

Efficiency in combating femicides in Estado de México

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Research article

Received: July 23, 2020

Accepted: November 19, 2020

Available online: December 21, 2020

Abstract

Femicide is one of the main problems currently occurring in Mexico. The level of femicide has been growing during the last decade resulting in many public protests and creation of new public strategies to combat it. However, these strategies seem inefficient as the situation is not getting better. Therefore, it is important to analyze public security systems in order to find possible areas that could lead to lower level of femicide. Estado de México is one of the most violent Mexican states. That is why, we apply Data Envelopment Analysis model to analyze the efficiency of public security system in 120 municipalities in Estado de México. The results revealed very low efficiency across the whole state and a relation between the population size and the level of the efficiency. The results suggest that the efficiency could be improved by eliminating the understaffing of personnel involved in security, gender equity and women's rights.

Key words: Data Envelopment Analysis, Femicide, Mexico, Municipalities, Public security system, Violence.

Eficiencia en la lucha contra los feminicidios en el Estado de México

Resumen

El feminicidio actualmente es uno de los principales problemas en México, su nivel ha ido aumentando durante la última década y, como consecuencia, han habido diversas protestas, así como la creación de nuevas estrategias públicas para su combate. Sin embargo, estas estrategias parecen ser ineficientes al no verse mejora en la situación. Por lo tanto, es importante analizar el sistema de seguridad pública, con el fin de encontrar áreas que puedan conducir a disminuir el nivel de feminicidios. El Estado de México es una de las entidades más violentas en México, por lo cual en este documento se aplicó el modelo DEA por sus siglas en inglés (Data Envelopment Analysis), para analizar la eficiencia de la seguridad pública en 120 de sus municipios. Los resultados mostraron una muy baja eficiencia en gran parte de la entidad, la cual se ve relacionada con la cantidad de población con la que cuentan. Los resultados sugieren que la seguridad brindada puede mejorar eliminando la falta de personal involucrada en equidad de género en resguardar la seguridad, así como los derechos de las mujeres.

Palabras claves: Data Envelopment Analysis, Feminicidio, México, Municipios, Sistema de seguridad pública, Violencia.

1 Introduction

Since the investigation done by the journalist Lorena Wolffer about the murder of women in Ciudad Juárez, Mexico, femicide is a topic in the eye of the storm and of huge importance for Mexican society (Álvarez Díaz, 2003). Lorena Wolffer has written about hundreds of disappeared women, much of them raped, mutilated and burned. As a result of this writing, at least 300 bodies were found in 2002 (Álvarez Díaz, 2003). After this investigation, we can distinguish the following stages in Mexico against this problem: visibility of the problem and its insertion into the public eye; the conceptual elaboration and creation of the category of “femicide”; the passage of legislation that protects the women’s right to a life free of violence; the recognition of systematic gender violence in Mexican culture; the approach to possible causes and solutions; and the inclusion of the problem on the national feminist agenda (Castañeda Salgado, 2016). Actually, since 2002, the problem has been attacked by a movement called “Ni una menos”, which consists of diverse domestic and international organizations and individuals. According to Wright (2006), their demands are plain: 1) that the state implements strategies for preventing further deaths and kidnappings; and 2) that state conducts competent investigations into the already committed crimes.

Unfortunately, between 2002 and 2014, only one person has been convicted for one murder. In Mexico, gender equity remains a pending issue that hurts not only society, but also the dignity of women who, numerically, constitute more than half of the country. We are far as society to achieve true gender equity. Inequity, lack of opportunities, violence, ignorance, poverty, and preventable deaths, among other relevant issues, continue to affect Mexican women (Moctezuma Navarro, Narro Robles & Orozco Hernández, 2014). According to data from the 2010 Population and Housing Census (INEGI, 2010), women currently represent 51.2% of the total population; 52% of the population aged 15 and over, (Population of working age) and 51.5% of Mexicans registered in the electoral roll. Likewise, in the 2011-2012 school year, women make up 49.8% of the country’s total school enrollment (SEP, 2012). The most condemnable expression of gender inequity is, without a doubt, violence against women. In addition to the inequality and discrimination faced by women in society, in politics and in the labor market, violence of a physical, sexual, or psychological nature is added.

Activists and scholars have called this violence as femicide, in reference not only to the crimes, but also to the impunity that surrounds them (Monárrez Fragoso, 2001). This term was introduced by Diana Russell and Jill Radford, as they defined femicide as “the misogynist murder of women just because they’re women” (Radford and Russell, 1990). The femicide practice covers a whole series of actions and process of sexual violence, from emotional and psychological abuse, hits, insults, torture, rape, prostitution, sexual harassment, child abuse, girls infanticide, genital mutilation, domestic violence, forced motherhood, food privation, pornography or any kind of practice that concludes with a woman’s murder (Monárrez Fragoso, 2000).

The national survey on household relationship dynamics (ENDIREH, 2016) helps us to determine the prevalence of violence against women in Mexico. We can certainly say that violence against women is a huge dimension problem and a social practice widely extended all around the country. The main findings in the survey were the following: 30.7 out of the 46.5 million of women over 15 years in Mexico (representing 66.1%) have suffered some kinds of violence at least once in their lives; 43.9% of them have suffered aggressions from their husbands, actual couples or even past couples. In 2018, in Mexico, 3,752 femicides were registered, the highest number in the last 29 years (1990-2018). In other words, this means that approximately 10 women

are murdered daily for intentional aggressions (INEGI, 2019). Currently, the impact of femicides in Mexico is attributed to their shocking increase in the recent years. As Figure 1 shows, we can assure that between years 1985-2007 the femicides tended to be constant with a little decreasing behavior. However, between 2008 and 2013 the numbers increased dramatically, followed by an improvement in the years 2013, 2014 and 2015. Unfortunately, for the last 2 years this behavior was interrupted by a stunning increase in the number of deaths.

