Correlation between second-tier bank credit and agricultural GDP in Mexico

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ABSTRACT
Objective: to evaluate the impact that the operation of second-tier bank loans has had on Mexico's agricultural Gross Domestic Product (GDP).
Design/Methodology/Approach: a set of 1360 data records corresponding to the operation of the discounted credit and the one guaranteed by the Trusts Instituted in Relation to Agriculture (in Mexico, FIRA) were used, as well as the agri-food Gross Domestic Product (GDP) reported by the Bank of Mexico (BANXICO). These records were grouped into 40 four-month periods between March 2013 and December 2022. The information was presented in constant values to be comparable; it was analyzed through a correlation model with the stepwise procedure in R statistical software.
Results: a 0.1471 positive impact on agricultural GDP growth was observed for each unit of credit drawn down by FIRA with a determination coefficient R^2=0.973. This impact derives from FIRA's large participation in the agri-food sector; and it was also highly influenced by seasonality in agricultural cycles.
Limitations/ Implications of the study: by shortening the periods of time analyzed, the results can be affected by external factors as happened with the recent global economic contraction generated by the CovID-19 pandemic in 2020 and whose effects have lasted for three years.
Findings/Conclusions: FIRA has fulfilled its character within development banking by adapting its policies and services to the economic conditions of the moment. And for adjusting to those that are required, within its financial model, to maintain and promote the placement of the credit necessary for the operation and growth of agricultural companies in Mexico.

Keywords: agricultural credit, development banking, FIRA (Mexico's Trusts in relation to Agriculture).

INTRODUCTION

Agricultural enterprises in Mexico present strong challenges, basically generated by the reconfiguration of the population towards urban areas and their demographic growth, climate change and change in eating habits, as well as the disaggregation of agricultural income towards other productive activities (Cartón, 2009; FIRA, 2020). In this new environment, a more productive and innovative agriculture is required (González & Orrantia, 2006; FIRA, 2020). It is also required to maintain an availability of economic resources wherever there is a high demand; second-tier credits must play an active role there.

However, the risks inherent to agricultural activity, such as variations in production yields, price fluctuations, and natural disasters, as well as asymmetric information and high transaction costs, cause a decreased motivation towards the activity of development banks to be able to serve the sector (Acevedo & Delgado, 2002). So greater efforts have been focused on addressing lower-risk activities, such as consumer and government credit.

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Although this ignores the favorable impact of agricultural activity on the national economy (Clavellina, 2013; Cruz & Mayren, 2014; Torre & Flores, 2020).

As a response to this problem, development banking (De la Vega *et al.*, 2014) emerges as an instrument specialized in mitigating risks by providing guarantees and other support to financial intermediaries that favor inclusion in more entrepreneurial credits. Such is the case of FIRA, as a second-tier bank specialized in meeting the financing needs of agriculture in Mexico. In addition to incentivize the placement of credits, FIRA seeks to diversify them by training credit subjects and incorporating new financial intermediaries to achieve greater incidence in this sector (Del Ángel, 2005 & Huidobro, 2012).

The importance of the agricultural sector lies in the fact that it is the starting engine of the economy (Cruz & Mayren, 2014), since in addition to supplying food to the population, it is a generator of labor and wealth to other productive sectors. This means it is both a primary consumer of manufacturing and industrial companies, and a supplier of raw materials. This sector is currently identified as the main source of foreign exchange in the trade balance of the country. It is important to recognize the impact of development banking on the generation of wealth and the capitalization of the sector (Espinoza & Martínez, 2017) and its future challenges. For example, according to the National Agricultural Survey (INEGI, 2019) only 8.4% of agricultural companies have access to credit.

For all of the above, the objective of this study was to measure, through a regression model, the impact that the credit of FIRA (Mexico's Trusts instituted in relation to Agriculture) and the use of their guarantees, both have had on the agri-food Gross Domestic Product -GDP between 2013 and 2022.

MATERIALS AND METHODS

The research was based on the compilation and analysis of 1360 records of FIRA's credit operation and the quarterly value of agricultural GDP, which make up the time series for the period 2013 to 2022. Figures presented in billions of Mexican pesos ($ MXN). The first group of data comes from the information provided by FIRA, divided into three categories and updated to constant values until December 2022. The first category corresponds to the credit operation of each regional division of FIRA in Mexico, Northwest, North, Central, South and the Yucatan Peninsula.

The second category refers to financed activity, primary, industry, commerce and services. And the third category corresponds to the operational records: Funding (F), Guarantee without Funding (GSF) and Paid Guarantees (GP). Because the GPs correspond to loans with recovery problems, they are outside the objective of this study, which is only to measure the impact of the dynamic resource. GP was thus discarded, and the variables of Funding and Guarantees without Funding were grouped. Funding indicates the FIRA resources used directly by financial intermediaries to grant credits (as discounts). On the other hand, the Guarantee without Funding refers to the resources granted by financial intermediaries with resources from their own treasury, but which are covered by a FIRA guarantee (induced credit).

