that the correlation found between Covid-19 cases and access to housing services such as drinking water, drainage, electricity, among others, was 0.9556. It should be noted that Tláhuac is a borough located between urban and rural areas.

Inequalities in money, skills, information, access to opportunities and food reflect asymmetries at the local, regional, and global levels.

It should be noted that among the limitations of the study is the lack of up-to-date information from primary sources. This work also finds as a suggestion for analysis the implementation of observatories to measure poverty according to local realities to create strategies to ensure access to food that contributes to nutrition and quality of life of the local population in the first place.

ACKNOWLEDGMENTS

This research is carried out within the framework of the research project registered with the SIP20211016.

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Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

Bibliographical Review

Sáez, D., & Cabanelas, J. (1997). Cooperar para competir con éxito. Madrid: Ediciones Pirámide.

https://doi.org/10.32870/myn.vi45.7668.g6727

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Received: December 5, 2021
Accepted: January 2, 2022

Cooperate to compete successfully is a short book in Spanish that provides a precise definition of cooperation between companies. The authors explain what cooperation entails and how companies can increase their competitiveness through cooperative ties. For the authors, cooperation is an intelligent response that aspires to increase competitiveness while facing changes.

The book consists of five chapters. The first, introductory chapter provides the founding base of the other four, the order of the contents and the way in which the book will achieve its objective and explain the aspects that substantially affect the competitiveness of companies.

The first chapter, *Structure of the work,* addresses the scenarios that encourage companies to cooperate in the contexts in which they need to adapt to the environment.

Determinants and implications (complexity, competitiveness and development) is the second chapter. It is dedicated to the theoretical concepts of cooperation. The authors clarify that approaching cooperation from a scientific perspective leads in practice to a better competitive advantage. The complexity of reality requires decision makers to have a better understanding, a long-term vision and the multiple realities' standpoint.

Cooperation, by itself, is not a guarantee of increased competitiveness. It is the reason why the authors have included as the third chapter *The decision to cooperate*. Cooperation is a

rational act that requires assessing and determining what will be created together, how and how much will be shared, all that in order to achieve jointly better results. The authors take as key elements: transaction costs, acts of opportunism and failure to cooperate (abandonment). The vision of these breaks with the romanticism and ideology that usually accompanies the term *cooperation*. It gives the reader a more realistic vision, focused on what reality the company faces when deciding between cooperating or competing with other economic agents (Cabanelas, Lorenzo & Liste, 2011; González, 2012, 2021; Cabanelas, 2019)

The fourth chapter, *Design of cooperation*, exposes to the reader the forms that cooperation can take as the result of negotiation and the interests of the stakeholders. The contractual form responds to a complex interpretation of the changing environment of each of the parties involved, plus the expectations of foreseeable and unpredictable changes.

The implementation of cooperation: instruments is the fifth and final chapter. In this part, the contractual forms of cooperation are put forward, presenting the legal environment and its role in closing and adjusting the cooperation.

The content and development of the work contributes to the objective stated by the authors, that is, explaining to the reader the aspects of cooperation that substantially affect the competitiveness of companies. It is a book that condenses many aspects and leaves the reader with the interest of delving further into the details of the rational act of cooperating, its design as well as the contractual forms of cooperation.

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Mercados y Negocios
1665-7039 printed
2594-0163 online
Year 23, N. 45, January-April (2022)

FINANCIAL AND ECONOMIC INDICATORS

Value at Risk (VaR)

https://doi.org/10.32870/myn.vi45.7665.g6726

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The technique (VaR) is a statistical measure of the risk. It is associated with financial risks related to the high volatility in prices, interest rates, or exchange rates. It is used massively by entities because of the necessity to measure risk in constantly traded portfolios.

The (VaR) is based on the principles of Portfolio Theory. With this, the risk resulting from the market position is managed and valued. This theory supports that a portfolio is efficient when it maximizes its return for a certain level of risk or minimizes its risk for a certain level of return. The (VaR) measures the relationship between profitability and risk to obtain an efficient portfolio. It takes up the concepts introduced by Markowitz (1959) and Sharpe (1964) and applies them in a standardized and statistically normalized context, with constantly updated databases.

Probability. The (VaR) of a portfolio is defined as the amount of money lost that does not exceed if the current portfolio is held for a certain period (market days instead of calendar days) with a specified probability. The level of significance or uncertainty in the benefits caused by changes in market conditions depends on the risk aversion of the investor, the more aversion, the lower the level of significance chosen.

Horizon. The risk horizon is the period over which the potential loss is measured. Depending on the liquidity, the different risks are valued over different periods, the more liquidity, the shorter the time over which the (VaR) is valued. In essence, the (VaR) of a portfolio is the minimum expected loss for a certain time horizon and confidence level, measured in a specific reference currency (Blanco & Garman, 1998).

For a single or simple position, risk is determined by position size and price volatility.

RISK = POSITION SIZE X VOLATILITY X PRICE

The (VaR) is calculated for a single financial product or all financial products in the portfolio. For example, if we have two highly correlated financial products (if one rises, the other tends to rise as well), the joint risk of the two securities may be greater than the sum of the individual risks. Lower correlations between financial products (the normal case) make the (VaR) of a portfolio less than the sum of the VaRs of the individual positions, this as an effect of diversification.

Methods for calculating the VAR. It is important to note that the (VaR) is valid under normal market conditions. If the market is in crisis, then the expected loss of a financial asset is calculated through other methods. Some of these alternative methods is the stress test or extreme values.

