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The effect of remittances and their relationship with exports in the face of USMCA

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ABSTRACT

The aim of this work is to analyze the reception of remittances in Mexico as a component of the migration phenomenon. We seek to understand the economic effect from the economic-fiscal policy and its relationship with exports after the entry into force of the USMCA. We applied the time series forecasting method using an unseasonal ARIMA model. As a result, we understand the correlation between remittances and exports, although there is also a prevalent benefit in fiscal income for the treasury of the country of origin.

KEYWORDS

Remittances, Exports in Mexico, Neoliberal theory, Economic-fiscal impact of remittances, USMCA.

1. Introduction

Migration is a phenomenon of social movement that has positive economic effects in the area of residence as well as the countries of origin. People leave their countries to migrate abroad for numerous reasons. In the past, some migrants pursued mystic and ideological goals that led them to cross lands with the firm belief of prosperity; in other cases, they sought to invest and do business (Figueroa, Pérez, & Godínez, 2015). Nowadays, migration has a different social context. Mobilizations are often academic and occupational which, in any case, are authorized and legitimized by the consul of the country migrants will reside. A further reality of the families and those who migrate is job seeking (OECD, 2010), aiming for economic stability (Ekanayake & Moslares, 2020). Additionally, migration is caused by insecurity: The displacement of communities is often the result of harassment by criminal groups or political persecution, lacking government support. Since there is an inefficacy to guarantee human rights, undocumented people and families migrate in an uncontrolled way, driven by purposes different from those of development, investment, and progress.

Whether legal or illegal, the migration phenomenon involves social and economic effects, both in the countries of origin and those of residence. The social effects as learning different lifestyles, customs, ideologies, and education are intrinsic to the migrant, while the incidence in the economy is evident in the public finances due to the economic flow of currencies (Levitt, 1998). Mexico has a complex migration dynamic since it is the origin, transit, and destination of migrants. Still, 99% of the Mexicans abroad live in the United States (OECD, 2010).

The Mexico-US migration dates back to the 19th century (Figueroa, Pérez, & Godínez, 2015).This mobility led the Mexican population to settle in specific states of the US. Mexico has always emphasized the respect for the sovereignty of all countries. Furthermore, both nations have created controlled migration programs, as the Bracero Program (Rosenblun, 2004), which likely contributed to the population density of the US. The population count of the 2020 census revealed that the second racial or ethnic group in the country is Hispanic or Latino (18.7%). The states with the highest Hispanic-Latino population density are California (39.4%), Arizona (30.7%), New Mexico (47.7%), Texas (39.3%), and Nevada (28.7%). Mexicans account for the largest population (61.4%) in the states bordering with Mexico (US Census Bureau, 2021 b).

Therefore, the commercial interaction of the North American Free Trade Agreement (NAFTA) concentrated 18.3% of the world GDP, amounting to nearly 16% of the global trade (Secretaria de Economia, 2020). The annual trade of the US with Mexico and Canada is over USD 1.3 trillion. It is estimated that exports to both markets support around three million jobs. Mexico is the second largest export market for the US and its third trade partner: The bilateral trade of goods and services between the two countries reached USD 678 billion in 2019. Mexico and Canada are the two major destinations for good exports for over 40 US states (ITA 2021).

The US and Canada are the first and second trade partners of Mexico. The exports (USD) of the Mexican states bordering with the US are as follows: Chihuahua, 43.77 billion; Coahuila, 32.9 billion; Baja California, 32.229 billion; Nuevo Leon 25.915 billion; and Tamaulipas, USD 22.943 billion. Additionally, Campeche and Jalisco, two states with oil and industrial activity, export USD 27.143 and 20.103 billion, respectively (Secretaria de Economia, 2020).

The United States-Mexico-Canada Agreement (USMCA) came into force on July 1, 2020 (Vargas, 2020). This new agreement innovated the clauses in the NAFTA, continuing with the trade and reinforcing the participation of companies and cover of industries to generate a more active trade dynamic in the global economy.

