Economic growth and investment in the agricultural sector in Mexico during the period 1993-2022

Valdez-Cornejo, Itzel Y.[1]; Vega-Valdivia, Dixia D.[1*]; Martínez-Damián, Miguel A.[2]; Núñez-Castrejón, Antonia[3]

[1] Universidad Autónoma Chapingo. Texcoco, Estado de México, México. C.P. 56230.
[2] Colegio de Postgraduados, Montecillo, Estado de México, C.P. 56264.
[3] Instituto Politécnico Nacional, Miguel Hidalgo, Ciudad de México, México. C.P. 11350.
* Correspondence: dixiadania@gmail.com

ABSTRACT

Objective: to analyze the behavior of the agriculture sector during the period 1993-2022, as well as investment in Mexican agriculture, in order to identify those factors contributing the most to the economic growth of the sector.

Design/Methodology/Approach: the two-stage Ordinary Least Squares (OLS) method was used. Subsequently, the corresponding elasticities (E) were obtained for each of the variables included in the analysis.

Results: results indicated that both the growth of agricultural GDP and the interest rate of the 91-day certificate CETES significantly influence foreign direct investment - FDI. However, results suggest that FDI has a limited impact on agricultural GDP growth, because a 1% increase in FDI causes only a marginal increase in the GDP of the sector. On the other hand, gross fixed capital formation shows a positive and significant effect.

Limitations/Implications of the study: the lack of data complicated the development of the model, since there were multiple variables that could have explained the behavior of investment and economic growth in the agricultural sector.

Findings/Conclusions: Gross fixed capital formation - GFCF is crucial for GDP growth in agriculture. However, the lag in investment in infrastructure and machinery continues to be a challenge for the agriculture sector in Mexico, limiting ability to grow at a faster pace. Increasing investment could create an environment that benefits both that sector, and Mexico's domestic economy.

Keywords: public and private investment, foreign direct investment, agriculture GDP.

Citation: Valdez-Cornejo, I. Y., Vega-Valdivia, D. D., Martínez-Damián, M. A., & Núñez-Castrejón, A. (2025). Economic growth and investment in the agricultural sector in Mexico during the period 1993-2022. *Agro Productividad*. https://doi.org/10.32854/926j5k91

Academic Editor: Jorge Cadena Iñiguez
Associate Editor: Dra. Lucero del Mar Ruiz Posadas
Guest Editor: Daniel Alejandro Cadena Zamudio

Received: November 05, 2024.
Accepted: April 16, 2025.
Published on-line: June XX, 2025.

Agro Productividad, 18(5). May. 2025. pp: 143-XXX.

INTRODUCTION

The primary sector is one of the most important sectors worldwide, because most countries depend on these activities for economic and food stability (SIAP, 2020). Currently, the demand for food worldwide has increased due to the growing population, so the growth rate of the economy is negatively affected, because it has to resort more and more to agri-food imports (Bula, 2020).

The primary sector includes agriculture, livestock farming and husbandry, forestry, fishing, and hunting activities (INEGI, 2023). This sector contributes approximately 3.7% of the national GDP. Within this sector, agriculture is positioned as the most significant activity, which contributed around 63% of the total value of the agriculture sector in 2022. INEGI (2023) identified various challenges faced by agricultural producers, such as insufficient government support, high costs of inputs and services, losses caused by climatic phenomena and pests, low product prices, reduced sales as a result of the CovID-19 pandemic, degradation of soil fertility, and lack of adequate infrastructure for production.

On the other hand, financing for agriculture in Mexico has experienced a significant reduction, attributed to the elimination of budget programs aimed at the rural sector. Between 2019 and 2020, the resources allocated to Mexico's Secretariat of Agriculture and Rural Development (SADER) decreased by 29.2% in real terms (SHCP, 2022), which has limited the ability of public institutions to offer subsidies. Since 1994, reduced government funding in the agricultural sector has affected key areas, such as research and development. This has resulted in a lack of technological innovations that would increase the competitiveness of the agricultural sector. Some studies such as that of Palacios and Ocampo (2012) underlined the scarcity of equipment in the Mexican labor lands, which limits the impact of public and private investment on growth.

A productive, profitable and efficient agricultural sector results in a multiplier effect for growth and is transformed into a potential generator of foreign exchange due to exports of products from agriculture (Galván, 2022). Investment has become one of the most powerful tools for economic growth and development in any sector of the economy for any country. Mordecki and Ramírez (2018, p. 116) stated that "investment is an essential element to examine growth, because it increases the productive capacity of an economy".

Because of all the aforementioned, the main variables that determine both growth and investment in agricultural activity in Mexico will be identified. This study aimed to analyze the behavior of the agricultural sector during the period 1993-2022, as well as investment on agriculture in Mexico, in order to identify the factors that have contributed the most to the economic growth of the sector.