Financial losses are the result of statistics and the models and parameters used for their calculation, therefore, there are several ways to calculate (VaR), highlighting three of them:

a) Monte Carlo Simulation Method. Estimate the (VaR) by generating thousands of possible outcomes based on the initial data entered.
b) Historical Simulation Method. Calculate the (VaR) through the historical price data of each financial asset.
c) Analytical / Parametric Method. Delta - Gamma. Estimate the (VaR) using estimated profitability data.

In all cases, it is necessary to estimate the profitability distribution of a portfolio in two components:

1. Estimating the joint probability distribution for various risk factors affecting a portfolio. These factors can include many interest rates, share prices, or exchange rates, assuming the risk factors have had distributed as a normal one, with volatilities and correlations based on recent market behavior.
2. Determining a probability distribution for portfolio return based on the previously constructed joint distribution and the portfolio's sensitivity to each risk factor. The sensitivity will depend on its current composition, and thus the estimated (VaR) reflects the portfolio's current exposure to risk. The (VaR) analysis can be systematized, although it is necessary to have a database of volatilities and estimated correlations for all risk factors that may affect the portfolio.

Condition for the selection of the Value at Risk method. The method assumes a normal distribution for the price of all financial products. Use the modified duration to relate the change in price to the movement of interest rates. It establishes a confidence interval given the maximum variations in the price of a portfolio that it is willing to support. They must also consider the existing correlations between the elements of the portfolio. The method is valid

to carry out measures and control risks under normal conditions of financial markets and is applicable to products traded in liquid and transparent markets. The methodology assumes parallel movements in the interest rate curve, not allowing to simulate other movements.

Methodology (VaR) weaknesses. One flaw is that it only measures future risk in one direction. This sense can be one of the following two:

> a) Since the joint distribution of risk factors is based on the recent behavior of these factors in the market, the analysis does not consider sudden behaviors until they have taken place. For this reason, VaR analysis is replaced by other methods, such as Stress Testing.
> b) Since the analysis is based on the current structure of the portfolio, it measures the future risk of the portfolio according to the current composition.

The Risk Metrics of J.P. Morgan. It approximates (VaR) based on volatility and correlation, which implies several historical prices, price volatilities, and correlative data for all types of transactions.

The RiskMetrics model emerged in 1989. The owner of J.P. Morgan, Dennis Weatherstone, asked for a report that would measure in detail the financial risk of his company. In 1992, after an exhaustive study, the company published the RiskMetrics methodology (Padula & Bacchini, 2014).

Essentially, the method uses price/series fluctuations for all financial products. It includes, for example, exchange rates for two currencies, yield curves for Treasuries in USD, or equity prices depending on the most important indices.

A comprehensive risk management and control system encompasses risk measurement and includes the establishment of policies, procedures, guidelines, and controls. All financial entities must consider risk management in their organization charts and promote commitment to this process by senior management.

The (VaR) is a commonly accepted report as a measure of market risk, allowing the setting of limits and the establishment of comparisons between strategic business units, also, it favors the evaluation of the degree of execution of each branch of activity on an adjusted basis to risk, at the same time that it becomes a crucial measure for the determination of own capital requirements, providing a complete report on market risk, without becoming a comprehensive risk management and control system.

Currently, there is no optimal methodology for estimating (VaR). All have advantages and disadvantages. In practice, many entities use more than one model to measure financial risk.

They are clear that all applied analytical approaches and processes provide a useful view of market risk.

Financial indicators are useful performance measures for charting long-term financial direction, proposing clear strategies, and taking appropriate actions.

Next, the evolution of some economic and financial indicators of the Mexican environment is described and provided to facilitate decision-making related to personal and company strategies in a comprehensive manner.

1. National Consumer Price Index (INPC, Spanish)
2. The Price and Quotation Index of the Mexican Stock Exchange (IPC, Spanish)
3. Exchange rate
4. Equilibrium interbank interest rate (TIIE, Spanish)
5. CETES rate of return
6. Investment units (UDIS, Spanish)

1. NATIONAL CONSUMER PRICE INDEX (INPC)

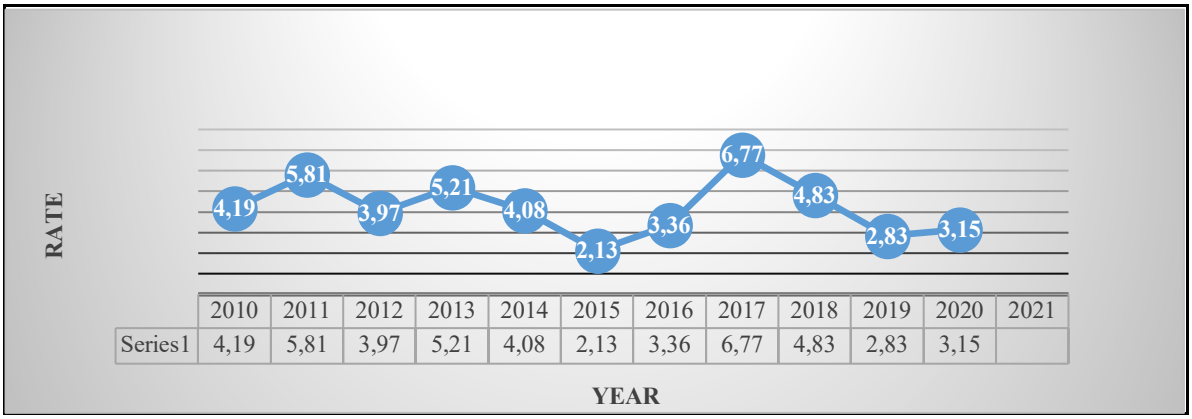
Born in 1995 and reflecting changes in consumer prices, measures the general increase in prices in the country. It is calculated fortnightly by the Bank of Mexico and INEGI (2021). INPC is published in the Official Gazette of the Federation on the 10th and 25th of each month. The reference period is the second half of December 2010.