Considering the social and economic dynamic, the questions in this study are How to acknowledge the relationship between trade and remittance transfers? Are trade agreements enough to maintain a solid and sustained economy? Is the increase in exports related to that of remittances to Mexico and the export opportunities to the US?

The motivation behind this study is to analyze the relationship between family remittances and export companies during the effect of the trade with the US and Canada in the wake of the signing of the USMCA. Our main hypothesis is that the new agreement will improve the economic-trade activity of companies in the US and Mexico, and it will allow for a continuous trend in remittance transfers in a global economy.

Our work is structured as follows. The next section is a review of the literature, including data from the World Bank and Banco de Mexico. We analyze the remittance flow worldwide to identify the position of Mexico, and our professional practice allows us to explain the economic and fiscal effect of this within the recipient country. We determine the states receiving the remittances and the indicators of the Mexican population to find the relationship with the economic value of the trade exports to the US.

Section 3 of this work applies the time series method to understand the relationship between remittance variables and exports during the effect of the NAFTA. The empirical results are presented in section 4 and, finally, section 5 includes the discussion and some implications.

2. Literature review

2.1. Remittance flow worldwide

The currency flow between the countries receiving and sending migrants exists mainly through private or government financial mechanisms. Mexican families receive remittances (Vargas-Silva, 2009) from relatives residing in the US, regardless of their legal status (CONDUSEF, 2020) as residents, citizens, or undocumented aliens (CONAPO, 2019). The fact is that those living in the US send money to their families living in the country of origin. The World Bank considers that the increase in remittances is due to the economic growth of the USE. Giuliano and Ruiz-Arranz (2009) have studied the increase in remittances on the Official Development Assistance (World Bank, 2021). In the year 2018, they reached the flow of the world foreign direct investment (FDI), excluding China (World Bank Group, 2019).

From the total current income in Mexican households, 0.79% corresponds to international transfers (INEGI, 2018). The migrants' productive activities have two economic effects from the income they receive (Nowrasteh, 2014). The first occurs directly in their country of residence. This is an acknowledged consideration since there is the association of the variables "center of predominant economic interest, […] and the status of the tax effects" migrants pay (Balance of Payments Manual, 2008, p.45). The second effect is indirect; it is the economic impact of the remittances in the country of origin.

The World Bank, with statistical data from the International Monetary Fund (IMF), provides the information of the central banks and statistical agencies (World Bank Group, 2019), and reports the remittance flow of the countries. Located to the north of Australia, Tonga is the first remittance recipient of remittances, which account for 38.5% of the national GDP. In the Central American Caribbean, Haiti holds the second position with 34.3%. They are followed by a group of Asian and Central American countries: Nepal (29.9%), Tajikistan (29.7%), Kyrgyzstan (29.6%), Honduras (21.4%), and El Salvador (20.8%) (see Table 1).

The countries receiving remittances equivalent to 10–19% of their GDP are: Samoa (18.4%) and the Marshal Islands (13.5%) in Australia and Oceania; the African countries Comoros (19.3%), Cape Verde (12.1%), Liberia 12.8%, Lesotho (15.7%), and Gambia (13.5%); Lebanon (12.5%), Yemen (13.3%), and the West Bank and Gaza (17.6%) in Asia; Georgia (12.3%) and Armenia (11.9%) in the border between Europe and Asia; Ukraine (11.9%), Moldova (15.6%), Montenegro (10.4%), Bosnia and Herzegovina (10.5%), and Kosovo (15.1%) in East and South Europe; and Jamaica (15.9%), Nicaragua (13.1%), and Guatemala (13%) in Central America.