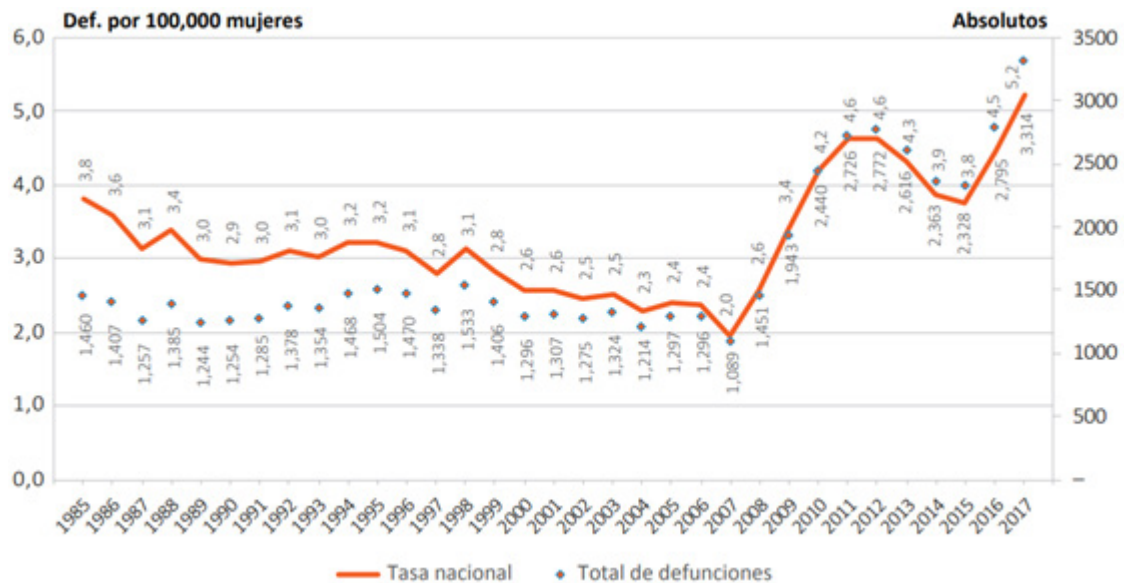


Figure 1: Female deaths with presumption of homicide in the periods 1985-2017 (ONU Mujeres, 2019)

Several reasons are assumed as the causes of femicide. One of the main reasons is related to the women’s search of autonomy, to be treated as a person, rather than as an object in every aspect of their lives (Chuque Sánchez & Tuesta Espinoza, 2019). Women’s autonomy is fundamental to ensure that their human rights are respected. There are 3 types of autonomy every woman should enjoy: *Physical autonomy*, which relates to having control and decisions over their own bodies; *Economic autonomy*, in which women have to be able to produce their own income and resources, and, finally, *Decision making autonomy*, which represents full participation and independence when women make decisions that affect their lives. However, in several occasions, men do not realize this, or they even disagree with it, and this creates the way to the confrontations (Chuque Sánchez & Tuesta Espinoza, 2019). The causes of this behavior are related with historical society facts. Many people have issues accepting that, nowadays, women have the same value and the opportunity to make things that encourage their personal and professional development (Russell et al., 2006).

Aggressors tend to have several common characteristics, such as insecurity associated with violence, regret about their actions, provoking that they end justifying themselves (Chuque Sánchez & Tuesta Espinoza, 2019). This regret is commonly a consequence of a woman’s murder since it has been shown that the aggressor is typically her intimate male partner. Moreover, these intimate femicides, whether committed by spouses, common-law partners or lovers, have several characteristics in common that distinguish them from other

primary killing groups (Dawson & Gartner, 1998). In fact, a regression analysis made among U.S., Germany and Italy showed young women result at higher risk, and most murdered women are killed by people they know (Terranova & Zen, 2018).

Consequences tend to be of serious magnitude because women usually do not give the proper importance to violence in their relationships (IMJUVE, 2017). As a consequence, in Mexico 76% of the teenagers between 15 and 17 years old have suffered psychological violence, 17% sexual violence and 15% physical violence. Nevertheless, this is not just a problem of teenagers. According to INMUJERES (2010), 41.2% of women aged 15 and over, married or with a partner, have suffered some type of violence from their partner and, in the case of divorced or separated women, this percentage reaches 72%. Thousands of women do not distinguish when their partner begins to have a violent behavior as some of the first signs are almost imperceptible. For example, awkward comments, small physical aggressions and complains about her clothes, friends, among others, are the first signs of the violent behavior (ENVIV, 2019). This behavior tends to be attributed to the current social violence that seems to be constantly presented in our country, in public spaces, homes, schools, etc. Problems such as narcotraffic, bullying, familiar violence, among others are things that Mexicans are related with since their early ages. This can be seen as the basis for the increase of violence in many cases (Olivera & Furio, 2006).

Other important cause of this kind of violence are stereotypes. The problem is that men are idealized as strong and dominant leaders, while the ideal of a woman is as fragile, submissive, pacific, etc. (Olivera & Furio, 2006). The violence against women is multiplied by these stereotypes and by the pressure produced by unemployment, poverty, social polarization, alcoholism, and insecurity, among the other problems that fill daily life with tension (Olivera & Furio, 2006). Analyzing this violence implies the recognition of inequities in different relations and contexts where women dominated by men is a regular scenario. According to Bejarano Celaya and Arellano Gálvez (2014), the abuse of power is the main element if violent expressions, where domination its permitted thanks to social structures that work with men logic. Male domination is originated by the social division of men and women, which gives place to things that do not require of any justification as long as it fits in these schemes. When accepting them, the violence becomes invisible, it is assumed, naturalized and assimilated. This is what is called the *symbolic violence* (Bejarano Celaya & Arellano Gálvez, 2014). When all of this gets out of control, violence against women is for sure the main consequence. It is important to point out that this crime not only affects the right to live, it is also a violation of women's rights which has a negative effect in the society, because it affects legal assets, security, equality and it increases discrimination, among others (OCNF, 2014). The way these thoughts are normalized and transmitted from generation to generation has become a worrying issue for Mexican population, and it only remarks the importance of taking actions as soon as possible.

We can see in Figure 2 the top ten Mexican states with the most femicides. We can verify the increase of the cases in the last years in the same way as Figure 1 shows. However, the aggregated result in Figure 1 is now disaggregated by states. In the last two years, Estado de México has been the entity with the most femicides and with the biggest growth of the femicide cases. Jaen Cortés et al. (2015) estimated that in Estado de Mexico in 2013 only 2% of the gender equity resources were destined to combat intrafamiliar violence (Jaen Cortés et al., 2015). It is relevant to put special attention to the municipality Ecatepec de Morelos where many social problems such as poverty, margination and analphabetism are very common. As a result, this

municipality has the highest numbers of violence against women, with more than 200,000 cases (Jaen Cortés et al., 2015).