Table 1. Accumulated inflation in the year (Base: 2nd. Fortnight of December 2010 = 100 with data provided by *Banco de México*)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	1.48	0.77	0.98	0.79	0.90	-0.09	0.38	1.70	0.53	0.09	0.48	0.86
February	2.15	1.42	1.47	1.46	1.15	0.09	0.82	2.29	0.91	0.06	0.90	1.50
March	2.52	1.84	1.55	1.99	1.43	0.51	0.97	2.92	1.24	0.44	0.85	2.34
April	1.98	0.72	0.69	1.81	1.24	0.25	0.65	3.04	0.90	0.50	-0.17	2.67
May	0.60	-0.70	-0.65	0.95	0.91	-0.26	0.20	2.92	0.73	0.21	0.22	2.88
June	0.49	-0.41	-0.41	1.12	1.09	-0.09	0.31	3.18	1.12	0.27	0.76	3.43
July	0.56	-0.04	0.32	1.14	1.42	0.06	0.57	3.57	1.66	0.65	1.43	4.04
August	0.91	0.30	0.92	1.31	1.73	0.27	0.86	4.08	2.26	0.63	1.82	4-24
September	1.27	0.73	1.12	1.61	2.18	0.27	1.47	4.41	2.69	0.89	2.06	4.88
October	2.35	2.33	2.12	2.77	2.74	1.16	2.09	5.06	3.22	1.44	2.68	5.76
November	3.89	4.87	3.86	4.57	3.57	1.71	2.89	6.15	4.10	2.26	2.76	6.97
December	4.19	5.81	3.97	5.21	4.08	2.13	3.36	6.77	4.83	2.83	3.15	

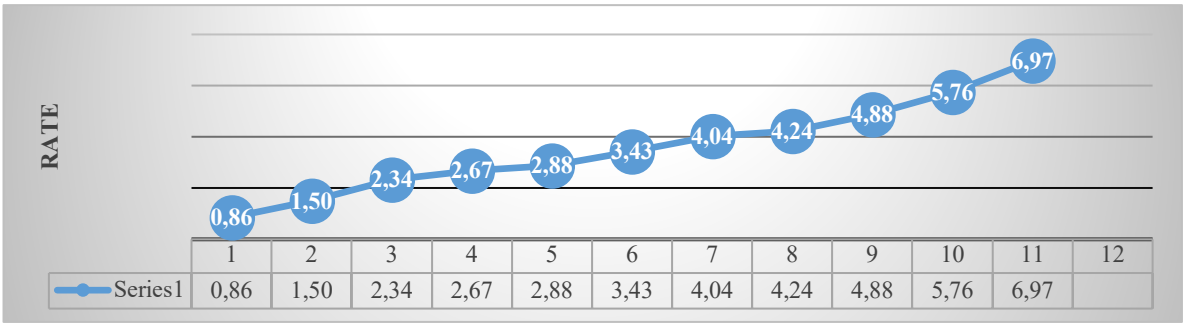
Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Índice de precios y cotizaciones de la Bolsa Mexicana de Valores > Último índice del mes

Graph 1. Inflation in Mexico (2010-2020 accumulated at the end of the year)



Source: Own elaboration (INEGI, 2021). Route: Precios e Inflation > National Consumer Price Index>Mensual > Índice > Índice general y por objeto del gasto > Índice general

Graph 2. Inflation in Mexico (accumulated January-November 2021)



Source: Own elaboration (INEGI, 2021). Route: Precios e Inflation > National Consumer Price Index>Mensual > Índice > Índice general y por objeto del gasto > Índice general

2. THE PRICE AND QUOTATION INDEX OF THE MEXICAN STOCK EXCHANGE (IPC)

Represents the change in the values traded on the Mexican Stock Exchange concerning the previous day to determine the percentage of rising or fall of the most representative shares of the companies listed therein.