Country	Remittances as a share of GDP in 2019 (%)	Country	Remittances as a share of GDP in 2019 (%)	Country	Remittances as a share of GDP in 2019 (%)
Armenia	11.9	Jamaica	15.9	Montenegro	10.4
Bosnia and Herzegovina	10.5	Jordan	10.4		
Cabo Verde	12.1	Kosovo	15.1	Nepal	29.9
Comoros	19.3			Nicaragua	13.1
El Salvador	20.8	Kyrgyz Republic	29.6	Philippines	9.8
Gambia, The	13.5	Lebanon	12.5	Samoa	18.4
		Lesotho	15.7	Tajikistan	29.7
Georgia	12.3	Liberia	12.8	Tonga	38.5
Guatemala	13	Marshall Islands	13.5	Ukraine	11.8
Haití	34.3	México	3.1	West Bank and Gaza	17.6
Honduras	21.4	Moldova	15.6	Yemen, Rep.	13.3

Table 1. Migrant remittance inflows. (US$ million)
Source: World Bank staff calculation based on data from IMF Balance of Payments Statistics database and data releases from central banks, national statistical agencies, and World Bank country desks. Note: All numbers are in current (nominal) US $. Date: April 2019

At the bottom of the list are Philippines (9.8%) and Mexico (3.1%), the lowest percentage of all; still, the countries with the smallest economies receive the most remittances (Ekanayake & Moslares, 2020). Data of the IMF and the World Bank reveal the

remittance flows in Mexico (USD): 22.08 billion in 2010, 23.446 billion in 2011, 23.209 billion in 2012, 23.189 billion in 2013, 24.802 billion in 2014, 26.233 billion in 2015, 28.691 billion in 2016, 32.271 billion in 2017, 35.562 in 2018 (Ekanayake & Moslares, 2020), and 38.655 in 2019, showing an upward trend (Dilip Ratha, Supriyo De, Eung Ju Kim, Sonia Plaz, Ganesh Seshan, Nadege Desiree Yameogo, 2021). In the year 2020, the country received USD 40.606 billion, the largest amount in its history.

2.2. Remittance flow in Mexico

Technology has accelerated remittance transfers for families; in the past, money orders and personal checks were used. In 2020, remittance transfers increased by 11.26%, and they were primarily sent via electronic transfers (OECD, 2010), nullifying the use of personal checks. The use of cash and payments in kind has decreased in time.

Concept	Jan-Dec		Variation
	2020	2019	Relative
	(A)	(B)	(A/B)
Total Remittances 1/	40,604.55	36,048.64	11.26
Electronic transfer	40,170.64	35,508.15	13.13
Money orders	162.93	163.58	-.99
Personal check	0.00	0.00	N/E
Cash and species	270.98	376.92	-28.10

Table 2. Remittance flow. Billions.
Source: Banco de México, Sistema de Información Económica, Recuperado de: https://www.banxico.org.mx/SieInternet/

Five of the 32 states in Mexico are recipients of the largest remittance flow (see Table 3), amounting to 39.3% in 2020 and 39.1% in 2019. The states are Michoacan (10 and 9.9%), Jalisco (10.2 and 9.7%), Guanajuato (8.5 and 9.1%), State of Mexico (5.9 and 5.6%), and Oaxaca (4.7 and 5%). Giuliano and Ruiz-Arranz (2009) have described the positive effect of remittances on the economic growth.

In 2020, 11 states (39.2%) received remittances: Puebla (4.6%), Guerrero (4.8%), Mexico City (5.3%), Veracruz (4%), San Luis Potosi (3.5%), Chihuahua (3.1%), Zacatecas (3.1%), Chiapas (2.8%), Hidalgo and Nuevo Leon (2.5%), and Baja California (3%). The same states received 39% of the remittances sent to Mexico in 2019.