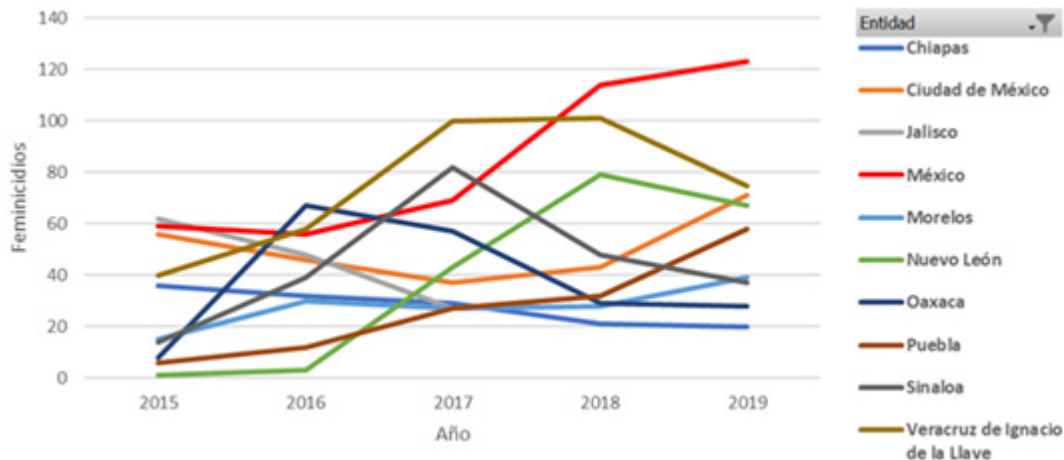


Figure 2: States with the highest number of femicides per year in the periods 2015-2019

The problem of femicide is complex and to find a solution that can improve this situation is hard. However, one of the possible ways how to improve this situation is to search for possible improvements of the public security system. The improved efficiency in public systems can lead to better public performance. For example, on August 2014 Giannikos and Pettas (2014) presented a framework for comparing the administrative efficiency of public spending programs at local level based on a novel application of Data Envelopment Analysis (DEA). The framework focused on the European Union context and, specifically, on the Greek Leader operational program. The results of this application indicate that DEA, in contrast to traditional performance metrics, is an insightful tool in revealing administrative inefficiencies in program delivery by capturing the operational and scale components of performance while taking into account the complex mix of tasks and interventions carried out by its operators (Giannikos & Pettas, 2014). On the other hand, we have the case of the excessive debt of the Spanish economy, which raised the problem in the management of public resources. This problem was also analyzed using DEA methodology. Orive Serrano, Latorre Martínez and Artero Muñoz (2016) observed that several corporations are not efficient and need to make decisions regarding their inputs if they want to guarantee their sustainability. Similarly, Muhammad A. (2017) used DEA to analyze resources allocation in Lahore, a large Metropolitan city in Pakistan. The authors wanted to create a framework for measuring police efficiency in order to detect areas for improvements.

The objective of this article is to analyze the efficiency of the public security system in all municipalities in Estado de México in order to combat the number of femicides using Data Envelopment Analysis. Such analysis can enable an efficient redistribution of public resources into those municipalities where needed.

2 Materials and Methods

Data Envelopment Analysis

The Data envelopment Analysis (DEA) allows to evaluate several decision-making units (DMU) regarding their capabilities to convert multiple inputs into multiple outputs (Cooper, Seiford & Zhu, 2011). Each DMU can

have several different m input quantities to produce different outputs. If the model assumes consistent yields at scale, you can use the so-called CCR model (Charnes, Cooper & Rhodes, 1978). The CCR output-oriented model for DMU_0 is formulated as follows:

Minimize

$$q = \sum_{i=1}^m v_i x_{i0} \tag{1}$$

subject to

$$\sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s \mu_r y_{rj} \geq 0, \quad j = 1, 2, \dots, n. \tag{2}$$

$$\sum_{r=1}^s \mu_r y_{r0} = 1,$$

$$\mu_r, v_i \geq \varepsilon \text{ and } \varepsilon > 0.$$

Where x_{ij} is the quantity of the input i of the DMU_j , y_{rj} is the amount of the output r of the DMU_j , and μ_r and v_i are the weights of the inputs and outputs $i = 1, 2, \dots, m$, $j = 1, 2, \dots, n$, $r = 1, 2, \dots, s$ and ε is the so-called non-Archimedean element necessary to eliminate zero weights of the inputs and outputs. DMU is 100% efficient if $q = 1$, i.e., there is no other DMU that produces more outputs with the same combination of inputs. Whereas, DMU is inefficient if $q < 1$.

Data

The analysis includes 120 out of the 125 municipalities of Estado de México (Figure 6). The 5 missing municipalities which we could not include due to lack of available information were: Donato Guerra, Lerma, Nicolas Romero, San Felipe del Progreso and Texcaltitlan. The level of femicide in the Estado de México is shown in Figure 3 (those states in in gray color are those with the missing information). We can see that the highest level of violence against women is reported in the Northern border of Mexico City in municipalities of Ecatepec de Morelos, Toluca, Tlalnepantla de Baz, Naucalpan de Juárez and Cuautitlán Izcalli.

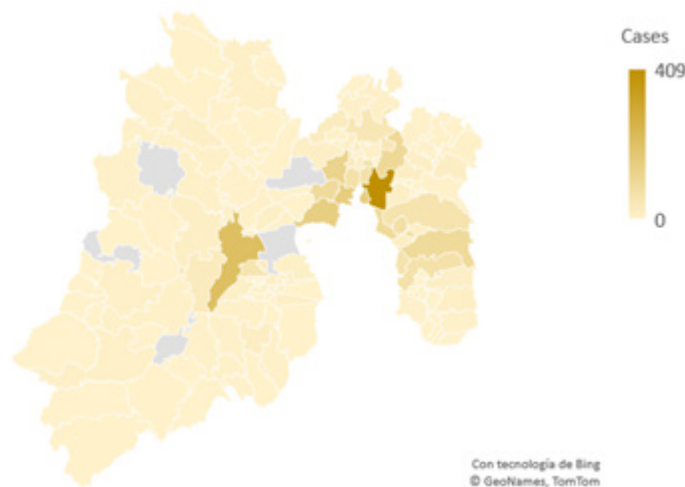


Figure 3: Cases of femicide, sexual abuse and gender violence in Estado de México 2015-2019