The third category corresponds to the information obtained from the Bank of Mexico, presented in constant values until December 2022. This group is made up of credit portfolios and national GDP. The credit portfolios are made up of the Commercial Banking portfolio, Total current credit portfolio to the private sector, Total current portfolio by credit destination, Companies and individuals with business activity, in the agricultural, forestry and fishing sectors. For its part, the quarterly GDP for the years 2013 to 2022, also in constant values until December 2022, is broken down into primary (agriculture), secondary (manufacturing) and tertiary (services and trade) activities. For this study, in order to limit the impact of FIRA and relate it to GDP, only the value corresponding to primary activities was considered.

The hypothesis proposes to demonstrate that FIRA, in its role as a development bank, positively affects agri-food GDP, by promoting investment activities and a better regional distribution of resources.

The data used for the construction of the model are described below:

Trim (X): Quarter of the year ($X=1-4$);
CASP: Total current credit portfolio by credit destination companies and individuals with business activity: Agriculture, forestry and fishing;
CCVT: Total outstanding credit portfolio to the private sector;
CCEM: Total current credit portfolio for companies and individuals with business activity;
FGSF: FIRA Funding and Guarantees without Funding for primary activity (100); Industry (200), Trade (300) and Services (400) by Regional and Total;
PIB: Gross Domestic Product (GDP);
PIAP: Domestic Product in Primary Activity;
PIPT: Total Domestic Product.

The model was adjusted with the use of the ordinary least squares method in the statistical package R; a selection of significant variables was made based on the adjusted R^2 value. With the stepwise procedure, those variables with a greater incidence in magnitude on the model were identified, to verify the obtaining of the expected signs.

RESULTS AND DISCUSSION

As a result, the following model was obtained:

$$PIAP_t = \beta_0 + \beta_1 COVID_t + \beta_2 T_t^{(2)} + \beta_3 T_t^{(3)} + \beta_4 T_t^{(4)} + \beta_4 T_t^{(4)} + \beta_5 t + \beta_5 FGDFTOT_t \\ + \varepsilon t, t = 1, \ldots, T$$

where: *PIAP*, PIB primary activities; *COVID*, indicator variable of the pandemic period caused by the SARS-Cov2 virus; $T^{(j)}$, indicator variable for the quarter j, j=2, 3, 4; T, tendency; FGDFTOT, funds from the Trusts Instituted in Relation to Agriculture $-$in Mexico FIRA; and ε, experimental error (0-mean and σ^2-variance).

It is shown that determining variables in the behavior of agricultural GDP in the period evaluated were Funding, the total amount guaranteed by FIRA (FGDFTPT), and the effect of the quarter of the year Trim (Q). The covid variable was included to evaluate the impact it had on the economic recession of 2020, and to determine how macroeconomic factors may affect the behavior of Mexico's agriculture credit.

As it can be seen, regression is significant ($p \leq 0.05$) with a coefficient of determination $R^2=0.973$; that is, 97% of the observed variability is explained by the adjusted model. In addition, all the effects were significant and with the expected signs.

The CovID pandemic had a negative effect (-10640) on PIAP. While the quarterly effects were all statistically significant and are expressed as differences compared to the first quarter. The fourth quarter (Q4) was the one in which a greater increase in the PIAP was observed compared to the first quarter. The effects of the trend variables (t) and FGSFTOT were statistically significant with $p \leq 0.0001$ and $p \leq 0.05$, respectively.

The adjusted model has a high predictive power, with a correlation between the values observed, in a test set (40%) and those predicted 0.98. This means that the prediction of the estimated future behavior of these data has a 98% probability, they will behave similarly to the actual observed data (Figure 1).

Similarly, through the graphical analysis of effects (Figure 2) it is seen how the PIAP varies as a function of FGFTOT with a high confidence interval; observable by the proximity of the processed data to the line estimated according to the model.

The quarters of the year had a significant effect on the PIAP behavior, which showed increases in quarters 1, 2 and 4. This can be explained by the behavior of agricultural cycles and their demand for credit; since 55% of FIRA's operation is allocated to agriculture (FIRA, 2022). Thus, 90% of the harvest of the spring-summer cycle (PV) is concentrated in January; while the planting and demand for inputs of this cycle occurs between March and April. On the other hand, in the autumn-winter cycle (OI), 64% of the harvest occurs during May and June, but its planting and demand for inputs is highest in the months of October and November (FIRA, 2023) (Figure 3).