State	Billions of dollars		Percentage		State	Billions of dollars		Percentage	
	2020	2019	2020	2019		2020	2019	2020	2019
Aguascalientes	539.9	500.3	1.3	1.4	Morelos	756.9	702.6	1.9	1.9
Baja California	1,234.90	938.6	3	2.6	Nayarit	672.8	578.1	1.7	1.6
Baja California Sur	111.6	87.4	0.3	0.2	Nuevo León	1,024.40	949.9	2.5	2.6
Campeche	115.2	87.8	0.3	0.2	Oaxaca	1,897.60	1,803.90	4.7	5
Coahuila	711.2	633.4	1.8	1.8	Puebla	1,872.90	1,763.00	4.6	4.9
Colima	348.2	300.7	0.9	0.8	Querétaro	802.2	703	2	2
Chiapas	1,142.80	996.3	2.8	2.8	Quintana Roo	239.5	184.8	0.6	0.5
Chihuahua	1,278.70	1,122.40	3.1	3.1	San Luis Potosí	1,425.20	1,331.10	3.5	3.7
Distrito Federal	2,141.50	1,705.20	5.3	4.7	Sinaloa	1,039.40	913.1	2.6	2.5
Durango	955.2	870.1	2.4	2.4	Sonora	708	586.6	1.7	1.6
Estado de México	2,415.60	2,032.80	5.9	5.6	Tabasco	279.5	249	0.7	0.7
Guanajuato	3,468.70	3,286.40	8.5	9.1	Tamaulipas	944.6	863.7	2.3	2.4
Guerrero	1,941.90	1,737.80	4.8	4.8	Tlaxcala	244.2	253.9	0.6	0.7
Hidalgo	1,022.90	952	2.5	2.6	Veracruz	1,614.20	1,495.40	4	4.1
Jalisco	4,153.20	3,499.10	10.2	9.7	Yucatán	243.7	219.1	0.6	0.6
Michoacán	4,055.70	3,584.40	10	9.9	Zacatecas	1,202.30	1,116.90	3	3.1
Total	25,637.20	22,334.70	63.10	61.70	Total	14,967.40	13,714.10	37.00	37.90

Tabla 3. Income from remittances. Distribution by State.
Source:https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=1&accion=consultarCuadroAnalitico&idCuadro=CA79&locale=es

The states that received the lowest remittances in 2020 and 2019 were Campeche (0.3 and 0.2%), Quintana Roo (0.6 and 0.5%), Yucatan (0.6% in both years), and Baja California (3 and 2.6%).

Remittance transfers create commission fees for residents. The money transfer operator discounts the amount of the commission from the total amount of the remittance. Some offices charge a commission on the value of the remittance and, if it exceeds the amount established by the operator, there is a double fee. Some operators offer higher fees but allow for more than one transfer.

2.3. Economic-fiscal effect of remittances

Migrants' income is a component to calculate the gross domestic product (GDP) for the services and goods they produce at work. Income is an indirect benefit for the countries of origin, since migrant income adds to the gross national product (GNP) (Vargas-Silva, 2009). The country of residence promotes employment as the employer withholds income tax and thus it is a fiscal income for the countries where migrants reside. Rosenblum

(2004) has described the most positive aspects of migration from the US. In the country, migrants cannot be easily identified by the fiscal policy; however, wages are known when employees are residents or have a work permit. Even when the employee's migration status is not documented, income tax is part of the tax policy since a natural person's wages are susceptible of income tax.

The fiscal benefit for countries of residence is tax collection. Migrants have a fixed wage and income is a legal-labor concept. Therefore, the employer withholds income tax, called *Impuesto Sobre la Renta* in Mexico (2021), and tax payment as well. The migrants' income is directly related to the payment of income tax in the country of residence. It is also directly linked to the value added tax (VAT) or *Impuesto al Valor Agregado* (IVA) in Mexico.

The US Census Bureau (2021a) points out that California is the state collecting the most income tax (USD 84,412,243), while Arizona collects USD 4,530,410 and New Mexico, USD 1,227,926. Nevada and Texas do not collect income tax, so only the federal rate remains. Nowrasteh (2014) describes the complexity of identifying how much of these amounts corresponds to migrant taxes. The author explains longitudinal studies have not managed to clarify this, yet they are recognized as a primary economic benefit for the countries sending and receiving migrants.