MATERIALS AND METHODS

This research covered national data from the period 1993-2022. The agricultural Gross Domestic Product (GDP) was selected to analyze the growth of the sector, according to the methodology of Mexico's National Institute of Statistics and Geography (INEGI, 2023). As an investment indicator, Gross Fixed Capital Formation (GFCF) was used, which integrates public and private investment in durable goods; based on the methodology of Mora (2011) and defined as "investment in long-term goods in the production process" (INEGI, 2023).

Agricultural exports were included as a critical variable for agricultural GDP growth. Because, according to the World Bank (2018) greater international trade boosts growth, innovation, and productivity. Also, remittances (REM), which are cash transfers from abroad (INEGI, 2023), were also incorporated due to their relationship with the acquisition of agricultural technology (Morales *et al.*, 2015; Turiján *et al.*, 2015), which in turn improves crop production.

The 91-day CETES interest rate (TIC-91), issued by the government, was added to the model due to its impact on investment decisions (Levy, 2012; Varela and Lázaro, 2016). The exchange rate MXN peso to USD dollar (TC) was also included, because it has a role in economic growth (Cerezo, 2022; Castañeda and López, 2023). For the variables to be analyzed, data were obtained from INEGI, Banco de México, and the United Nations Food and Agriculture Organization (FAO). FDI and exports data were deflated using the Real Exchange Rate (RER).

To estimate the determinants of investment and growth in the agricultural sector, the two-stage Ordinary Least Squares (OLS) method was used. The statistical analyses were performed in EViews 12 SV, using agricultural GDP as an indicator of growth in that primary sector (Equation 1).

$$PIBA = \beta_0 + \beta_1 RIED + \beta_2 RFBCF + \beta_3 TC + \beta_4 REM + \beta_5 X + \varepsilon_i \quad (1)$$

where, *RIED*: foreign direct investment in millions of MXN pesos constant to 2015 that was used with a lag; *RFBCF*: public and private investment in millions of MXN pesos constant to 2015 that was used with a lag for a better fit; *TC*: exchange rate (MXN pesos to USD dollars); *REM*: remittances in millions of MXN pesos constant to 2015; *X*: agriculture exports in millions of MXN pesos constant to 2015. Equation 2 calculates Foreign Direct Investment (FDI) as follows:

$$IED = \beta_0 + \beta_1 PIBAP + \beta_2 LTIC91 + \varepsilon_i \quad (2)$$

where: *FDI*: foreign direct investment in millions of MXN pesos constant to 2015; *PIBAP*: Agriculture GDP estimated in equation (1) in millions of MXN pesos constant to 2015; *LTIC*: logarithm of the interest rate (CETES at 91 days).

Once the model was estimated, the corresponding elasticities (E) were obtained for each of the variables included in the analysis.

$E = \left(\beta_i * \frac{\bar{X}}{\bar{Y}}\right)$ y para el caso del modelo lin-log $E = \frac{\beta_i}{\bar{Y}}$

where, β_i represents the coefficient of the explanatory variable, $\bar{X}$ is the average of the data of the explanatory variable; and $\bar{Y}$ is the average of the dependent variable.

RESULTS AND DISCUSSION

From Equation 1, results for growth of the Agriculture GDP are as follows:

$$PIBA = 4033.581 + 0.068978 RIED + 9.131719 RFBCF - 125.4274 TC + 0.141756 REM + 0.007764 X$$

$$t.t = (7.939097) \quad (1.309492) \quad (2.486365) \quad (-3.075648) \quad (2.702822) \quad (2.503052) \quad (R^2 = 0.93)$$

These results indicate that FDI with a lag in a period had a limited effect on the growth of the sector, since a 1% increase in FDI only caused a 0.02% increase in agricultural GDP. This low incidence can be attributed to some structural challenges faced by the sector, such as limited job creation, heterogeneity in production, lack of financing, and the effects of climate change (Basurto and Escalante, 2012).

A 1% increase in public and private investment with a lag period (RFBCF), generated a 0.25% increase in agricultural GDP the following year. This result highlights the importance of investment (for agricultural infrastructure, machinery and equipment, such as tractors and irrigation systems) in the growth of the Agriculture sector (Gutiérrez and Moreno, 2021).

The model also presents that a 1% increase in the exchange rate (TC) reduced agricultural GDP by 0.29%; This is explained by the increase in the cost of imported inputs, such as fertilizers, which negatively affected agricultural production in Mexico (IICA, 2023). Since fertilizer is one of the most widely used inputs in agriculture, these data support the findings of the model.