In Mexico, the state preventive police oversee protecting the integrity and human rights of its inhabitants, their responsibility is to avoid crime commission and to guarantee and maintain peace and public order. They protect the people's security and their heritage in danger situations or when they are threatened by unrests or any situation that implies violence or imminent risk, such as any crime that has severe consequences. They coordinate and execute different methods that help them to identify groups and their ways of operating that are related with criminal activities (Olivares Ferreto, 2010). As ICESI (2010) pointed out, offering attractive projects of life to the elements of the police is indispensable for raising quality, efficiency, and effectiveness in combating unsafety in Mexico. Thus, it is necessary that all the people who work in the police department have as minimum: stability, decent wages, benefits that allow them to access heritage and social (Olivares Ferreto, 2010). Mexico is currently facing high levels of femicides and the use of the public security personal has had a direct impact on the protection of human rights and the rule of law (Comisión Mexicana de Defensa y Promoción de los Derechos Humanos, 2012). It is known that the majority of femicides go unpunished mainly due to the limited access that women have to justice, gender bias and the deficient public security personal work (MESECVI, 2008). Therefore, PREVENTIVE POLICE and AVERAGE WAGE OF PREVENTIVE POLICE variables are considered in our analysis.

Further, according to INMUJERES (2006), there are approximately 1,000 organizations that are engaged to search gender equity for Mexican women that due to their efforts they have achieved lots of great achievements or women, such as breaking with the stereotypes of women related to their jobs, better conditions in schools, the abortion legalization, a bigger and important participation of women in science and different jobs, etc. but between the most important ones are the creation of different laws that support mistreated women (INMUJERES (2006). Hence, we chose the variables PUBLIC SECURITY PERSONAL and GENDER EQUITY AND WOMEN'S RIGHTS PERSONAL to take in account the above in the analysis. The primary concern in Mexico to reduce the cases of femicide is to allocate enough resources to combat violence against women, because despite the legislative progress on this issue, they have not stopped receiving this kind of cases. Since to eradicate all these cases, it is necessary to focus on the budget for this, and the variable which helped us to deem this is the FEDERAL AND STATE BUDGET (Santos, 2018).

On the other hand, the FEMICIDES cases, SEXUAL ABUSE and GENDER VIOLENCE are used to represent the level of women's insecurity. To evaluate the efficiency of the public security system, we use data from INEGI (2020) for the period of 2016. Each municipality is thus evaluated by the following variables:

- PREVENTIVE POLICE (PP): It describes the amount of people in the municipality that are responsible of monitoring and caring of public order. Protecting the integrity, heritage and its habitants' rights.
- AVERAGE WAGE OF PREVENTIVE POLICE (AWPP): The average salary received every month by the preventive police.
- PUBLIC SECURITY PERSONAL (PSP): It describes the amount of people in the municipality who work in public security.
- GENDER EQUITY AND WOMEN'S RIGHTS PERSONAL (GE): It describes the amount of people in the municipality that work for gender equity and women's rights.
- FEDERAL AND STATE BUDGET (FSB): It describes the amount of money that the federal and state government give to each municipality.
- FEMICIDES (FEM): Describes the number of denouncements of gender-based murder of a women or girl by men.

- SEXUAL ABUSE (SA): Number of denouncements of unwanted sexual activity, with perpetrators using force, making threats, or taking advantage of victims not able to give consent.
- GENDER VIOLENCE (GV): Number of denouncements of rape, sexual assault, intimate partner violence in heterosexual and same sex partnerships, sexual harassment, stalking, prostitution, or sex trafficking.

Table 1 includes the descriptive statistics of the data regarding each variable.

	PP	AWPP	PSP	GE	FSB	FEM	SA	GV
Max	1,685.00	15,876.00	9,882.00	445.00	1,727,214,276.00	10.00	203.00	196.00
Min	0.00	2,500.00	82.00	0.00	9,728,036.00	0.00	0.00	0.00
Average	157.85	6,322.46	1,015.71	41.72	170,758,611.63	0.47	11.28	9.43
SD	308.21	3,553.41	1,801.92	71.01	279,202,578.67	1.23	26.14	23.32

Table 1: Descriptive statistics of the data

Model structure

We will use an output-oriented DEA model as we seek to analyze how efficient are the municipalities avoiding the femicides. Further, the DEA model operates under constant returns to scale (CCR model) as each municipality operates separately on its own territory with their federal budget. To measure this, PP, AWPP, PSP, GE and FSB are used as the inputs of the DEA model, describing the personnel and financial resources of each municipality. On the other hand, FEM, SA and GV are the outputs in the analysis. However, as these variables do not have the maximization character required for outputs in DEA models, those are undesirable variables. That is why, we need to invert their direction. As proposed by Dyson et al. (2001), we subtracted the value of the undesirable output from a large number M as follows:

$$M = \max \{a_{i2}\} + \min \{a_{i2}\}, \quad i = 1, 2, \dots, n.$$

and

$$Invert_{i2} = M - a_{i2}, \quad i = 1, 2, \dots, n.$$

where n is the number of DMUs ($n=120$).

For all the calculations we used MaxDEA software. First of all, we have to verify that we have a satisfactory discrimination level in our DEA model. For this, according to Dyson et al. (2001), the following condition should be satisfied:

$$\sum_n DMU \geq 2 \times m \times s$$

where n is the number of Decision Making Units, m is the number of inputs and s is the number of outputs. In our case, $n=120$, $m=5$ and $s=3$. Therefore, we satisfy the condition as $120 \geq 30$. To assure that each variable has high importance in the model, we selected $\varepsilon = .3$. In this case, we obtain the following percentages which measure the average importance of the variables in the model; for PP we have 4.13%, AWPP 21.08%, PSP 48.00%, GE 12.03% and FSB with 14.76%, whereas the importance of the outputs is balanced as FEM 34.93%,

SA 33.51% and GV 31.55%. We can consider these levels of importance as satisfactory as no variable is close to zero.