The economic-fiscal policy of the countries does not consider remittance flow as a fiscal income for public finances since the flow is mostly private. We analyzed the percentage of the remittance value at the end of 2020 and its relationship with the fiscal revenue of the federation the same year. It represents 12.86% of the fiscal budget, without being part of the revenue.

Remittances to Mexico are not subject to income tax; still, the families receiving them pay taxes when buying immovable properties or goods (López-Arévalo, Sovilla-Sogne, & García-Fernández, 2011). They pay for utilities (phone, electricity, internet service), housing (leasing), and even mortgages, construction, or house expansion. These actions are taxable in terms of IVA, at a general rate of 16%. Furthermore, families contribute to the fiscal system by consuming goods and paying especial taxes on gas, internet service, cigarettes, and gambling, among others.

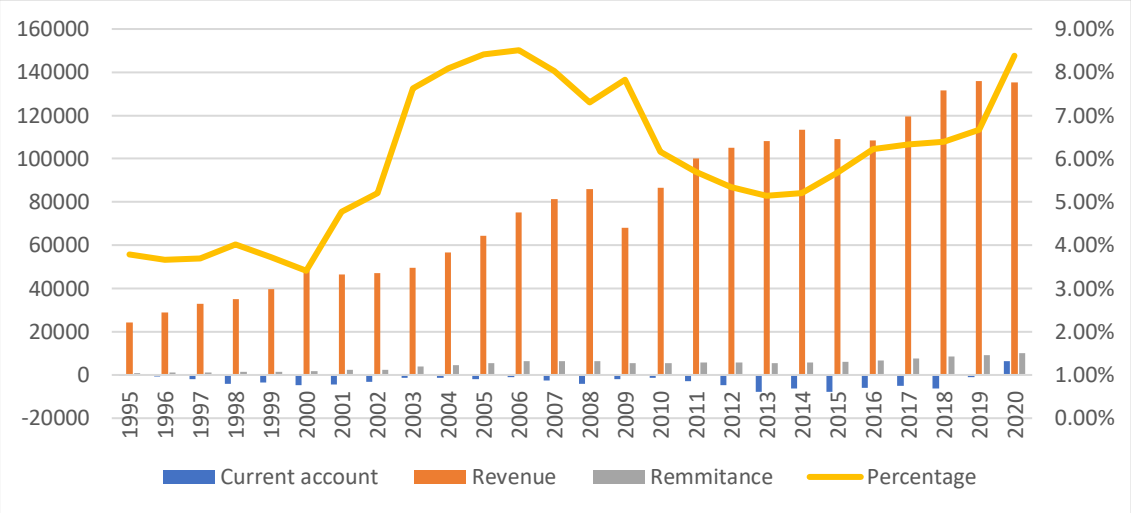
Remittances are a component of the balance of payments (OECD, 2010). This is a good referent to know the cash flow of the country and the relationship between remittances and revenue. From the sum of the goods and services and the trade operations (current

account), it is understood that the relationship between remittances (percentage) and revenue is relatively low (see Table 4).

Year	Current account	Revenue	Remmitances	Percentage	Year	Current account	Revenue	Remittances	Percentage
1995	-394.25	24,257.25	918	3.78%	2008	-4,201.25	86,049.25	6,286.50	7.31%
1996	-627	28,829.00	1,056.00	3.66%	2009	-1,939.15	68,136.63	5,326.50	7.82%
1997	-1,916.25	32,829.50	1,216.25	3.70%	2010	-1,207.13	86,488.02	5,326.00	6.16%
1998	-3,998.25	35,037.25	1,406.75	4.02%	2011	-2,971.60	100,010.60	5,701.00	5.70%
1999	-3,497.25	39,727.50	1,477.25	3.72%	2012	-4,657.66	105,146.10	5,609.50	5.34%
2000	-4,687.50	48,219.00	1,643.00	3.41%	2013	-7,877.91	108,181.19	5,575.50	5.15%
2001	-4,370.50	46,607.00	2,224.00	4.77%	2014	-6,357.16	113,490.21	5,912.00	5.21%
2002	-3,292.50	47,158.75	2,453.50	5.20%	2015	-7,768.40	109,135.42	6,196.25	5.68%
2003	-1,382.25	49,632.25	3,784.75	7.63%	2016	-6,095.76	108,581.53	6,748.50	6.22%
2004	-1,401.75	56,663.75	4,583.00	8.09%	2017	-5,102.28	119,694.86	7,572.75	6.33%
2005	-1,885.75	64,392.00	5,422.25	8.42%	2018	-6,275.09	131,710.26	8,419.25	6.40%
2006	-888	75,142.00	6,391.75	8.51%	2019	-986.2	135,920.01	9,011.50	6.67%
2007	-2,474.50	81,268.00	6,514.75	8.02%	2020	6,530.60	121,075.18	10,151.14	8.38%

