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GUARANTEED PRICES AND THEIR EFFECTS ON SMALL-SCALE FARMS IN MEXICO

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ABSTRACT

Since 2019, with the implementation of the Guaranteed Prices Program for basic food products, the government established a plan linked to the volume of corn production with which it acquired the grain from small-scale farms at a higher price than the market's, with the intention of improving the income and increasing the national production. The difference-in-differences and matching method was used to test whether public intervention had the desired effect on the production surface of the recipients. With the estimations, evidence was found that the decrease in corn surface between 2018 and 2020 was a general characteristic for all producers in the country; however, the program helped to decrease the reduction of the surface cultivated by its recipients. Likewise, it was found that the increase in income of recipients is due mainly to the increase in the price of the product, rather than an increase in the volume produced as consequence of the expansion of the surface cultivated.

Keywords: causal inference, small-scale farmers, strategic program, subsidy.

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INTRODUCTION

In Mexico, one of the effects of trade liberalization has been the entry of products from other countries which have prices under the production cost, disrupting food sovereignty and self-sufficiency. This effect led to the de-structuring of agriculture and livestock production units and, therefore, an unprecedented increase of rural migration, to the point that remittances sent by migrants, particularly from Mexicans, became an essential source of income for families (Rubio and Peña Ramírez, 2013).

As a result of the volatility of global food prices and concerns over global food security, there is a debate about the recognition of small and medium-scale producers as important contributors to food production (Baer-Nawrocka and Sadowski, 2019). In line with this current, the Mexican government has promoted a new framework for public policies, materialized into specific programs to address the small-scale farmers who were excluded under Neoliberal policies.

The new Mexican agrifood policy (2019-2024) is a tool implemented by the government that seeks to counterbalance the situation in the farmland, directed at self-sufficiency in basic grains through five priority programs[1], one of which is the program for Guaranteed Prices for Basic Food Products (GPP or program), whose objective is to increase the income of producers, as well as to attain a greater production of corn, bean, rice, wheat and milk. The PGP in corn is directed exclusively at small-scale farmers, with a maximum limit of

surface and production volume, so its success to increase the national productive offer will be achieved to the extent that recipients: a) expand their cultivation area, b) substitute their crops with one considered by the program, or c) increase their yield with the same production surface.

The increase in production through a larger surface is desirable as long as the new surface is without farming; on the contrary, it could have undesirable consequences, especially when the producer converts ecologically important lands (such as forests, grasslands and wetlands) into farming lands, or uses marginal and environmentally fragile lands (Wu *et al.*, 2019). The increase in production, through crop substitution, is achieved to the degree that the producer adopts crops with a higher profit margin; however, this could also mean a temporary shortage of other crops. The increase in the offer through yield is originated if the producer adopts new technologies and transforms its production process, so that in addition to being the most desirable option, it allows the producer to obtain higher income per surface unit.

The objective of this study was to analyze, through the econometric method of difference-in-differences and matching, the national impact of the program on the corn production surface of recipients; the latter because it is correlated with the production. The hypothesis tested is that the program had a causal effect on the recipient producers. That is to say, it was considered that if producers have expectations on the program for their near future, this can alter the farmer's decisions, where one of the most important effects is the increase in production surface.

The corn crop was selected as the study object because it is a traditional crop for small-scale farmers, since it is the alimentary basis of the Mexican diet. In addition, it is one of the most important cyclic crops in Mexico, in terms of production surface, reaching 7.5 million hectares at the end of the last decade (SIAP, 2022). In terms of consumption, in 2020, white corn was the most consumed cereal in Mexico, with an intake of 196.4 kg *per capita*.

With the aim of achieving a greater attention to the different aspects addressed, the article was structured in the following way: the first section offers a context of location in relation to the government program analyzed; the second presents the background on guaranteed prices as State policy; the third makes a brief description of the program; the fourth examines the methodological aspects, the sources of data, and the characteristics of the subjects analyzed; the fifth section presents and discusses the results obtained. The last part of the document presents the study's conclusions.

Background

Guaranteed prices are a state policy instrument that has as precedent the policies applied in the 1930s after the capitalist crisis of 1929. Facing this global scenario, the leaders of Latin American countries were convinced that it was necessary for the State to apply policies to stimulate the recovery of economies, where countries like Mexico, Brazil, Argentina and Chile were resenting the negative effects derived from the European debacle after the First

World War, which made governments from these countries use the Keynesian model in all the application scopes of their public policies (Suárez Dávila, 2013).

In this sense, the Mexican government incorporated protectionist instruments to their government policies. Thus, the policies used in the sphere of tariffs, fees, tax supports, subsidies and minimum prices stand out. Therefore, the development of the national industry was focused on the configuration of the import-substitution model, with the objective of strengthening the internal market.

Throughout its development, of slightly more than forty years (1940-1982), the import-substitution model was focused on the substitution of non-lasting consumption goods and the import of intermediate industrial goods and capital, which implied a reorganization of the economy. In its direct role as investor, and indirectly in its role as orchestrator of the new model of national economic policy, the State generated protectionist safeguards and stimuli for industrialization as a basis for the promotion of its growth strategy, and consolidating its role as Benefactor State with the increase of commercial protectionism. The backwardness of the agriculture and livestock structure decreased the production of raw materials and basic products, and generated the loss of food self-sufficiency (Torres and Rojas, 2015).

In this scenario, the process of capital accumulation started in the decade of the 1960s began to show signs of exhaustion at the beginning of the 1980s. Excessive social spending, indiscriminate subsidies, and salary increases not based on productivity caused a crisis in the national agriculture and livestock sector, which was increased by high inflation. The immoderate creation of public enterprises generated an excessive state with serious fiscal imbalances (Suárez Dávila, 2013). All of this led to a lack of confidence to invest, the exit of capitals, devaluations, and financial crises, which were resolved with stricter commercial and financing controls.