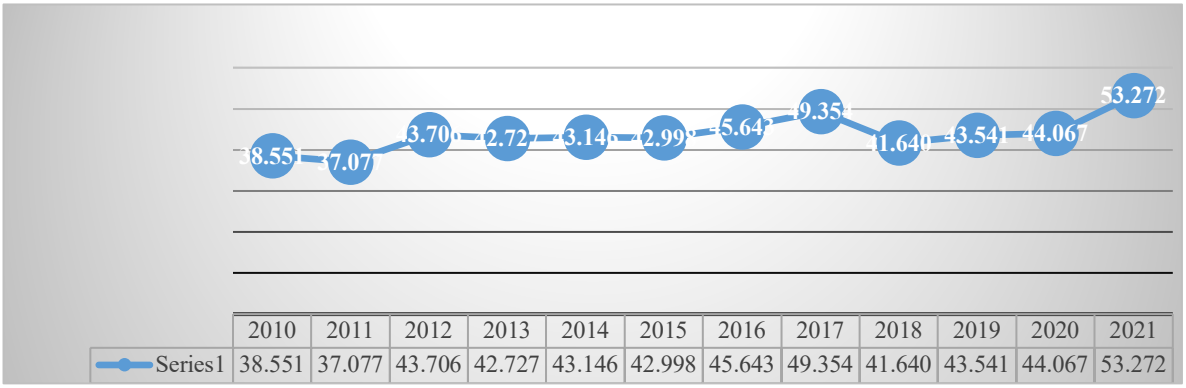
Table 2. The Price and Quotation Index of the Mexican Stock Exchange (Base: October 1978, 0.78=100)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	30,392	36,982	37,422	45,278	40,879	40,951	43,631	47,001	50,456	43,988	44,862	42,986
February	31,635	37,020	37,816	44,121	38,783	44,190	43,715	46,857	47,438	42,824	41,324	44,593
March	33,266	37,441	39,521	44,077	40,462	43,725	45,881	48,542	46,125	43,281	34,554	47,246
April	32,687	36,963	39,461	42,263	40,712	44,582	45,785	49,261	48,354	44,597	36,470	48,010
May	32,039	35,833	37,872	41,588	41,363	44,704	45,459	48,788	44,663	42,749	36,122	50,886
June	31,157	36,558	40,199	40,623	42,737	45,054	45,966	49,857	47,663	43,161	37,716	50,290
July	32,309	35,999	40,704	40,838	43,818	44,753	46,661	51,012	49,698	40,863	37,020	50,868
August	31,680	35,721	39,422	39,492	45,628	43,722	47,541	51,210	49,548	42,623	36,841	53,305

Sep.	33,330	33,503	40,867	40,185	44,986	42,633	47,246	50,346	49,504	43,011	37,459	51,386
Oct.	35,568	36,160	41,620	41,039	45,028	44,543	48,009	48,626	43,943	43,337	36,988	51,310
Nov.	36,817	36,829	41,834	42,499	44,190	43,419	45,286	47,092	41,733	42,820	41,779	49,699
Dec.	38,551	37,077	43,706	42,727	43,146	42,998	45,643	49,354	41,640	43,541	44,067	53,272

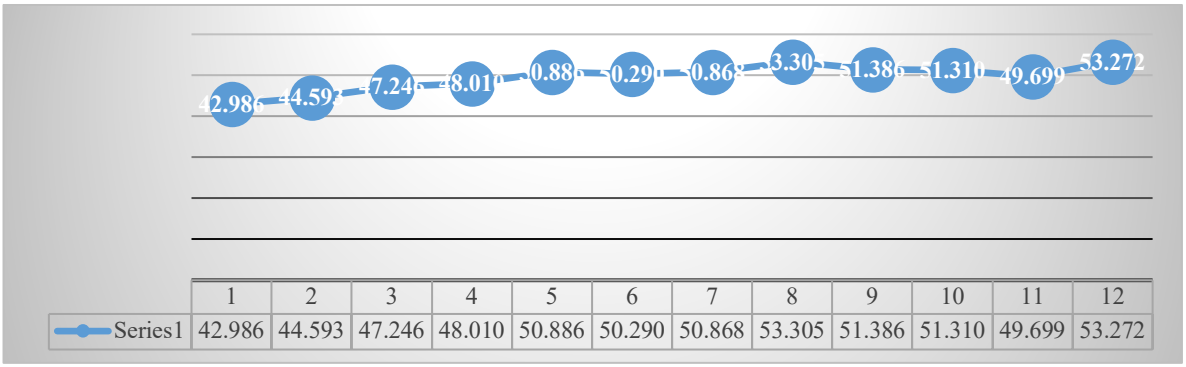
Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Índice de precios y cotizaciones de la Bolsa Mexicana de Valores > Último índice del mes

Graph 3. The Price and Quotation Index of the Mexican Stock Exchange, 2010 - 2021 (Score at the end of each year)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Índice de precios y cotizaciones de la Bolsa Mexicana de Valores > Último índice del mes

Graph 4. The Price and Quotation Index of the Mexican Stock Exchange, January-December 2021 (Score at the end of each month)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Índice de precios y cotizaciones de la Bolsa Mexicana de Valores > Último índice del mes

3. EXCHANGE RATE

Es el valor del peso mexicano con respecto al dólar calculado con el Promedio diario de los cinco bancos más importantes del país, que refleja el precio spot (de contado), negociado entre bancos. Está altamente relacionado con la Inflation, la rate de interés, y la Bolsa Mexicana de Valores.