Table 4. Balance of payments (billions of dollars)
Source: Banco de México CE139, Trimestral, Millones de Dólares, https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=1&accion=consultarCuadro&idCuadro=CE139&locale=es

There is a clear decrease in revenue from 2008 to 2009 (Graph 1), which becomes stable again in 2011. However, remittances increased by 100% in 2003 and remained above this percentage for seven continuous years (see Table 7). The most remittances were received in the years 2003–2009.



Graph 1. Balance of Payments
Source: Prepared by the authors based on Banco de Mexico CE139, quarterly; millions of dollars; current cash flow.
https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=1&accion=consultarCuadro&idCuadro=CE139&locale=es

2.4. Foreign trade in the context of the trade agreement

Foreign trade operations carried out as part of the NAFTA have maintained a favorable trend. In a 14-year period (2007–2019) exports showed an increasing upward trend. Their value went from USD 237.809 billion in 2007 to USD 417.579 billion in 2019. The USMCA came into effect in 2020, during the pandemic (Vargas, 2020). The same year, the value of exports was USD 374.310 billion, reflecting a slight decrease vs 2019 as a result of the sanitary contingency. This was when the NAFTA was repealed to pave the way for the USMCA (Vargas, 2020). Total exports (see Table 5) were distributed as follows: Agriculture, forestry, fishing, and hunting accounted for 3.95%; mining, quarrying, and oil and gas extraction, 6.28%; manufacturing, 89.77%; and the automotive industry represented 37.35% of the transportation equipment manufacturing. This agreement is the most important instrument for Mexican economy since it mainly contains the regulation of the automotive industry and the links to auto part companies (AMIA, 2018).

Code	Description	2019	%	2020	%
	Total exports	417,579.83		374,310.57	
11	Agriculture, Forestry, Fishing and Hunting	14,776.95	3.54%	14,788.89	3.95%
21	Mining, Quarrying, and Oil and Gas Extraction	30,021.27	7.19%	23,510.27	6.28%
31-33	Manufacturing	372,781.60	89.27%	336,011.40	89.77%
336	Transportation Equipment	171,120.76	40.98%	139,793.80	37.35%

Table 5. Yearly exports per North American Industry Classification System (NAICS) sector and subsector. Billions of dollars.
Source: Quarterly exports per state, INEGI, 2021. Data retrieved from Annex 1.

The states that contributed the most to annual exports in 2020 (see Table 6) were Baja California (10.86%), Coahuila (12.01%), Chihuahua (14.67%), Guanajuato (6.40%), Jalisco (5.37%), Nuevo Leon (9.20%), Sonora (4.74%), and Tamaulipas (7.13%). Together, they account for 70.40% of the total exports (INEGI, 2021).

State	2019	%	2020	%

Total exports*	417,579.83		374,310.57	
Baja California	42,396.95	10.15%	40,659.06	10.86%
Coahuila	47,659.46	11.41%	44,961.56	12.01%
Chihuahua	57,434.14	13.75%	54,920.39	14.67%
Guanajuato	25,065.79	6.00%	23,974.57	6.40%
Jalisco	21,659.64	5.19%	20,099.36	5.37%
Nuevo Leon	39,857.05	9.54%	34,455.03	9.20%
Sonora	19,840.53	4.75%	17,735.40	4.74%
Tamaulipas	29,130.16	6.98%	26,691.00	7.13%

Table 6. Annual exports per state. Billions of dollars. Source: Quarterly exports per state, INEGI, 2021. Data retrieved from Annex 1.