At the beginning of the 1980s, Mexico, together with other Latin American countries, joined the foreign debt crisis resulting from lack of liquidity and insolvency, which led them to incorporate a series of structural reforms that formalized their entry into the Neoliberal model (Torres Reina, 2020). As a sequel to this, the process of dismantling of the developmental model, which had dominated the national economic policy since the middle of the 1930s, was unleashed.

According to Peña (2021), in this period, Keynesian economics began to be replaced by Neoliberalism. The new global model was aligned to the so-called Washington Consensus, promoted by several international financial institutions, which contained a set of recommendations that modified the economic model, ten of which were "like hand in glove" in a highly indebted Latin America. They were based on three main ideas: macroeconomic discipline, market economy and openness to the world in matters of trade and direct foreign investment. Thus, the new international policies were centered on trade liberalization, for which the agricultural sector was not an exception.

With the negotiations of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), between 1986 and 1994, the agricultural policy began to change

from traditional schemes of price maintenance, which stemmed from an agricultural sector strongly subsidized by national governments to the economic disengagement or decoupling[2] of most of the countries linked to the Organization for Economic Cooperation and Development (OECD), of which Mexico was and still is a member (Antón, 2001). Presently, supports for the farmland tend to be part of decoupled schemes in many economies. For example, the trend in the European Union is to conditionally displace agricultural supports for environmental protection, food security, animal and plant health and welfare, land conservation, and water management (Heinrich Böll Stiftung, 2019).

Guaranteed prices for basic food products

According to the Ministry of Agriculture and Rural Development (2020), the principles of the new agrifood policy are centered on three large objectives:

1. Attaining food self-sufficiency via the increase in agriculture, livestock and fishing production and productivity.
2. Contributing to the rural population's welfare.
3. Increasing the sustainable production practices in the agriculture, livestock and fishing sector in face of agroclimatic risks.

With the purpose of achieving these objectives, the State executed several strategic programs, one of them being the Guaranteed Prices for Basic Food Products, which is focused on five products included in the consumer's basic basket common in Mexico, as well as those products that are part of the agroindustrial supply chain. Its main objective is to increase the income of small-scale farmers, at the same time protecting them from price fluctuations, so it can be perceived as a security network for the recipients inscribed in the program (Guerrero-Ortiz et al., 2021).

In the specific case of small-scale corn farmers, the program is national and limited to producers with up to five rainfed hectares, who handle a maximum level of 20 tons per farm. Payment for transport of the producer's harvest is also made. Thus, if a farmer produces more than the predetermined production limit, he cannot receive support for the part of his production that is above the limit. For example, if a farmer produces 25 tons in 5 hectares, this means that he can only receive support for 20 out of the 25 tons produced.

The changes made to the program, for the case of corn, are related to the denomination of the product, the value of the price, and the payment for transport (Table 1).

METHODOLOGICAL FRAMEWORK

DID matching estimation method

There are different estimation tools used in causal inference based on observational data, in a context of quasi-experimental methods, which are divided into three large groups: matching, difference-in-differences or DID, and instrumental variables. A particularity

Table 1. Changes in the guaranteed prices plan for small-scale corn farmers.

Year	Product	Price ($)	Transport support ($/t)
2019	White corn	5,610	150
2020	Corn for human consumption	5,610	150
2021	Corn from small-scale farmers	5,610	150
2021	Corn from small-scale farmers	6,060	160
2022	Corn from small-scale farmers	6,278	160

Source: prepared by the authors based on data provided by the Diario Oficial de la Federación 2019, 2020a, 2020b, 2021.

of these methods is that they attempt to simulate the conditions of an experimental design, data from recipients and non-recipients are used, and they use advanced statistical techniques to eliminate or minimize the differences between both groups. The choice of methods depends on the structure of the databases and the objective of the study, since there is not one method that prevails *a priori* over the other (Geldres W. *et al*., 2009).

DID matching is the most popular method to evaluate the effect of a public policy because, when the methods of matching and DID are combined, it becomes one of the most robust non-experimental causal inference methods that best reproduces the results from randomly controlled assays (Geldres W. *et al*., 2009). Therefore, this study used the DID matching method to evaluate the effect of the change in surface for corn production in a group of farmers who participated in the program (intervention or treatment), versus a group that did not participate (control).

A limitation of the quasi-experimental methods is the selection bias problem. In the case of the GPP evaluation, this problem emerges to the extent that it is not possible to compare the recipient producers (treated group) with the non-recipient (control group), because the estimation of the impact could be biased if the recipient producers are statistically different from the non-recipient. An aspect that could contribute to the selection bias problem is that the program is not distributed randomly, and it is only allotted to those who request it and comply with the formal requirements of the program. In addition, its implementation depends on the availability of the budget assigned, as well as the producers' decision of not participating, which is why they could exclude themselves deliberately.

A technique to overcome the selection bias is to apply a matching method (Rosenbaum and Rubin, 1983). One of those methods is the Propensity Score Matching (PSM) method, which consists in selecting a subset of individuals within a control group whose observable characteristics (co-variables) agree with those of the treated group. The result are two groups (control and treated) whose observable characteristics are statistically similar and, therefore, comparable; and there are no important variables lacking which could alter the estimated effect of the treatment, since the groups differ solely in the application of a treatment during an observation period (for the case of the GPP, their participation in the program).

In this case, DID matching was used to analyze the trends between the treatment and control groups. The difference in the impact variable between recipients and non-recipients was considered in the situation before and after the program. Thus, when the before situation is subtracted from the after situation, the effect of all the characteristics that are unique for this individual and which do not change over time was annulled. In fact, the DID annuls or controls not only the effect of the invariable observable characteristics, but also the effect of the invariable non-observable characteristics in time (Gertler *et al*., 2017).

In the control group selection, the Kernel Matching estimator was used, with which a couple was found from a weighted average of all the observations of the control group, for each observation of the treatment group, through the STATA package (https://www.stata.com).