Finally, a 1% increase in remittances increased agricultural GDP by 0.09%, which coincides with the findings of Morales *et al.* (2015), who identified that remittances allow farmers to access better technologies, and to expand their activities towards regional or export markets. Mendoza and Valdivia (2016) stated that remittances have a positive influence on agricultural GDP, however, this impact may vary depending on the location being analyzed.

Likewise, a 1% increase in agricultural exports raised agricultural GDP by 0.21%. Exports are an important activity for economic growth, according to Avendaño and Acosta (2009). Although this result is lower than that reported by Galván (2022), the differences can be explained by variations in the period of analysis.

Equation 3 yielded the following:

$$IED = 1493.280 + 0.796012PIBA - 616.9985LTIC91$$
$$t.t = (2.047376) \quad (4.120160) \quad (-2.402307) \quad (R^2 = 0.55)$$

These results indicate that, facing a 1% increase in agricultural GDP, FDI increases by 0.88%, which coincides with studies such as that of Pérez *et al.* (2022), who highlighted the importance of the primary sector for attracting FDI. According to data from the Secretaría de Economía (2023), vegetables accounted for 61.2% of investment in this sector, followed by fruit production, and chicken and pig breeding.

Likewise, a 1% increase in the 91-day CETES interest rate reduced FDI by 0.44%. This finding is consistent with previous research, such as the study by Varela and Lázaro (2016), who found an inverse relationship between the interest rate and FDI in Mexico. The analysis done by Varela and Lázaro covered the entire domestic economy, while this study focused exclusively on the agricultural sector, which is particularly sensitive to factors such as climatic conditions (Ortíz and Ortega, 2018).

On the other hand, the exchange rate is presented as a factor that negatively affects the agricultural sector, due to its influence on the cost of imported inputs, such as fertilizers,

which are essential for agricultural production. This finding underscores the vulnerability of the primary sector to exchange rate fluctuations, particularly when a large part of the necessary inputs come from abroad.

It was shown that remittances have a positive effect on the growth of agricultural GDP, which coincides with previous studies that suggest that those resources help producers to improve their infrastructure, and to expand their operations into more profitable markets. Similarly, agricultural exports contribute marginally to the GDP growth of the sector.

In addition, the growth of agricultural GDP and the interest rate of the 91-day CETES significantly influenced FDI. In particular, an increase in agricultural GDP encourages the attraction of foreign investment, while an increase in the interest rate discourages investment in the sector. These findings are consistent with the available economic literature, which highlights the sensitivity of FDI to variations in interest rates, and the importance of the primary sector in attracting foreign capital.

CONCLUSIONS

This study made it possible to identify the main determinants of foreign direct investment and economic growth in the Agriculture sector in Mexico during the period 1993-2022 through an econometric model. The marginal increase in Agriculture GDP caused by the lagged FDI suggests that, although foreign investment is a relevant factor, there are other variables that play a more crucial role in the growth of agricultural production, such as Gross Fixed Capital Formation, which showed a positive and significant effect. The lag in investment in infrastructure, machinery and equipment remains a challenge for the agricultural sector in Mexico, limiting its ability to grow at a faster pace.

Our results highlighted the importance of promoting investment in agricultural infrastructure, machinery and equipment to improve the productivity of the agricultural sector in Mexico. Moreover, despite foreign investment is a positive factor, the development of the sector is highly dependent on domestic factors, such as fixed capital investment and the ability of producers to cope with exchange rate fluctuations. Therefore, to maximize the potential of Agriculture in Mexico, it seems essential to implement policies that strengthen competitiveness, improve access to inputs, and promote economic stability.

REFERENCES

Avendaño R., B. & Acosta M., A. (2009). Midiendo los resultados del comercio agropecuario mexicano en el contexto del TLCAN. *Estudios sociales, 17*(33), 41-81. https://www.scielo.org.mx/pdf/estsoc/v17n33/v17n33a2.pdf

Basurto H., S. & Escalante S., R. (2012). Impacto de la crisis en el sector agropecuario en México. *Economía UNAM, 9*(25), 51-73 https://www.redalyc.org/articulo.oa?id=363533414004

Bula, A. (2020). Importancia en la agricultura en el desarrollo. *Observatorio económico social UNR, 50*(16), 1-29. https://observatorio.unr.edu.ar/wp-content/uploads/2020/08/Importancia-de-la-agricultura-en-el-desarrollo-socio-econ%C3%B3mico.pdf

Castañeda M., A. & López G., T. (2023). Crecimiento económico, tipo de cambio real y exportaciones manufactureras de México, 1998-2020. *Investigación económica, LXXXII*(323), 53-79. https://www.redalyc.org/journal/601/60175441003/60175441003.pdf