3 Results

The obtained results of the analysis are represented in Table 2. The average efficiency of the municipalities is 41.65% and nine municipalities are 100% efficient. More specifically, the top 10 of the most efficient municipalities in combating the femicide in Estado de Mexico are: Almoloya de Alquisiras (100% efficient), Ayapango (100%), Chapultepec (100%), Isidro Fabela (100%), Papalotla (100%), Sultepec (100%), Tenango del Aire (100%), Texcalyacac (100%), Tonicato (100%) and Zacualpan (99.53%). On the other hand, the worst 10 efficient municipalities are: Ecatepec de Morelos (0.39%), Nezahualcoyotl (2.12%), Tlanepantla de Baz (2.38%), Toluca (2.85%), Naucalpan de Juárez (3.05%), Ixtapaluca (3.84%), Chimalhuacan (4.25%), Cuautitlán Izcalli (4.65%), Atizapán de Zaragoza (4.67%) and Valle de Chalco Solidaridad (5.08%). We can see that the level of efficiency of the worst municipalities is far below the state average and near to zero level.

Municipality	Score	Municipality	Score	Municipality	Score
Acambay de Ruíz Castañeda	21.62%	Ixtapan de la Sal	35.87%	Temamatla	68.16%
Acolman	21.78%	Ixtapan del Oro	69.43%	Temascalapa	46.99%
Aculco	24.66%	Ixtlahuaca	16.54%	Temascalcingo	29.30%
Almoloya de Alquisiras	100.00%	Jaltenco	44.06%	Temascaltepec	25.69%
Almoloya de Juárez	31.65%	Jilotepec	29.17%	Temoaya	95.10%
Almoloya del Río	77.12%	Jilotzingo	99.49%	Tenancingo	20.87%
Amanalco	98.86%	Jiquipilco	17.69%	Tenango del Aire	100.00%
Amatepec	44.27%	Jocotitlán	28.21%	Tenango del Valle	21.37%
Amecameca	27.23%	Joquicingo	53.45%	Teoloyucan	19.46%
Apaxco	27.98%	Juchitepec	53.83%	Teotihuacán	28.04%
Atenco	35.20%	La Paz	10.65%	Tepetlaoxtoc	42.74%
Atizapán	79.60%	Luvianos	34.56%	Tepetlixpa	37.06%
Atizapán de Zaragoza	4.67%	Malinalco	41.68%	Tepetzotlán	13.00%
Atlacomulco	14.77%	Melchor Ocampo	28.11%	Tequixquiac	45.88%
Atlautla	45.25%	Metepec	7.68%	Texcalyacac	100.00%
Axapusco	46.02%	Mexicaltzingo	94.68%	Texcoco	10.07%
Ayapango	100.00%	Morelos	29.52%	Tezoyuca	44.11%
Calimaya	84.96%	Naucalpan de Juárez	3.05%	Tianguiestenco	29.82%
Capulhuac	38.64%	Nextlalpan	30.00%	Timilpan	85.46%
Chalco	9.75%	Nezahualcóyotl	2.12%	Tlalmanalco	21.32%
Chapa de Mota	42.97%	Nopaltepec	83.65%	Tlanepantla de Baz	2.38%
Chapultepec	100.00%	Ocoyoacac	19.63%	Tlatlaya	21.31%
Chiautla	48.56%	Ocuilan	55.43%	Toluca	2.85%
Chicoloapan	14.00%	Otumba	45.30%	Tonanitla	69.48%
Chiconcuac	40.23%	Otzoloapan	53.68%	Tonicato	100.00%
Chimalhuacán	4.25%	Otzolotepec	23.40%	Tultepec	29.86%
Coacalco de Berriozábal	9.30%	Ozumba	34.18%	Tultitlán	6.72%
Coatepec Harinas	35.27%	Papalotla	100.00%	Valle de Bravo	17.80%
Cocotitlán	57.96%	Polotitlán	53.73%	Valle de Chalco Solidaridad	5.08%
Coyotepec	35.91%	Rayón	48.08%	Villa de Allende	32.02%
Cuautitlán	10.45%	San Antonio la Isla	37.83%	Villa del Carbón	46.78%
Cuautitlán Izcalli	4.65%	San José del Rincón	20.52%	Villa Guerrero	85.65%
Ecatepec de Morelos	0.39%	San Martín de las Pirámides	39.74%	Villa Victoria	37.69%
Ecatzingo	49.36%	San Mateo Atenco	24.65%	Xalatlaco	55.78%
El Oro	41.35%	San Simón de Guerrero	79.96%	Xonacatlán	26.04%
Huehuetoca	13.49%	Santo Tomás	77.51%	Zacazonapan	76.58%
Hueyoxtlá	30.56%	Soyaniquilpan de Juárez	73.94%	Zacualpan	99.53%
Huixquilucan	5.94%	Sultepec	100.00%	Zinacantepec	11.63%
Isidro Fabela	100.00%	Tecámac	11.65%	Zumpahuacán	43.21%
Ixtapaluca	3.84%	Teiupilco	30.94%	Zumpango	16.53%

Table 2: Efficiency results of 120 municipalities

To go more in detail to identify which parts of Estado de México can improve their public security system, Figure 4 shows the level of the efficiency of the municipalities. In general, the level of efficiency is very low across the state. This results in 70 municipalities being evaluated below the average (50 above) and only 14 municipalities above the level of efficiency of 90%. We can observe that the municipalities very low efficiency are the ones located in the Northern border of Mexico City, whereas the higher efficiency is located on the West and West-South from Mexico City.