Model

A linear model was adjusted to estimate the effect of the GPP on the surface of corn production, in the following way:

$$Sup_{igt} = \beta_0 + \beta_1 Trat_{igt} + \beta_2 Periodo_{igt} + \beta(Trat * Periodo) + \theta B + \varphi_{edad} + \gamma_{estado} + \varepsilon_{igt}$$

where the response variable *Sup* is the surface, measured in hectares, which the *i-th* farmer of the group *g* (treatment or control) in the year *t* (2018 and 2020) destined to corn production; $Trat_{igt}$ is the treatment indicator, a binary variable that takes the value of 1 if the *i-th* producer, in the year *t*, participated in the program; and 0 in another case; $Periodo_{igt}$ is a binary variable that indicates the observation period that takes the value of 1 if the observation year is after the program and 0 in another case. The year 2020 is taken as the year after the program; *B* is a vector of the co-variables on the characteristics of the producer; θ is a transposed vector of coefficients relative to each of the co-variables; γ_{estado} are the fixed effects of the state where the farmers are located; φ_{edad} are the fixed effects of the age group to which farmers belong; $\beta_0, \beta_1, \beta_2, \beta_3$ are the intercept estimators, treatment effect, time effect, and program effect, respectively. The latter is the variable of interest; ε_{igt} is the error of producer *i*, of the group *g*, in time *t* (2018 and 2020).

Data and descriptive statistics

The data from individuals, for the control and treatment sample, were taken by participant farmer of the programs PROAGRO[3] (2016 and 2018) and *Producción para el bienestar* (PpB) (2020)[4], dependent on the Ministry of Agriculture, Livestock Production, Rural Development, Fishing and Food (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación*, SAGARPA), now Ministry of Agriculture and Rural Development (*Secretaría de Agricultura y Desarrollo Rural*, SADER). The information from these programs was used because they are focused on farmers who produce basic foods. These

bases allow approximately identifying the corn producers according to the size of the property, as well as characteristics of the recipients such as age and gender.

In order to identify and select the producers who received supports from the GPP, the information of its recipients in 2020 was used, obtained through the National Transparency Platform; then, the data were crossed with information from PROAGRO and PpB. The information from 2019 was not used because that could affect the true effect of the GPP because, according to Guerrero-Ortiz *et al*. (2021), in that year the program started having implementation problems where the farmers were not informed and, probably, were reluctant to participate. Information about poverty at the municipal level from 2015 was used, from the database of the National Population Council (*Consejo Nacional de Población*, CONAPO). The demographic, social and economic information about the municipalities, used to characterize the producers, was obtained from the National Statistics and Geography Institute (*Instituto Nacional de Estadística y Geografía*, INEGI), 2015. The information obtained both from CONAPO and from INEGI were control variables related to the socioeconomic characteristics of the place where the producers reside. Some variables used were municipal variables, since more disaggregated information about the farmers is not available (Table 2).

Table 2. Control variables used.

Variable	Additional Information
Gender	1=man, 0=woman.
Bean surface	Relevant variable because the GPP also supported the production of bean. It is expected that this affects the decision to participate in the GPP.
Other crops	Indicates the diversification of production by farmers.
Plots	It is expected that a producer with a larger number of plots has a higher propensity to participate, because there is a larger production surface.
Marginalization	The marginalization index allows differenting localities of the country according to the global impact of the shortages that the population endures.
Age	1=older adult, 0=adult. Any person who is 18 years or older is considered an adult, and an older adult those who are 65 years or older.
Unemployment rate	It is expected that farmers located in the municipalities with lower unemployment rate are less prone to participate in the GPP, because they can have diverse options for their sustenance.
Mean municipal income	This indicator is a proxy of the mean wealth level of inhabitants of the municipality, where the farmer is from, which is why in principle, it is expected that with higher income there will be lower propensity to participate in the GPP.
Municipal agricultural surface	It reflects the farmers who are located in municipalities with agricultural vocation.
Farmers	It is expected that in the municipalities with higher number of farmers, people will be more willing to participate because they will receive more attention from executors of the GPP, for example, through installation of more stockpiling centers.

Source: prepared by the authors.

The unit of analysis for this study was small-scale corn farmers. A balanced panel of 11,439 farmers was analyzed (5,804 control and 5,635 treatment) in three periods: 2016, 2018 and 2020. Therefore, a panel with 34,317 observations was used. The objective of using three periods was, as a robustness test, to prove that before the treatments the farmers behaved exactly the same as in its absence.

Next, the descriptive statistics of the variables are presented, for the farmers who participated and those who did not participate in the program (Table 3).

Adjustment test

With the purpose of discarding the selection bias, it must be true that the groups are similar in absence of the program, at least in their observable characteristics. The sample means of the model's variables, for the control and treatment groups in the base period were equal, with the exception of the "plots" variable. The sample means of this last variable presented a difference of -0.04, which is minimal if the magnitude of the variable is considered, so it is expected that the difference will not affect the decision to participate in the GPP (Table 4).

The common support of the propensity to participate was also analyzed, based on the observable characteristics of producers. It was observed that producers from both groups,

Table 3. Descriptive statistics by analysis group, 2018.

Variable	Mean	Std. Dev.	Minimum	Maximum
Control sample				
Gender	0.90	0.30	0.00	1.00
Bean surface	0.04	0.50	0.00	14.00
Other crops	0.04	0.20	0.00	2.00
Plots	1.12	0.39	1.00	5.00
Marginalization index	0.24	0.99	-1.88	5.03
Age	0.64	0.48	0.00	1.00
Unemployment rate	3.89	2.86	0.00	37.40
Mean municipal income	3,814	1,272	1,062	19,822
Municipal agricultural surface	52.61	24.75	0.00	100.00
Farmers	4,268	3,689	21.00	17,926
Treatment sample				
Gender	0.90	0.31	0.00	1.00
Bean surface	0.06	0.64	0.00	15.00
Other crops	0.04	0.22	0.00	2.00
Plots	1.16	0.44	1.00	5.00
Marginalization index	0.24	0.99	-1.88	5.03
Age	0.63	0.48	0.00	1.00
Unemployment rate	3.90	2.86	0.00	37.40
Mean municipal income	3,809	1,248	1,062	19,822
Municipal agricultural surface	52.83	24.83	0.00	100.00
Farmers	4,269	3,705	21.00	17,926

Source: prepared by the authors.