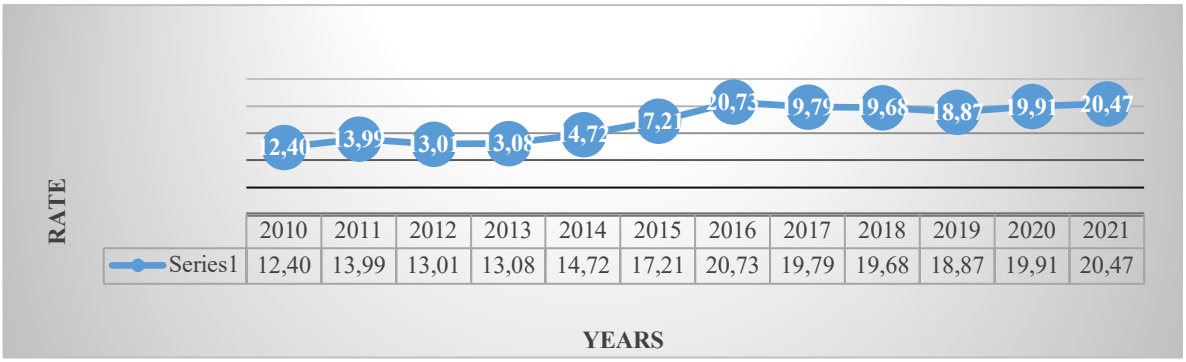
Table 3. Exchange rate (National currency per US dollar, parity at the end of each period)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	12.81	12.02	12.95	12.71	13.37	14.69	18.45	21.02	18.62	19.04	18.91	20.22
February	12.96	12.17	12.87	12.87	13.30	14.92	18.17	19.83	18.65	19.26	19.78	20.94
March	12.61	11.97	12.80	12.36	13.08	15.15	17.40	18.81	18.33	19.38	23.48	20.44
April	12.24	11.59	13.20	12.16	13.14	15.22	19.40	19.11	18.86	19.01	23.93	20.18
May	12.68	11.63	13.91	12.63	12.87	15.36	18.45	18.51	19.75	19.64	22.18	19.92
June	12.72	11.84	13.66	13.19	13.03	15.57	18.91	17.90	20.06	19.21	23.09	19.91
July	12.83	11.65	13.28	12.73	13.06	16.21	18.86	17.69	18.55	19.99	22.20	19.85
August	12.73	12.41	13.27	13.25	13.08	16.89	18.58	17.88	19.07	20.07	21.89	20.06
September	12.86	13.42	12.92	13.01	13.45	17.01	19.50	18.13	18.90	19.68	22.14	20.56
October	12.45	13.20	13.09	12.89	13.42	16.45	18.84	19.15	19.80	19.16	21.25	20.53
November	12.33	14.03	13.04	13.09	13.72	16.55	20.55	18.58	20.41	19.61	20.14	21.45
December	12.40	13.99	13.01	13.08	14.72	17.21	20.73	19.79	19.68	18.87	19.91	20.47

NOTE: Exchange rate FIX by The Banco de México, used for settle obligations denominated in foreign currency. Quote at the end

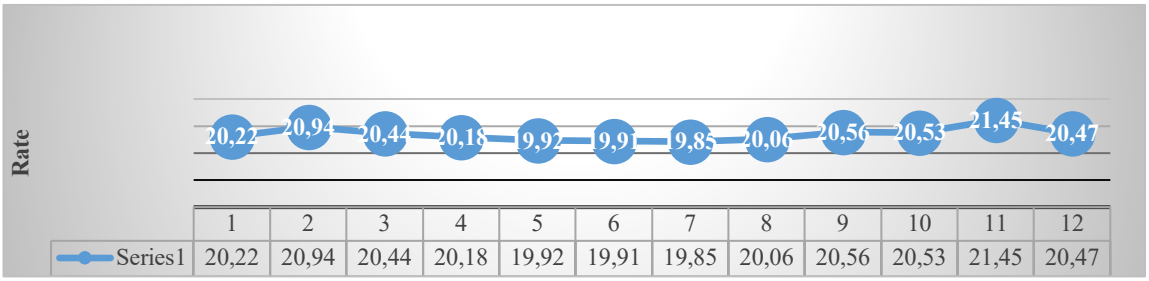
Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Cotización del dólar en el mercado cambiario nacional > Exchange rate para solventar obligaciones en moneda extranjera > Cotizaciones al cierre del mes. Venta

Graph 5. Exchange rate (National currency per US dollar, 2010-2021, FIX parity at the end of each year)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Cotización del dólar en el mercado cambiario nacional > Exchange rate para solventar obligaciones en moneda extranjera > Cotizaciones al cierre del mes. Venta

Graph 6. Exchange rate (National currency per US dollar, January-December, FIX parity at the end of each month)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Cotización del dólar en el mercado cambiario nacional > Exchange rate para solventar obligaciones en moneda extranjera > Cotizaciones al cierre del mes. Venta

4. EQUILIBRIUM INTERBANK INTEREST RATE (TIIE).

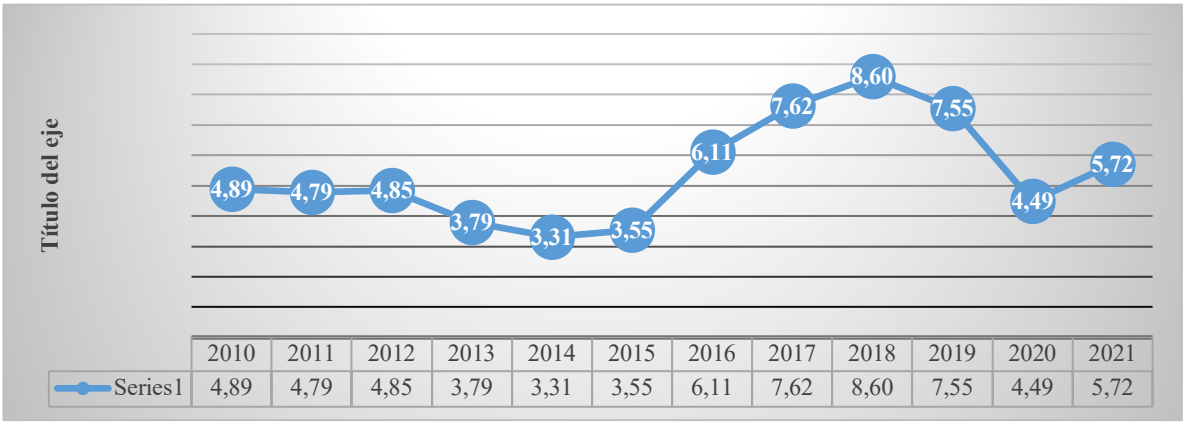
On March 23, 1995, the Bank of Mexico, to establish an interbank interest rate that better reflects market conditions, released the Interbank Equilibrium Interest Rate through the Official Gazette of the Federation.