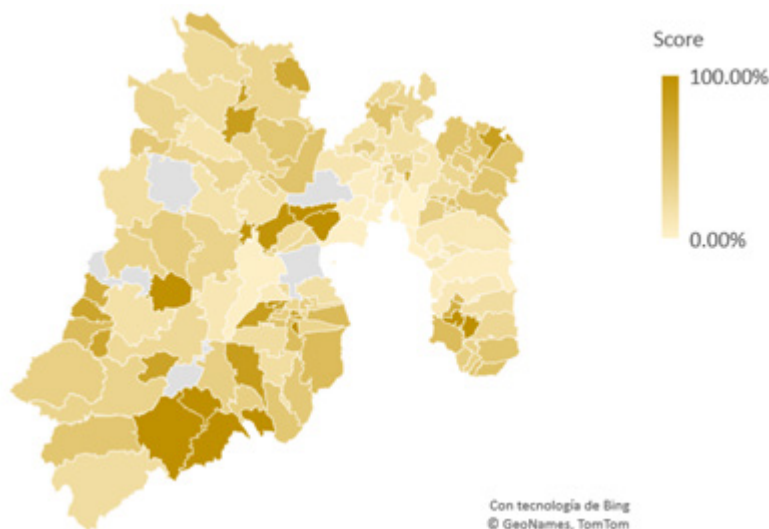


Figure 4: Efficiency of public security system of each municipality in Estado de Mexico

The municipalities with the lower efficiency have more murdered women, sexual abused women or victims of gender violence, meaning that the public security system does not work, in other words, there is an inefficiency of using their resources. In more detail, Ecatepec de Morelos, Nezahualcóyotl, Tlalnepantla de Baz, Toluca and Naucalpan de Juárez are the 5 least efficient municipalities. These municipalities are one of the biggest ones regarding the population of the state, representing 31.73% of the total population of Estado de México. That is why, there should be assigned the biggest number of police units. The data indicates that these municipalities include 35.95% of the Preventive Police, whose average salaries (AWPP) are 145.24% above the state average. Moreover, 34.58% of the total of Public Security Personnel operates in these five municipalities. However, these numbers are not reflected in the level of security, as 35.71% of Femicide, 39.51% of Sexual Abuse cases and 40.11% of reported Gender Violence belong to them. On the other hand, the 10 best municipalities (Table 2) represent very small municipalities (0.77% of the total population). As a result, they have 0.67% of the total Preventive Police whose salary is 41.04% of the state average. Their efficiency is then reflected in the level of security as no femicide was reported, only 0.44% of Sexual Abuse cases and 0.44% of Gender Violence were reported in these municipalities. It is then obvious that smaller municipalities have better chance to provide security to their people. The results indicate a correlation between the size of a municipality and the efficiency -0.5168 (i.e. moderate negative correlation). However, the data also indicates that the best evaluated municipalities have slightly higher amount of Public Security Personnel. The top ten municipalities have in average 1,240 people per one PSP, compare to 6,263 people per one PSP in the

5 worst municipalities. What is more, the best evaluated have the ratio of PSP/PP 78.74%, whereas in the worst 5 municipalities this ratio is 12.04%.

Adjusted model by population and salary

The previous results indicate the effect of population size on the efficiency level. That is why, it is necessary to adjust the model to eliminate the effect of the population (i.e. recalculate the variable per capita). In this second model, we recalculated the Preventive Police as people per one PP (PP2), Public security personal as people per one PSP (PSP2), and Gender equity and women's rights personal as people per one GE (GE2). In the case of the Federal and estatal budget, we recalculated it as a budget per one person (FSB2). Finally, we recalculated the Average wage of preventive police as a level of salary compare to the Mexican average salary level¹ (AWPP2). To secure the comparability of the results, we kept the level of epsilon $\epsilon = .3$. In this case, the importance of PP2 is 5.26%, AWPP2 15.80%, PSP2 30.54%, GE2 0.96% and FSB2 with 47.44%. There is a clear change in the importance towards the Federal and estatal budget in the adjusted model (+32.67%), whereas the importance of Public security personal and Gender equity and women's rights personal decreased by -17.46% and -11.07% respectively. The importance level of the outputs remained approximately the same: FEM 34.72% (-0.22%), SA 33.25% (-1.26%) and GV 33.04% (+1.48%).

Table 3 presents the new efficiencies of the public security system. In this case, the average efficiency increased to 66.97% (25.33%), but nine municipalities remained with 100% efficiency. The increase of the efficiency is then reflected in Figure 5, which shows lower disparity within the municipalities. Consequently, the correlation between the population and efficiency dropped to -0.2914. (i.e. negligible/low negative correlation). Four municipalities remained 100% efficient: Chapultepec, Isidro Fabela, Papalotla and Tonalico. Zacualpan (94.56%, 13th), Almoloya de Alquisiras (94.36%, 14th), Sultepec (86.79%, 22nd) and Ayapango (77.13%, 34th) remained relatively high efficient, whereas Texcalyacac (62.82%, 69th) is no evaluated below the state average and Tenango del Aire (44.15%, 110th) is evaluated within the worst municipalities. We can observe similar behaviour in the worst 10 municipalities. Ecatepec de Morelos (6.62%, 120th) remained the worst efficient, and Ixtapaluca (27.60%, 119th), Chimalhuacán (39.02%, 115th) and Nezahualcóyotl (39.18%, 114th) remained within those 10 least efficient. The biggest improvements marked Valle de Chalco Solidaridad (89.91%, 19th) and Atizapán de Zaragoza (81.85%, 27th). Considering that the first number is the efficiency percentage and the second one is the ranking position in the final model, sorted largest to smallest efficiency.

As the adjusted model diminished the effect of the population size, the explanation of the high and low efficiency differs now. Both have assigned more Federal and estatal budget per person (efficient +43.40% and inefficient +31.37% compare to the state average), but the inefficient municipalities pay +45.12% higher salaries to the protective police compare to the state average, whereas the efficient pays -43.87% less. The saving in the lower salaries are compensated in higher number of protective police (resulting in 35.49% less people per one PP), public security personal (42.17% less people per one PSP) and Gender equity and women's rights personal (69.30% less people per one GE). This higher level of the staff results in zero femicide, -63.64% of Sexual abuse cases and -67.14% of Gender violence cases. On the other hand, the inefficient municipalities have lower number of protective police (resulting in 49.96% more people per one PP), public security personal

¹ We used the data from Comisión Nacional de los Salarios Mínimos (CONASAMI) available in <https://datos.gob.mx/busca/dataset/salario-minimo-historico-1877-2019> [18 Jul 2020].

(27.36% more people per one PSP) and Gender equity and women’s rights personal (110.02% more people per one GE). This lower level of the staff results in +350% more cases of femicide, +245.90% more cases of Sexual abuse cases and +216.96% more cases of Gender violence. The alarming difference is in the case of Gender equity and women’s rights personal, which can be the main cause of the femicide level in those municipalities.