Table 4. Pre-treatment means test (2018).

Variable	Control	Treatment	Difference	t	Pr(T>t)
Gender	0.90	0.90	0.00	0.35	0.72
Bean surface	0.04	0.06	-0.02	-1.47	0.14
Other crops (number)	0.04	0.04	0.00	-0.06	0.06
Plots (number)	1.12	1.16	-0.04	-4.90	0.00
Marginalization	0.24	0.24	0.00	0.06	0.95
Age (1=older adult)	0.64	0.63	0.00	0.40	0.69
Unemployment rate	3.89	3.90	0.00	-0.03	0.97
Mean municipal income	3,814	3,809	5.00	0.23	0.82
Municipal agricultural surface	53.00	53.00	0.00	-0.49	0.62
Farmers	4,268	4,269	-1.00	-0.02	0.99

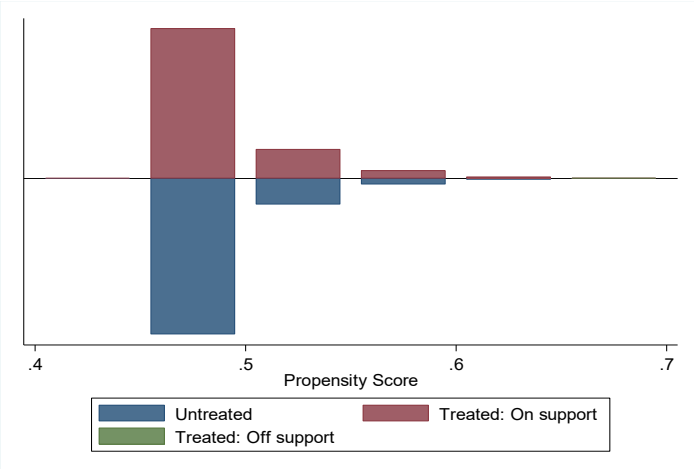
Source: prepared by the authors.

control and treatment, were located in the same range of PSM, which means that the groups are comparable (Figure 1). Visually, there is a substantial superposition in the distribution of the propensity scores of the recipient and non-recipient groups.

RESULTS AND DISCUSSION

Effect on the production surface

Next, the estimated effect of the GPP on the corn production surface is shown. Specifically, the results indicate that the implementation of the program exerted an impact on the production surface. The fourth column of the table shows the results of comparing the control and the treatment groups during the 2018-2020 period (Table 5). It was found that the recipient farmer, having not participated in the program, would follow the same



Source: prepared by the authors.
Figure 1. Common support.

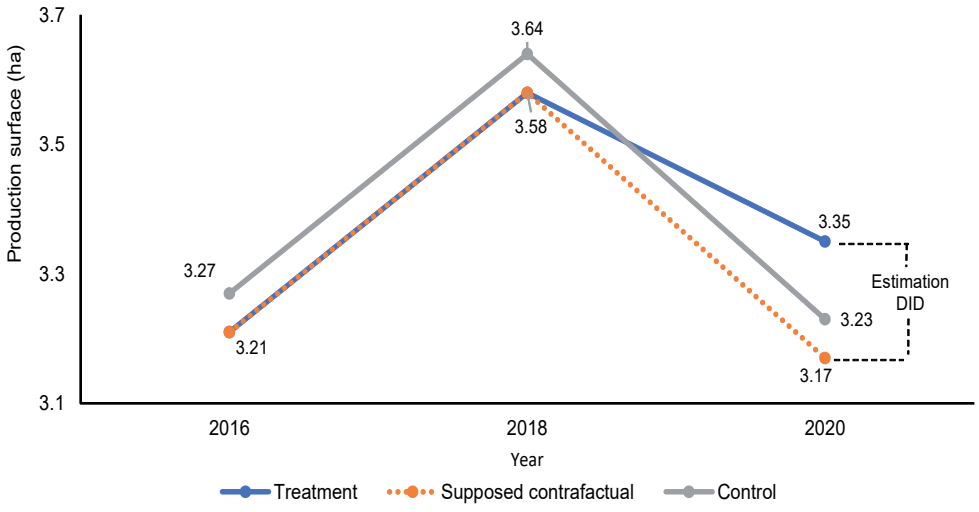
Table 5. Results from the estimation of difference-in-differences with the corn production surface as response variable.

Sample	Effect of GPP			Effect of GPP		
	Period		DID	Period		DID
	Previous (2018)	Later (2020)		Previous (2016)	Later (2018)	
Control	3.64	3.23		3.27	3.64	
Treatment	3.58	3.35		3.21	3.58	
Difference	-0.06 (0.05)	0.12 (0.06)	0.18 (0.08)	-0.05 (-0.048)	-0.06 (-0.05)	0.001 (-0.07)
|t|	-1.17	1.97	2.26	-1.13	1.12	0.04
p>|t|	0.24	0.048**	0.02**	0.26	0.26	0.97

*** p<0.01; ** p<0.05; * p<0.1; robust errors with heteroscedasticity test in parenthesis.
Source: prepared by the authors.

trend of the control group, with a decrease going from 3.64 hectares to 3.23 hectares, while the treatment group went from 3.58 to 3.35 hectares. That is to say, because of the program, the decrease in surface of the treatment group was not as marked as the control group. In net terms, for an average recipient, the effect of the program avoided a reduction of his production surface of 5% compared to the non-recipient producers.

With the estimations, it was evidenced that the reduction of the production surface between 2018 and 2020 was a general characteristics among all the farmers; however, the program prevented the farmers from reducing their surface in 0.18 hectares (Figure 2).