Table 4. Equilibrium interbank interest rate (28-day quote)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	4.91	4.86	4.79	4.84	3.78	3.29	3.56	6.15	7.66	8.59	7.50	4.47
February	4.92	4.84	4.78	4.80	3.79	3.29	4.05	6.61	7.83	8.54	7.29	4.36
March	4.92	4.84	4.77	4.35	3.81	3.30	4.07	6.68	7.85	8.51	6.74	4.28
April	4.94	4.85	4.75	4.33	3.80	3.30	4.07	6.89	7.85	8.50	6.25	4.28
May	4.94	4.85	4.76	4.30	3.79	3.30	4.10	7.15	7.86	8.51	5.74	4.29
June	4.94	4.85	4.77	4.31	3.31	3.30	4.11	7.36	8.10	8.49	5.28	4.32
July	4.92	4.82	4.78	4.32	3.31	3.31	4.59	7.38	8.11	8.47	5.19	4.52
August	4.90	4.81	4.79	4.30	3.30	3.33	4.60	7.38	8.10	8.26	4.76	4.65
September	4.90	4.78	4.81	4.03	3.29	3.33	4.67	7.38	8.12	8.04	4.55	4.75
October	4.87	4.79	4.83	3.78	3.28	3.30	5.11	7.38	8.15	7.97	4.51	4.98
November	4.87	4.80	4.85	3.80	3.31	3.32	5.57	7.39	8.34	7.78	4.48	5.13
December	4.89	4.79	4.85	3.79	3.31	3.55	6.11	7.62	8.60	7.55	4.49	5.72

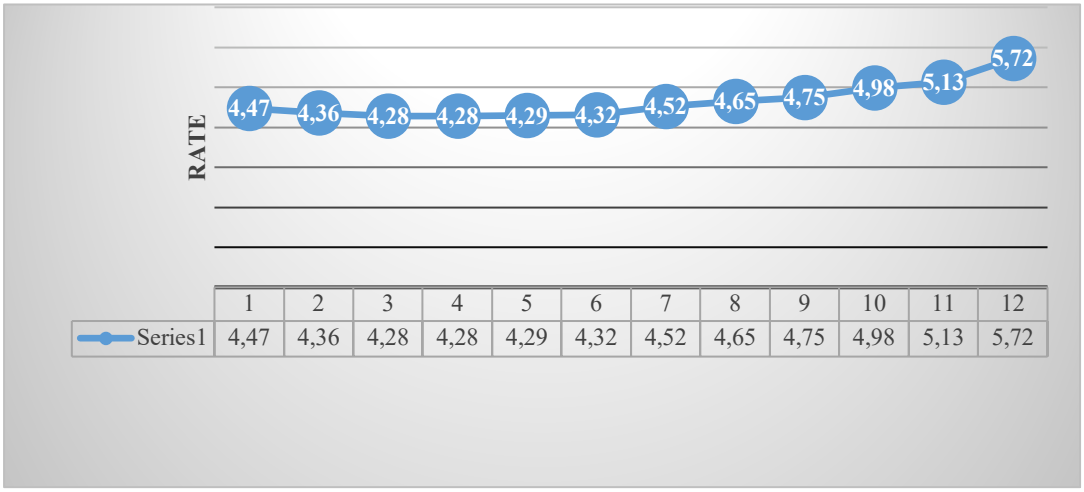
Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de interés bancarias > Equilibrium interbank interest rate (TIIE)(TIIE) >A 28 días (al cierre del mes)

Graph 7. Equilibrium interbank interest rate, 2010- 2021 (at the end of each year)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de interés bancarias > Equilibrium interbank interest rate (TIIE)(TIIE) >A 28 días (al cierre del mes)

Graph 8. Equilibrium interbank interest rate, January-December 2021 (28-day quote)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de interés bancarias > Equilibrium interbank interest rate (TIIE)(TIIE) >A 28 días (al cierre del mes)