It is also important to mention the case of Amatepec (among others). This municipality is ranked within the least efficient (43.66%, 111th) although this municipality reported zero cases of FEM, SA and GV. However, compare to the efficient municipalities with similar level of reported cases, Amatepec pays +5,357 pesos more to protective police and receives +2,461 pesos more from Federal and statal budget per on person compare to 100% efficient Amanalco. So, in this case, the inefficiency is related to the structure of public spending rather than to insecurity, which corresponds to the objective of the article (analysis of public security system) that includes both the financial and personnel resources.

Municipality	Score	Municipality	Score	Municipality	Score
Acambay de Ruíz Castañeda	49.21%	Ixtapan de la Sal	78.78%	Temamatla	95.30%
Acolman	76.47%	Ixtapan del Oro	84.52%	Temascalapa	74.59%
Aculco	45.92%	Ixtlahuaca	47.91%	Temascalcingo	46.72%
Almoloya de Alquisiras	94.36%	Jaltenco	100.00%	Temascaltepec	60.13%
Almoloya de Juárez	73.38%	Jilotepec	67.60%	Temoaya	98.56%
Almoloya del Río	70.22%	Jilotzingo	100.00%	Tenancingo	71.26%
Amanalco	100.00%	Jiquipilco	53.38%	Tenango del Aire	44.15%
Amatepec	43.66%	Jocotitlán	64.17%	Tenango del Valle	77.22%
Amecameca	47.33%	Joquicingo	73.99%	Teoloyucan	79.28%
Apaxco	70.53%	Juchitepec	65.56%	Teotihuacán	62.91%
Atenco	56.82%	La Paz	92.34%	Tepetlaoxtoc	73.42%
Atizapán	67.39%	Luvianos	52.92%	Tepetlipa	61.89%
Atizapán de Zaragoza	81.85%	Malinalco	63.73%	Tepetzotlán	71.13%
Atlacomulco	56.66%	Melchor Ocampo	66.00%	Tequixquiac	63.65%
Atlautla	62.46%	Metepc	51.59%	Texcalyacac	62.82%
Axapusco	50.18%	Mexicaltzingo	94.06%	Texcoco	44.80%
Ayapango	77.13%	Morelos	50.88%	Tezoyuca	66.00%
Calimaya	100.00%	Naucalpan de Juárez	63.31%	Tianguistenco	90.56%
Capulhuac	77.33%	Nextlalpan	48.22%	Timilpan	40.89%
Chalco	86.81%	Nezahualcóyotl	39.18%	Tlalmanalco	69.74%
Chapa de Mota	47.12%	Nopaltepec	64.62%	Tlalnepantla de Baz	62.67%
Chapultepec	100.00%	Ocoyoacac	66.86%	Tlatlaya	62.77%
Chiautla	75.12%	Ocuilan	34.45%	Toluca	62.74%
Chicoloapan	85.06%	Otumba	37.96%	Tonanitla	64.74%
Chiconcuac	69.48%	Otzoloapan	100.00%	Tonatico	100.00%
Chimalhuacán	39.02%	Otzolotepec	62.82%	Tultepec	69.74%
Coacalco de Berriozábal	77.49%	Ozumba	53.85%	Tultitlán	85.59%
Coatepec Harinas	54.10%	Papalotla	100.00%	Valle de Bravo	80.45%
Cocotitlán	69.87%	Polotitlán	61.89%	Valle de Chalco Solidaridad	89.91%
Coyotepec	59.90%	Rayón	82.37%	Villa de Allende	47.19%
Cuautitlán	73.99%	San Antonio la Isla	65.03%	Villa del Carbón	57.71%
Cuautitlán Izcalli	64.90%	San José del Rincón	37.96%	Villa Guerrero	60.76%
Ecatepec de Morelos	6.62%	San Martín de las Pirámides	55.25%	Villa Victoria	50.61%
Ecatzingo	88.62%	San Mateo Atenco	55.39%	Xalatlaco	68.31%
El Oro	57.13%	San Simón de Guerrero	58.68%	Xonacatlán	63.19%
Huehuetoca	56.31%	Santo Tomás	73.55%	Zacazonapan	93.90%
Hueypoxtla	68.02%	Soyaniquilpan de Juárez	44.30%	Zacualpan	94.56%
Huixquilucan	51.57%	Sultepec	86.79%	Zinacantepec	59.75%
Isidro Fabela	100.00%	Tecámac	56.37%	Zumpahuacán	52.33%
Ixtapaluca	27.60%	Teiupilco	39.48%	Zumpango	99.50%

Table 3: Efficiency results of 120 municipalities (adjusted model)

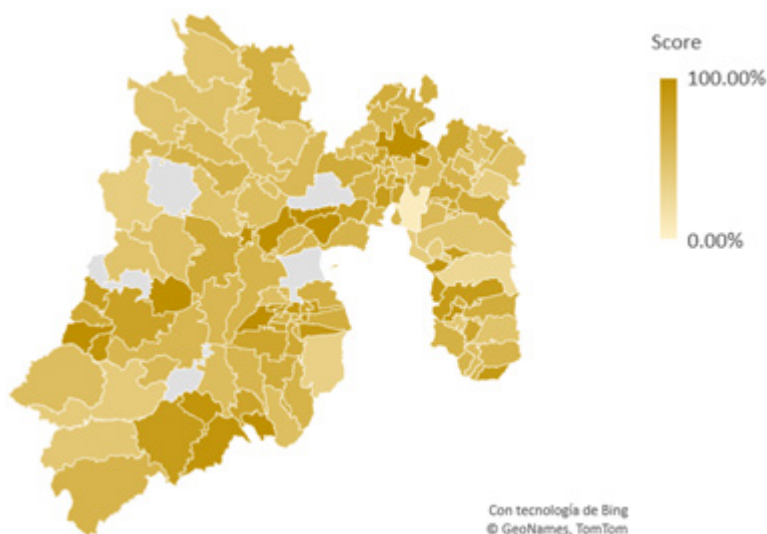


Figure 5: Efficiency of public security system of each municipality in Estado de Mexico (adjusted model)

4 Discussion

As we mentioned earlier, femicide is a very delicate issue because we are talking about the loss of valuable human lives and, particularly in Estado de Mexico, it has worsened over time. Given this, the authorities have taken some preventive measures, such as those considered in this model to obtain an improvement of the femicide level. However, as Santos (2018) mentioned, not the same attention has been given to all municipalities and, therefore, the level of femicide was not treated equally. So, it is necessary to develop new strategies to improve the current situation.