Source: prepared by the authors.
Figure 2. DID estimation of two groups and two periods.

The results showed that the recipient producers also reduced their production area in 2020 compared to 2018, although to a lesser degree, regardless of the program having fixed a price above the market price. The reduction in the corn production area, in itself, is an important finding because it shows that the benefits of the program are not enough to promote an increase of the production surface, so that it could promote self-sufficiency in the country.

Eakin *et al*. (2014) showed that the corn farmers classified as sellers, in general, are the ones that have a larger agricultural production surface compared to non-sellers or auto-consumption producers. Therefore, regardless of the GPP having a positive effect on the production surface of the recipients, it is not likely that self-sufficiency will be attained, as long as the program restricts the producers by setting limits on surface and production and not including medium and large scale farmers.

Aditya *et al*. (2017) indicate that the implementation of guaranteed prices has a positive impact promoting the continuous expansion of the surface planted with cereal. In China, the guaranteed price has a greater impact in the wheat planting area, which indicates that farmers' decision to sow is strongly affected by this price (Li *et al*., 2020). In India, the guaranteed prices had a positive impact on the surface although they did not find a significant impact in productivity of the crops (Ritu *et al*., 2020).

Effect on the income of farmers

The effect of the program also translated into a higher income for the recipients. The increase in income is due, on the one hand, to a higher production from the increase in the surface planted, and on the other, to the higher price that the farmer received.

Effect on the income due to an increase in surface

An increase in production can be accompanied by an expansion of farming land (Organización para la Cooperación y el Desarrollo Económicos, OCDE/FAO, 2020; Conferencia de las Naciones Unidas sobre el Comercio y el Desarrollo, UNCTAD, 2013). The alternative of increasing the production offer of farmers, and with that their income, through increases in their production surface, is not trivial. Small-scale farms find the possibility of growing this way increasingly limited. Further still, the policies that stimulate the expansion of agricultural areas are not desirable because they also cause deforestation and, often, precarious yields in fragile ecosystems, which is why their effect in the long term is harmful (Bourgoin *et al*., 2020; Santpoort, 2020).

Taking as a basis the average surface of the producers in absence of the program (3.64 ha), with an average yield of 3.76 t/ha, then the farmer obtained a production of 13.69, for which he received MX$ 58,319, considering a mean rural price of MX$ 4,260. However, if a farmer participated in the program, this increased his surface by 0.18 hectares, which is why he obtained an additional production of 0.67 tons, which translates into an additional income of MX$ 2,854 to reach MX$ 61,173, considering the same level of yield and price. That is, thanks to the GPP, an average producer managed to increase his gross income by 5%.

Effect on the income due to an increase in price

Assuming that the only difference between the recipient and non-recipient farmers was the sale price (guaranteed price for the recipient and market price for the non-recipient), and considering again a production surface of 3.64 ha, with an average yield of 3.76 t/ha, if the farmer decided to participate in the program, he obtained a production of 13.69 tons, considering that his production surface did not increase. With this level of production, at a guaranteed price of MX$ 5,610, the producer received MX$ 76,801; that is, the farmer increased his income in MX$ 18,482; however, if the farmer also increased his surface in 0.18 ha, as this study shows, the farmer received up to MX$ 80,560, which translates into an increase of MX$ 22,241.

In the same way, agricultural policies implemented by the Chinese government constantly increased the guaranteed price, raising the income of farmers (Hejazi and Marchant, 2017). This was also confirmed by Othman *et al*. (2020) in Malaysia, where the guaranteed price of rice is the main instrument used to increase the income of farmers.

The model proposed by Qian *et al*. (2020) showed that an increase of 10% in the guaranteed price of rice increased the net income of farmers; and in wheat, due to the increase in production costs, the effect on the income was small and even negative in some cases.

In sum, for a representative farmer, the benefit of having participated in the program meant an increase in his income of MX$ 58,319 to MX$ 80,560, of which MX$ 3,759 was due to a higher production from the increase in surface and MX$ 18,482 to a higher sale price of their product; that is, 83% of the increase in income of farmers is because of the higher price recipients got and only 17% due to an increase of their production surface.

With these scenarios, it was identified that the greater benefit for farmers is because the program fixed a guaranteed price 32% above the market price, regardless of the producer increasing or not the production surface. Based on this, the findings by Santoyo (1977) were corroborated which show that the rise of the guaranteed price increases the benefits of the farmer, compensating the rises in production costs and improving their level of life; however, it is also corroborated that handout mentality policies tend to be a temporary palliative that can increase the income of producers only through the generation of a margin between the market price and the guaranteed price, providing them with scarce resources for production, without offering them the opportunity of really leave poverty behind, as suggested by Gómez Oliver and Tacuba Santos (2017) and Velázquez López *et al*. (2019).

Benefits from the program by state

The benefit from the GPP is not homogeneous in all states of the country because the amount allotted by the government in each state is in function of the number of producers interested in receiving the backing, which in turn depends, among other things, on the