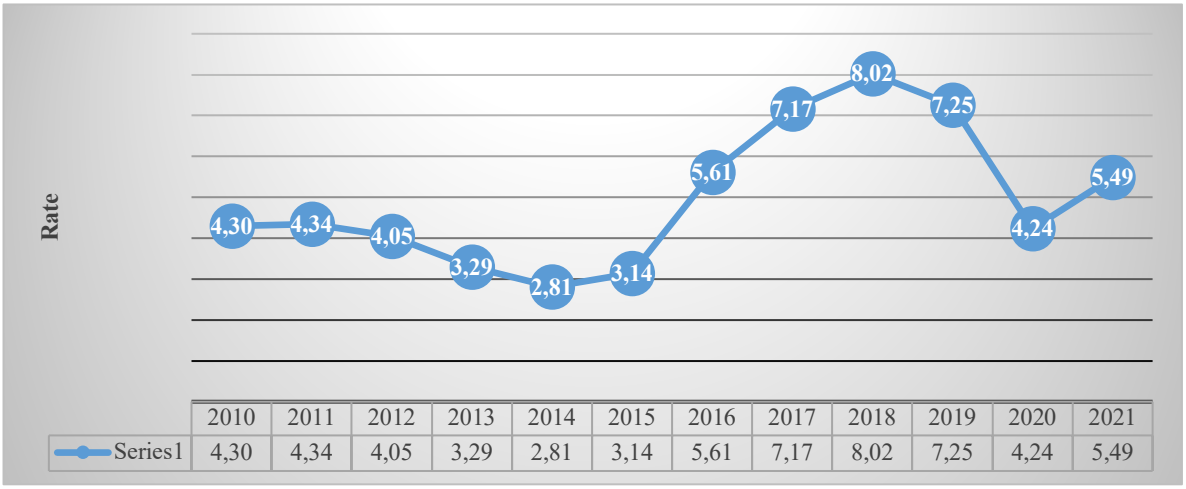
5. CETES RATE OF RETURN

Table 5. CETES rate of return (28-day)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	4.49	4.14	4.27	4.15	3.14	2.67	3.08	5.83	7.25	7.95	7.04	4.22
February	4.49	4.04	4.32	4.19	3.16	2.81	3.36	6.06	7.40	7.93	6.91	4.02
March	4.45	4.27	4.24	3.98	3.17	3.04	3.80	6.32	7.47	8.02	6.59	4.08
April	4.44	4.28	4.29	3.82	3.23	2.97	3.74	6.50	7.46	7.78	5.84	4.06
May	4.52	4.31	4.39	3.72	3.28	2.98	3.81	6.56	7.51	8.07	5.38	4.07
June	4.59	4.37	4.34	3.78	3.02	2.96	3.81	6.82	7.64	8.18	4.85	4.03
July	4.60	4.14	4.15	3.85	2.83	2.99	4.21	6.99	7.73	8.15	4.63	4.35
August	4.52	4.05	4.13	3.84	2.77	3.04	4.24	6.94	7.73	7.87	4.50	4.49
September	4.43	4.23	4.17	3.64	2.83	3.10	4.28	6.99	7.69	7.61	4.25	4.69
October	4.03	4.36	4.21	3.39	2.90	3.02	4.69	7.03	7.69	7.62	4.22	4.93
November	3.97	4.35	4.23	3.39	2.85	3.02	5.15	7.02	7.83	7.46	4.28	5.05
December	4.30	4.34	4.05	3.29	2.81	3.14	5.61	7.17	8.02	7.25	4.24	5.49

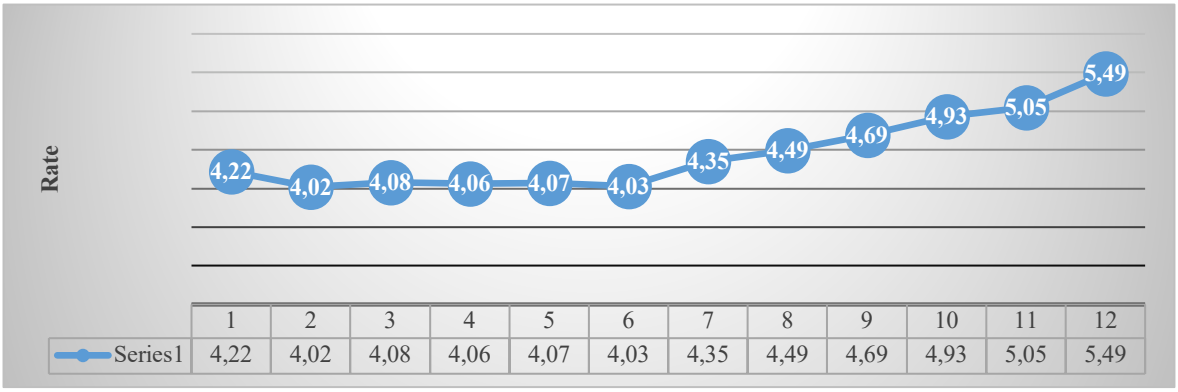
Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de rendimiento en instrumentos del mercado primario > Certificados de la Tesorería de la Federación (CETES) > 28 días

Graph 9. CETES rate of return 2010- 2021 (at the end of each year)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de rendimiento en instrumentos del mercado primario > Certificados de la Tesorería de la Federación (CETES) > 28 días

Graph 10. CETES rate of return, January-December del 2021 (at the end of each month)



Source: Own elaboration (INEGI, 2021). Route: Financiero y bursátil > Indicadores financieros y bursátiles > Rates de rendimiento en instrumentos del mercado primario > Certificados de la Tesorería de la Federación (CETES) > 28 días

6. INVESTMENT UNITS (UDIS)

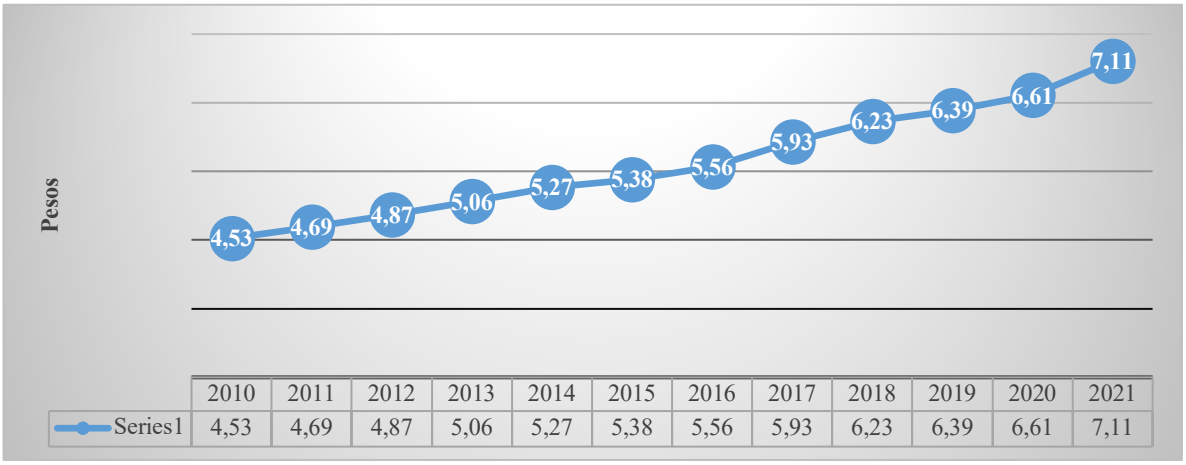
The UDI is a unit of account of constant real value to denominate credit titles. It does not apply to checks, commercial contracts, or other acts of commerce.