Results are consistent and expected, according to the findings by other authors. Huidobro (2012), for example, pointed out the fundamental role of development banks in

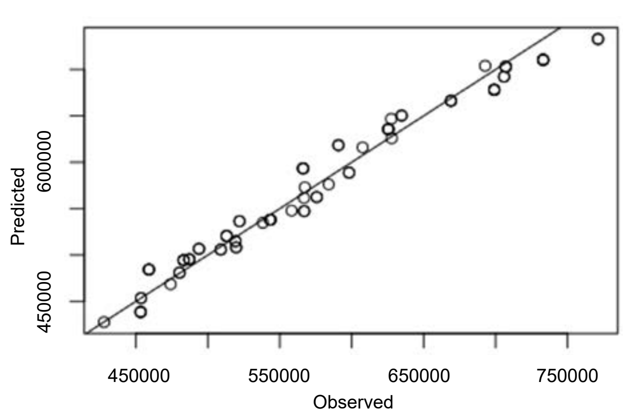

Figure 1. Prediction of the behavior of expected GDP *vs.* real GDP.
Source: elaborated by the authors for this study.

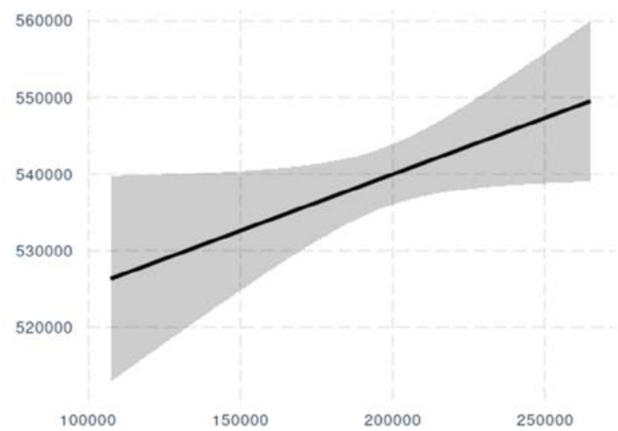

Figure 2. Confidence interval of the impact of the FGSFTOT on the PIAP.
Source: elaborated by the authors for this study.

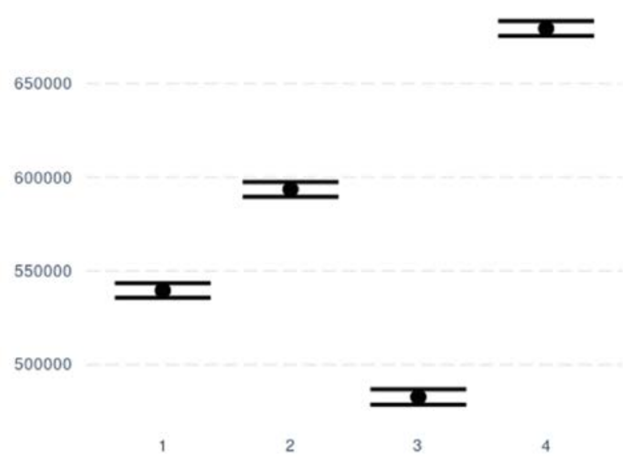

Figure 3. Impact of the quarters of the year on the PIAP.
Source: elaborated by the authors for this study.

providing solutions to long-term financing needs, in order to contribute to the economic development of companies. A fact that leads to the generation of wealth, growth, increase in the labor force and with it, the economic gross income to the country, which is measured as an increase in GDP.

Lara (2021) in his research, highlighted the importance of the entry over time of those companies that had access to financing with FIRA resources. While Espinoza and Martínez (2017) highlighted the positive role played by development bank credit in increasing agriculture GDP analyzed from 1970 to 2010.

However, there is still a long way to go, therefore, according to De la Vega *et al.* (2014), development banks have sought their permanence towards increasing their revenues through higher financing costs. Because of this, second-tier banking remains at short results in terms of depth and scope, since it has not generated enough impact to grow support for the most unprotected producers. Nor for more innovative projects, but still focuses its efforts on servicing short-term loans, added to the low interest of banks in supporting loans to the primary sector (Almeraya, 2011). In addition, the lack of mechanisms for attention to producers and credits, plus the asymmetry of the markets, all of which limits the interest of producers with fewer resources to apply for a loan or even approaching the banks.

CONCLUSIONS

The CovID pandemic (2020-2021) had a negative effect on the GDP of primary activities. The gross domestic product at the end of the evaluation period was 10,640 units lower than that at the beginning, in March 2020. In the second and fourth quarters, increases were observed in the GDP of primary activities; while in the third quarter a decrease was observed. This seasonality effect is explained by the demand for resources exerted by the agricultural cycles, in which there is a high demand combined both for harvesting work and for the continuous start of sowing in the autumn-winter and spring-summer cycles.

In the study period, a quarterly increase of 2531 units in the GDP of primary activities was observed, which shows a positive trend in the timeline. Regarding the impact that the FIRA resource has on agricultural GDP, the model showed that for each credit unit drawn by FIRA, a positive impact of 0.1471 can be observed on agricultural GDP. This confirms the important role that FIRA plays in this development banking sector. As well as the need to establish strategies with companies and the government to continue growing operations in support of the agricultural sector.

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