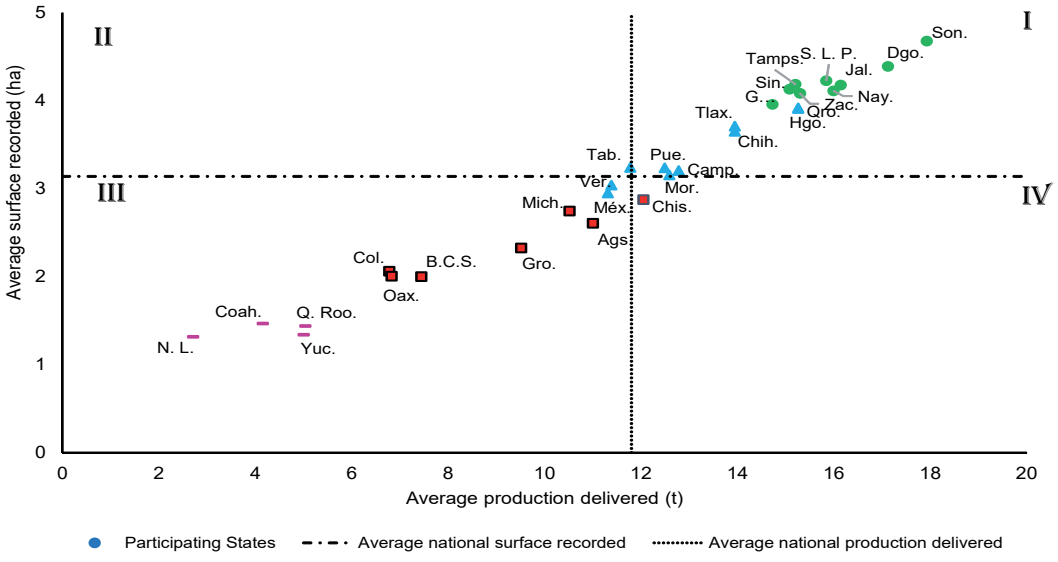
dissemination and implementation by the program's operators, as well as the conditions for production faced by the farmers.

For example, Ali *et al.* (2012) show that the policy of guaranteed prices implemented in India has not been uniform in the different states; in some it has been more effective and has helped to improve rice production, while in others this policy has had a negative balance.

Figure 3 shows the relationship between corn production volumes stockpiled and average surface recorded by producer in the states that participated in the GPP from 2019 to 2021. The states can be classified into two types. Quadrant I was integrated by 17 states whose production and surface is above the national average, jointly representing 58% of the total production stockpiled. Quadrant II is formed by 12 states whose production and surface is under the average, jointly representing 17% of the production. Chiapas, a particular case, is found in Quadrant IV, whose volume is above the average production but below the average surface recorded, and representing 25% of the production stockpiled.

Figure 3 also shows that there was a direct relationship in the states between the production level stockpiled and the agricultural surface recorded of the recipients; that is, with greater surface recorded by producers they delivered higher production. Thus, in Sonora, although only 59 producers participated, each delivered on average 18 tons and recorded 4.7 rainfed hectares. The contrary case was seen in Nuevo León, where seven producers participated, they delivered 2.7 tons on average and recorded 1.3 hectares per producer.

The states where producers recorded, on average, between 4 and 4.9 hectares per producer, stockpiled 45% of the production. Jalisco, which stockpiled 32%, is found in this range.



Source: prepared by the authors.

Figure 3. Results of the program by state.

The states where producers recorded between 2 and 2.9 hectares stockpiled 34%, and those that recorded from 3 to 3.9 hectares, 21%.

Farmers in the states of Quadrant I, with greater production and better use of the surface, are the ones that received a greater benefit from the program, because they delivered a higher production by farmer, although they were not necessarily located in the states that had a higher participation in the program in terms of recipients.

Most of the states that are close to the intersection of Quadrants I and III are states from the center and south of the country, where small-scale producers predominate, which are often characterized for having limited access to productive resources (land and capital, institutional services and technology or preponderant use of family workforce). Some of the states from Quadrant III stood out for their orientation towards crops other than corn.

The states that had the most stockpiling were Jalisco (32%), Chiapas (25%), Guerrero (7%), Estado de México (5%), and Puebla (4%) (Table 6). The surface recorded was in this same order of contribution and percentage. In terms of the participation of farmers, the order only changes in Chiapas by Jalisco, and is as follows: Chiapas (27%), Jalisco (26%), Guerrero (10%), Estado de México (5%) and Puebla (4%).

The stockpiling obtained in Jalisco was 233 thousand tons of corn, which makes it the state that received the highest volume of production in the stockpiling centers and the second one with highest number of program recipients.

Finally, although the program helped to improve the income of the recipients, to a greater or lesser extent, it had low impact on the trade balance, considering that one of the objectives of the program increasing production to reduce imports and to achieve self-sufficiency in basic grains.

In terms of corn, Mexico consumes 43 million tons per year, of which it produces 3.2 million tons of yellow corn and 24.4 of white corn; the remaining 15.7 million are imported primarily from the United States. The imports made by the country are 95% yellow corn, mainly for livestock consumption, and the rest is white corn to supply the national industry. Mexico is self-sufficient in white corn; however, in yellow corn, 84% of the demand is covered with imports, which affects the country's food security.

According to Lazos (2013), the reconversion programs of white corn to yellow corn, despite having subsidies and important government backing, have failed. Large-scale farmers have preferred to continue sowing white corn. This is due to the lack of trust in federal agrarian policies, and contradictions of the agrarian policy.

The recipients of the GPP contributed 2.7% of the domestic production, 98% white corn and 2% yellow corn, which is stockpiled solely from Chiapas. An area of opportunity of the program is to increase the production of yellow corn (Table 7); however, this could be affected given the decree published in 2020 which demands the revocation of permits to liberate genetically modified (GM) corn seeds and the abstention from granting authorizations for the use of GM corn in human consumption.

Evaluating what was the impact of GM corn in the program requires a greater analysis that is outside of the reach of this study.

Table 6. Average information by state.