Table 6. Investment units (value concerning pesos)

Period	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
January	4.37	4.56	4.73	4.89	5.10	5.29	5.41	5.62	5.97	6.25	6.44	6.64
February	4.41	4.57	4.75	4.92	5.13	5.29	5.43	5.69	6.00	6.25	6.46	6.70
March	4.44	4.59	4.75	4.94	5.15	5.30	5.44	5.71	6.02	6.26	6.49	6.75
April	4.46	4.59	4.75	4.97	5.15	5.32	5.45	5.75	6.03	6.28	6.43	6.79
May	4.43	4.58	4.71	4.96	5.13	5.29	5.42	5.75	6.01	6.27	6.42	6.81
June	4.41	4.55	4.74	4.95	5.13	5.28	5.42	5.75	6.01	6.26	6.44	6.83
July	4.42	4.57	4.77	4.95	5.14	5.28	5.42	5.76	6.04	6.27	6.49	6.87
August	4.43	4.58	4.78	4.95	5.16	5.29	5.44	5.79	6.07	6.29	6.52	6.90
September	4.44	4.59	4.80	4.97	5.18	5.31	5.45	5.82	6.11	6.29	6.55	6.92
October	4.47	4.61	4.83	4.99	5.20	5.33	5.49	5.84	6.13	6.31	6.57	6.97
November	4.50	4.64	4.85	5.02	5.23	5.36	5.53	5.89	6.17	6.35	6.60	7.04
December	4.53	4.69	4.87	5.06	5.27	5.38	5.56	5.93	6.23	6.39	6.61	7.11

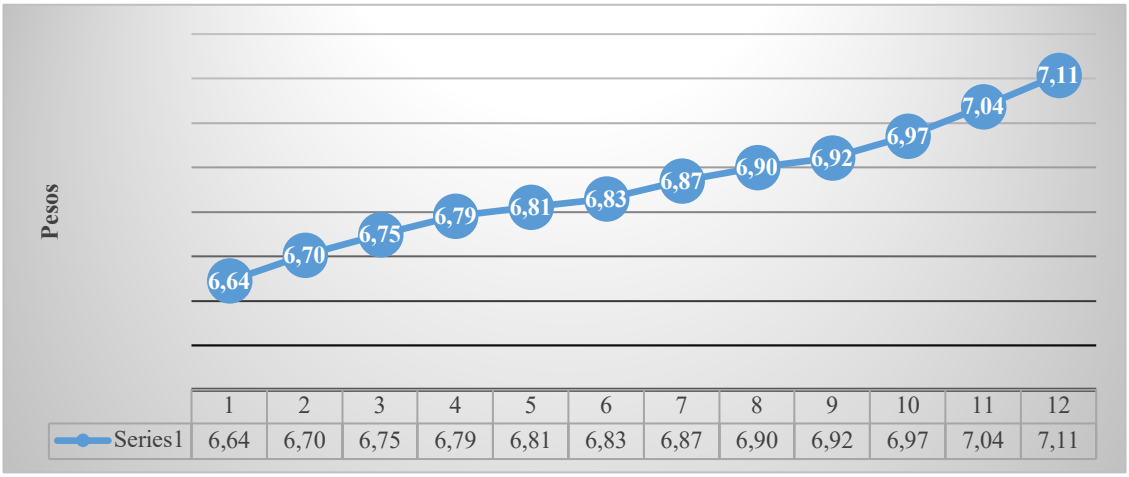
Source: Own elaboration (INEGI, 2021). Route: Indicadores económicos de coyuntura > Indicadores financieros > Exchange rate del peso respecto al dólar y valor de las UDIS > Valor de las Investment units (UDIS)

Graph 11. Investment units 2010-2021 (At the end of the year)



Source: Own elaboration (INEGI, 2021). Route: Indicadores económicos de coyuntura > Indicadores financieros > Exchange rate del peso respecto al dólar y valor de las UDIS > Valor de las Investment units (UDIS)

Graph 12. Investment units, January-December 2021



	1	2	3	4	5	6	7	8	9	10	11	12
Series1	6,64	6,70	6,75	6,79	6,81	6,83	6,87	6,90	6,92	6,97	7,04	7,11

Source: Own elaboration (INEGI, 2021). Route: Indicadores económicos de coyuntura > Indicadores financieros > Exchange rate del peso respecto al dólar y valor de las UDIS > Valor de las Investment units (UDIS)

On April 1, 1995, the Decree establishing the obligations corresponding to the UDIS was published in the Official Gazette of the Federation. Since April 4, 1995, the Bank of Mexico publishes in the Official Gazette of the Federation the value in the national currency of the Investment Unit, for each day.

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