Considering the achieved results, we propose to focus on the improvement of the municipalities near Mexico City, especially on improving the measures that are being applied to reduce this phenomenon. The results of the analysis (as well as the structure of the model) can be considered correct, as the achieved results about the highly inefficient municipalities correspond with the results published by INEGI in the middle of the last year (Expansión Político, 2019). According to them, Ecatepec de Morelos and Naucalpan de Juarez are the 2 municipalities with a higher insecurity perception. Other municipalities where its habitants confirmed that they live with constant fear and feeling insecure are Tlanepantla de Baz, Atizapan de Zaragoza and Chimalhuacan.

It is very important for the government of Estado de México to focus main effort on Ecatepec de Morelos (among others) because it is the most worrying municipality based on both DEA models. Ecatepec is the one that presents the higher average of femicides, but also is the one with the lower percentage of effectiveness when combating it. Ecatepec de Morelos uses a lot of resources as this municipality has the second biggest number of preventive police and public security personal, as well as they also receive the second higher state and federal budget. Despite this, they have the highest number of femicides, sexual abuse victims and gender violence victims in the whole state. The analysis indicates that the number of personnel included in the security area is crucial. Those municipalities that were evaluated as the best have usually lower level of people per one security personnel. The biggest alarming difference was observed regarding the Gender

equity and women's rights personal, where the inefficient municipalities have 110.02% more people per one GE person. This represents worrying understaffing, especially in order to combat the femicide.

As a possible solution for the worrying situation in Ecatepec de Morelos, Ixtapaluca, Chimalhuacan and Nezahualcoyotl, which count with a high budget, instead of allocating it in security personal, we can take as reference the situation in Malaga, Spain, where a study was performed of new tendencies in spatial control for dangerous people and public places. This study was performed in order to prevent delinquency and other disturbing behaviors. The study centers in use of video vigilance systems placed in public places. This strategy makes citizens to feel secure and, at the same time, the public security personnel has access to the recordings and discover where do they have to emphasize their attention (Díez Ripollés & Cerezo Domínguez, 2009). The results of the study confirm that crimes slightly decreased in the areas where the cameras were placed, conversely, in the areas where they did not place cameras the number of crimes increased.

Another example of such strategy is from the United Kingdom, particularly in London, where there are more than 10,000 cameras distributed by the Government and 500 thousand cameras installed by companies and families. As a result, nowadays, approximately more than 4 million cameras are installed across the country (INFOBAE, 2012). Similarly, as in the previous example, this strategy works as a preventive tool rather than identifying crimes. Together with the installed cameras, the government installed speakers reminding everybody that everything is being filmed. So, people have the certainty that any strange movement will not go unnoticed. As a result, between 2000 and 2010, murders in London passed from 190 to 113 per year, representing a reduction of 40%. Moreover, the assaults decreased by 43% and crimes against properties decrease by 71% (INFOBAE, 2012).

Installing cameras (CCTV) is one of the strategies that may be considered as a strategy to reduce the femicide level in Estado de Mexico. Contrasting the previous examples, strategies can also focus on different areas. For example, we can refer to the case of Peru (ONU, 2019), where the budget was distributed differently between the following strategies:

- To begin with, the Rural Strategy against Violence was expanded in 85 additional areas of the country, in addition to the 29 already existing. They have nine Neighborhood Prevention and Protection Networks against Violence.
- There are numerous Women's Emergency Centers (CEM) in the country for victims of family and sexual violence. Currently, in cities with the greatest violence against women (Lima, Arequipa, Moquegua and Cusco), six new CEMs have been installed in police stations, operating seven days a week, 24 hours a day.
- Based on multisectoral work, the Police Squad for the prevention against family violence was doubled in 2018 and, in addition, the police visit victims who have protection measures.
- At the same time, the Single Center for Complaints (Line 1818) was strengthened, which handles complaints of undue attention in police stations in cases of violence against women, which will make it possible to provide comprehensive services to neighborhoods and communities with a greater number of complaints and take immediate corrective action.

As a result, according to the UN (ONU, 2019), Peru was the country with the fewest femicides, with a rate of 0.8 per 100,000 women in 2018. This rate is much lower compare to the one that we have in Mexico. Analyzing the measures that were taken, such strategies could be implemented to improve the difficult situation in the municipalities in Estado de Mexico.

It is important to mention that the analysis presented in this article is limited to only one year. To have a broader perspective over the level of efficiency of the public security system in Estado de México (as well as in other Mexican states), it is necessary to extend the analysis including more years. This would allow us to see if the level of efficiency is stable and the list of the worst/best municipalities remain the same, or there is high volatility year-to-year and the list of changes. This would lead to better understanding of the situation and, consequently, to better public security strategies to combat the femicide.

5 Conclusions

Mexico is a beautiful country, rich in many things such as natural resources and culture. It also has a huge and interesting history and traditions. However, it is not a secret that Mexico is also a deficient country in many aspects, in fact the 5 main social problems in Mexico are insecurity, poverty, inequality, corruption and unemployment (Castel, 2018). Estado de México is the state that surrounds Mexico City, which concentrates a huge percentage of population, and it is also the main political, economic, social, academic, financial and cultural center of this country.

Analyzing the obtained results in the second model which eliminates the population effect we were able to appreciate more clearly that in general, a greater number of financial and personnel resources, return into a better efficiency in combating femicides, sexual abuse and gender violence. Although, as we already mentioned, it is important to emphasize the cases such as Amatepec in which an unnecessary high amount of resources is assigned when it did not present a high number of the referred crimes. On the other hand, there are cases of inefficiency such as Ecatepec de Morelos, Nezahualcóyotl, Tlalnepantla de Baz, Toluca and Naucalpan de Juárez where despite of counting with the highest budgets, the number of cases is very high. As a result, Estado de México is one of the Mexican states that reports the highest level of femicide cases. That is why, the objective of the article was to analyze the efficiency of the public security system in this state. The analysis revealed very low level of public security system efficiency, principally observed in bigger municipalities. The analysis suggests that higher attention should be paid to the level of security personnel and better use of the financial resources. To see the impact of such improvements can be verified by, for example, an econometric analysis in the future research.

"We weren't born as girls to die for being one"

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7 Appendix



Figure 6: Political division of Estado de México in its 125 municipalities