State	Farmer	Surface recorded (ha)			Production delivered (t)		
		Maximum / farmer	Minimum / farmer	Total	Maximum / farmer	Minimum / farmer	Total
Jal.	14,431	5.0	0.5	60,283.6	20.0	0.1	232,961.9
Chis.	14,775	5.0	0.5	42,496.8	20.0	0.1	178,058.6
Gro.	5,263	5.0	0.5	12,243.7	20.0	0.1	50,093.3
Méx.	2,935	5.0	0.5	8,660.9	20.0	0.0	33,214.5
Pue.	2,357	5.0	0.5	7,627.8	20.0	0.1	29,441.3
Tlax.	2,049	5.0	0.5	7,603.9	20.0	0.3	28,580.6
Nay.	1,419	5.0	0.5	5,834.9	20.0	0.2	22,695.6
Ver.	1,942	5.0	0.5	5,903.6	20.0	0.1	22,113.4
Gto.	1,478	5.0	0.6	5,847.3	20.0	0.4	21,760.2
Dgo.	1,202	5.0	0.5	5,278.0	20.0	0.4	20,584.0
Camp.	1,342	5.0	0.5	4,303.5	20.0	0.1	17,158.2
Oax.	1,691	5.0	0.5	3,388.3	20.0	0.0	11,542.4
Tamps.	722	5.0	0.6	3,020.5	20.0	0.4	10,970.1
Qro.	656	5.0	0.5	2,568.0	20.0	0.3	10,004.2
S. L. P.	377	4.9	0.6	1,593.9	19.8	0.4	5,973.1
Sin.	377	5.0	1.4	1,557.5	20.0	3.6	5,686.7
Hgo.	368	5.0	0.5	1,439.4	20.0	0.2	5,615.8
Mich.	520	5.0	0.5	1,426.8	20.0	0.1	5,465.9
Mor.	17	5.0	0.5	1,316.4	20.0	0.3	5,250.8
Zac.	283	5.0	0.6	1,155.8	20.0	0.8	4,329.7
Son.	59	5.0	1.0	276.0	20.0	0.2	1,057.8
Ags.	67	5.0	0.6	174.7	19.9	0.7	737.2
Chih.	51	5.0	0.7	184.4	20.0	1.3	704.4
Tab.	46	5.0	0.9	149.1	19.9	1.8	541.8
Yuc.	46	3.1	0.5	61.0	12.4	0.2	227.7
Col.	16	4.0	1.0	33.0	14.0	0.5	108.5
Q. Roo.	9	4.5	0.5	12.2	17.4	0.4	42.8
N. L.	7	2.0	0.5	8.5	3.7	0.4	17.6
Coah.	2	1.9	1.9	2.9	7.3	6.2	8.3
B.C.S.	1	2.0	2.0	2.0	7.4	7.4	7.4
Total	54,864			184,299.0			724,367.0

Source: prepared by the authors with data from the program.

CONCLUSIONS

Quasi-experimental research designs are an effective form of learning about the causal relationships that are important in agricultural policies. This article used difference-in-differences and matching to estimate the effect of the Guaranteed Prices Program on the production surface of the recipients, given the nature of the data and the availability of the information before and after the program's execution.

It was found that the Guaranteed Prices Program incentivized farmers to not decrease the corn production surface in the same proportion as non-recipient farmers, with a higher income. The results from the estimation indicate that small-scale farmers who participated

Table 7. Corn stockpiled on average from S-S 2019-2020 and 2020-2021.

Corn	Surface recorded (ha)	Production delivered (t)
Yellow	3,863	12,693
White	188,610	711,674
Total	192,473	724,367

Source: prepared by the authors with data from the program.

in the program increased on average 1,810 square meters each; therefore, the program did have a causal effect on the producers, impacting the production surface.

The increase in the program recipients' income is mainly due to the increase in the price of the product, rather than an increase in the volume produced as consequence of the expansion of the surface cultivated. This is because farmers, particularly small-scale, cannot develop a productive scaling that generates higher agricultural profitability because their condition limits them since they have scale economies.

Based on the government's expectation, the program did not manage to increase the production since the surface planted by recipients did not increase enough, so that, in global terms, it could have an impact on the national corn surface to allow reaching food self-sufficiency.

This study shows that the guaranteed price implemented by the government in corn with small-scale farmers is inefficient, because it is not successful in promoting the increase in production; therefore, other alternatives should be sought that allow reaching the desired objectives.

It is important to mention that the program is not studied individually but rather as a key piece in local development, which is integrated with other strategic programs into an improvement plan that promotes food self-sufficiency and the welfare of producers.

As complement to this study, the use of alternative sources of information is recommended which would allow to verify whether the effects estimated are of permanent or temporal nature, in addition to analyzing different periods of the program. Therefore, the conclusions of this article should not be taken as definitive.

NOTES

[1]The package of priority programs managed under the segment Agriculture and Rural Development are: *Producción para el bienestar* (Production for welfare); *Precios de garantía para alimentos básicos* (Guaranteed prices for basic foods); *Fertilizantes para el bienestar* (Fertilizers for welfare); *Abasto rural* (Rural supply); *Bienpesca*.

[2]Decoupling is the support disconnected from the price or the production decisions of farmers (Antón, 2001).

[3]Farmland Support Program (*Programa de Apoyos al Campo*) PROAGRO, before PROCAMPO.

[4]PpB before PROAGRO.

REFERENCES

Aditya KS, Subash SP, Praveen KV, Nithyashree ML, Bhuvana N, Sharma A. 2017. Awareness about minimum support price and its impact on diversification decision of farmers in India. Asia y the Pacific Policy Studies, 4(3), 514–526. https://doi.org/10.1002/app5.197.

Ali SZ, Sidhu RS, Vatta K. 2012. Effectiveness of minimum support price policy for Paddy in India with a case study of Punjab. Agricultural Economics Research Review, 25(2), 231–242. https://doi.org/10.22004/ag.econ.137357.

Antón J. 2001. Decoupling: A conceptual overview. OCDE Papers, France. https://doi.org/10.1787/oecd_papers-v5-art37-en.

Baer-Nawrocka A, Sadowski A. 2019. Food security and food self-sufficiency around the world: A typology of countries. PLoS ONE, 14(3), 1–15. https://doi.org/10.1371/journal.

Bourgoin C, Oszwald J, Bourgoin J, Gond V, Blanc L, Dessard H, Van Phan T, Sist P, Läderach P, Reymondin L. 2020. Assessing the ecological vulnerability of forest landscape to agricultural frontier expansion in the Central Highlands of Vietnam. International Journal of Applied Earth Observation and Geoinformation, 84. https://doi.org/10.1016/j.jag.2019.101958.

DOF. 2019. Lineamientos de operación del programa precios de garantía a productos alimentarios básicos para el ejercicio fiscal 2019. Diario Oficial de la Federación, México.