Cerezo G., V. (2022). Tipo de cambio y crecimiento económico en México. *Contaduría y administración, 66*(3), 1-27. https://www.scielo.org.mx/pdf/cya/v66n3/0186-1042-cya-66-03-00016.pdf

Galván V., A. (2022). Productividad agrícola en México y sus determinantes: perspectiva del gasto público. *Revista Iberoamericana de Viticultura, Agroindustrial y Ruralidad, 9*(27), 233-249. https://www.scielo.cl/pdf/rivar/v9n27/0719-4994-rivar-9-27-233.pdf

Gutiérrez C., F. & Moreno B., J. (2021). El impacto de la inversión pública sobre la privada en las entidades federativas de México. *Problemas del desarrollo, 52*(206), 61-83 https://www.redalyc.org/journal/118/11869402003/11869402003.pdf

IICA (Instituto Interamericano de Cooperación para la Agricultura) (2023). Aumenta 137% el valor de las importaciones de fertilizantes químicos de América Latina y el Caribe en 2022. https://blog.iica.int/blog/aumenta-137-valor-las-importaciones-fertilizantes-quimicos-america-latina-caribe-en-2022

INEGI (Instituto Nacional de Estadística y Geografía). (2023). Resultados definitivos del censo agropecuario 2022. Editorial INEGI. https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2023/CA_Def/CA_Def2022.pdf

Levy O., N. (2012). Tasas de interés, demanda efectiva y crecimiento económico. *Economía UNAM, 9*(25), 74-93. https://www.scielo.org.mx/pdf/eunam/v9n25/v9n25a5.pdf

Mendoza G., M. & Valdivia L., M. (2016). Remesas, crecimiento y convergencia regional en México: aproximación con un modelo panel espacial. *Estudios Económicos, 31*(1), 125-167. https://www.scielo.org.mx/pdf/ee/v31n1/0186-7202-ee-31-01-00125.pdf

Mora R., J., Arellano G., J. & Mendoza F., E. (2011). Determinantes de la inversión en la agricultura mexicana. *Centro de Estudios Económicos*, 6, 1-29. https://cee.colmex.mx/dts/2011/DT-2011-6.pdf

Morales, H., Aguilar-Stoen, M., Castellanos-López, E. (2015). Migración y remesas: ¿Están afectando la sustentabilidad de la agricultura y la soberanía alimentaria en Chiapas? *LiminaR, 13*(1), 29-40. https://www.scielo.org.mx/pdf/liminar/v13n1/v13n1a3.pdf

Mordecki, G. y Ramírez, L. (2018). ¿Qué es lo primero: el crecimiento del PIB o la inversión? El caso de una economía pequeña y abierta. *El trimestre económico*, 337, 115-136. https://www.redalyc.org/articulo.oa?id=31357556004

Ortíz, C. & Ortega, A. (2018). Riesgo económico-agrícola y escenarios de cambio climático (2025-2075) en una región del trópico seco mexicano. *Sociedad y ambiente*, 17, 115-142. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-65762018000200115

Palacios R., M. & Ocampo L., J. (2012). Los tractores agrícolas de México. *Revista mexicana de ciencias agrícolas*, 4, 812-824. https://www.scielo.org.mx/pdf/remexca/v3nspe4/v3nspe4a26.pdf

Pérez S., F., Hernández P., J. & Figueroa H., E. (2022). Efecto de la Inversión Extranjera Directa sobre el PIB de México, *Economía UNAM*, 31-46. https://ru.iiec.unam.mx/5821/1/2.%20058-P%C3%A9rez-Hern%C3%A1ndez-Figueroa.pdf

Secretaría de Economía. (2023). Comisión nacional de Inversiones Extranjeras. IED en México por subsector económico. Recuperado de: https://www.gob.mx/cms/uploads/attachment/file/881946/20231204_Informe_Congreso_2023-3T.pdf

SIAP (Servicio de Información Agroalimentaria y Pesquera). (2020). La importancia del sector agroalimentario en México. https://www.gob.mx/siap/articulos/la-importancia-del-sector-primario-en-mexico?idiom=es

Turiján A., T., Ramírez-Valerde, B., Damián H., M.A., Juárez S., J.P., Estrella C., N. (2015). Uso de remesas para la adquisición de tecnología agrícola en maíz en San José Chiapa, Puebla, México. *Nova Scientia 17*(14): 674-693. https://www.scielo.org.mx/scielo.php?pid=S2007-07052015000200674&script=sci_abstract&tlng=es

Varela L., R. & Lázaro C., R. (2016). Inversión extranjera directa y tasa de interés en México: un análisis dinámico. *Revista de Ciencias Sociales y Humanidades, 25*(50): 127-149. https://www.redalyc.org/pdf/859/85944887005.pdf