DOF. 2020a. Reglas de operación del programa de precios de garantía a productos alimentarios básicos para el ejercicio fiscal 2020. Diario Oficial de la Federación, México.

DOF. 2020b. Reglas de operación del programa de precios de garantía a productos alimentarios básicos para el ejercicio fiscal 2021. Diario Oficial de la Federación, México.

DOF. 2021. Reglas de operación del programa de precios de garantía a productos alimentarios básicos para el ejercicio fiscal 2022. Diario Oficial de la Federación, México.

Eakin, H., Perales, H., Appendini, K., y Sweeney, S. (2014). Selling maize in Mexico: The persistence of peasant farming in an era of global markets. Development and Change, 45(1), 133–155. https://doi.org/10.1111/dech.12074.

Geldres WVV, Etchebarne LMS, Bustos MLH. 2009. Metodología DID-Matching aplicada a la política pública de promoción de exportaciones. Estudios de Administración, 16(1), 59–90.

Gertler PJ, Martínez S, Premand P, Rawlings LB, Vermeersch CMJ. 2017. La evaluación de impacto en la práctica. Segunda edición. Washington, D.C: BID. https://doi.org/10.1596/978-1-4648-0888-3.

Gómez Oliver L, Tacuba Santos A. 2017. La política de desarrollo rural en México. ¿Existe correspondencia entre lo formal y lo real? Journal of Economic Literature, 14(42), 93–117. https://doi.org/10.1016/j.eunam.2017.09.004.

Guerrero-Ortiz PL, Palacio-Muñoz VH, Leos-Rodríguez JA, Ocampo-Ledesma JG. 2021. Precios de Garantía en México (2019-2020): diseño e implementación de política agrícola. Economía Agraria y Recursos Naturales, 21(2), 121–141. https://doi.org/10.7201/earn.2021.02.06.

Heinrich Böll Stiftung. 2019. Agriculture Atlas 2019. Facts and figures on EU farming policy. Heinrich Böll Stiftung. Friends of the Earth Europe, BirdLife International.

Hejazi M, Marchant MA. 2017. China's evolving agricultural support policies. CHOICES, 32(2), 1–7. https://doi.org/10.22004/ag.econ.257822.

Lazos E. 2013. ¿Estamos listos en México para defender nuestros maíces? Agricultores y consumidores en la encrucijada. Dimensión Antropológica, 58(20), 89–114.

Li J, Liu W, Song Z. 2020. Sustainability of the adjustment schemes in China's grain price support policy. An empirical analysis based on the partial equilibrium model of wheat. Sustainability, 12(6447). https://doi.org/10.3390/su12166447.

OCDE/FAO. 2020. Perspectivas agrícolas 2020-2029. OCDE Publishing, Paris. https://doi.org/https://doi.org/10.1787/a0848ac0-es.

Othman K, Omar H, Fuad HA, Laidin J, Ramli IM. 2020. The Causal Impact Of Government Support On The Small Strategic Crop Industry: Malaysia's Experience. https://doi.org/10.18488/journal.1005/2020.10.1/1005.1.298.310.

Peña J. 2021. Las políticas de competencia en América Latina post-consenso de Washington. Investigaciones CeCo. Universidad Adolfo Ibáñez. http://www.centrocompetencia.com/category/investigaciones%0AEnvíanos.

Qian J, Ito S, Zhao Z. 2020. The effect of price support policies on food security and farmers ' income in China. August. https://doi.org/10.1111/1467-8489.12398.

Ritu M, Malik DP, Kumar R, Nisha. 2020. Impact of agricultural price policy on major food crops in Haryana. Economic Affairs, 65(2), 267–274. https://doi.org/10.46852/0424-2513.2.2020.20.

Rosenbaum PR, Rubin DB. 1983. The central role of the propensity score in observational studies for causal

effects. Biometrika, 70(1), 41–55. https://doi.org/10.1017/CBO9780511810725.016.
Rubio B, Peña Ramírez J. 2013. Una visión histórica del dominio agroalimentario de Estados Unidos: de la postguerra a la crisis alimentaria. Revista Interdisciplinaria de Estudios Agrarios, 38, 5–23.
Santoyo S. 1977. La política de precios de garantía. Antecedentes, situación actual y perspectivas. Demografía y Economía, 11(1), 77–98. https://doi.org/10.24201/edu.v11i01.383.
Santpoort R. 2020. The drivers of maize area expansion in Sub-Saharan Africa. How policies to boost maize production overlook the interests of smallholder farmers. Land, 9(68). https://doi.org/10.3390/land9030068.
Secretaría de Agricultura y Desarrollo Rural. 2020. Programa sectorial de Agricultura y Desarrollo Rural 2020-2024. Secretaria de Agricultura y Desarrollo Rural.
SIAP. 2022. Anuario estadístico de la producción agrícola. In Cierre de la producción agrícola. https://nube.siap.gob.mx/cierreagricola/
Suárez Dávila F. 2013. Crecer o no crecer. Del estancamiento estabilizador al nuevo desarrollo. Taurus.
Torres F, Rojas A. 2015. Política económica y política social en México: desequilibrio y saldos. Problemas Del Desarrollo, 46(182), 41–66. https://doi.org/10.1016/j.rpd.2015.06.001.
Torres Reina D. 2020. Las políticas de ajuste estructural en Colombia y Venezuela durante los años ochenta y noventa. Apuntes Del CENES, 39(69), 71–101.
UNCTAD. 2013. Informe sobre el comercio y el desarrollo.
Velázquez López J, Juárez Sánchez JP, Ramírez-Valverde B, Jiménez Morales J, Taboada Gaytán OR, Del Valle Sánchez M. 2019. Adoption of agricultural technology and its influence on productivity and competitiveness of maize in the central-eastern region of the state of Puebla, Mexico. Revista de Geografía Agrícola, 63, 101–119. https://doi.org/10.5154/r.rga.2019.63.02.