2.5. Theory of liberalism, neoliberalism, and globalization

Meyer (2000) studied liberal and neoliberal theory that states liberals hold an optimistic view of the world. They consider that international economic interdependence, offshore interactions, and international institutions promote cooperation and even peace among nations. The development of economic activities makes multinational corporations the main actors in the relationship between economy and society, and they are key to establishing migration policies.

In the context of the neoliberalism where the NAFTA operated, neoliberal theory considers it is of common interest and deals with common problems; it promotes collaboration and coordination between countries. Meyer (2000) quotes Krasner (1983), who studies international regimes, and Keohane (1985), who analyzed the cooperation of the world economic policies. The study period of this document (1995–2020), the analysis variables, the increase in remittances, export trends, and the phenomenon of migration are all determined by the theory of economic globalization. Meyer maintains that international migration is a key component of globalization. If governments welcome capital mobility, investments, and ideas, then human mobility will likely not stop. Rosenblum (2004) studied this in special mobility systems of trade agreements as NAFTA, an agreement between the governments of the countries.

Vargas-Silva (2009) has studied the representativity of remittances in the income of Mexican families since previous studies only dealt with some variables. The main reason to carry out this study was the lack of knowledge regarding the impact of remittances in tax collection, since it is wrongly believed that the Mexican economy largely depends on remittances. The correlation between remittances with exports and the population in the border states in both countries has not been studied.

With the data presented in this work, we seek to integrate the neoliberal and globalization theories with a data trend, considering the relevance of the new USMCA (ITA, 2021). This new agreement adds a section for small and medium size enterprises that promotes the participation of these businesses to increase trade and investment opportunities. According to Vargas (2020), the new agreement meets the general principles that implement good regulatory practices to reduce or eliminate costly, duplicate, or divergent procedures in their scope of application. In this sense, we analyze the data for forecasting, seeking to observe the relationship between Mexican exports, remittances, and population movement in the border states of Mexico and the US.

3. Method

To analyze the distribution of exports and remittances in Mexico, we use the time series method, considering data of 1995–2020 for remittances and 2007–2020 for exports. The analysis of time series is a quantitative method applied to identify patterns in data collected along a period of time. Once the time series is analyzed, projections are created from the patterns found to assess future values regardless of their cause (Pérez-Ramírez, 2007).

The data considered for the analysis are observations, carried out over time, that can have an internal structure (autocorrelation, trend, or seasonal variation). They are relevant enough to be treated as functions in a time variable.

There are different methods to analyze time series. For instance, simple smoothing methods are based on the supposition that the future value of a variable Y in time $t + 1$ depends on the value of the time series in the current period t, of the previous period $t - 1$,…; therefore, there is the following expression:

$$Y_{t+1} = f(Y_t, Y_{t-1}, Y_{t-2}, Y_{t-3}, \dots).$$

A nonseasonal autoregressive integrated moving average (ARIMA) model will be used to make forecasts for time series (Mauricio, 2007). The ARIMA model allows to forecast without historical data and mistakes caused by chance. Using this method, data can be analyzed when they do not show a seasonal behavior along a certain period of time that might be considered significant.

It is known that the historical behavior of remittances is different between periods of time. The ARIMA method is a simple alternative to econometric models, for instance. In clear

terms, an ARIMA model can be considered a filter that seeks to separate the signal from the noise, and the signal is extrapolated in the future to obtain a forecast.

The ARIMA forecasting equation for a stationary time series is a linear equation in which the predictors consist of lags of the dependent variable and/or lags of the forecast errors.

A nonseasonal ARIMA model is classified as an "ARIMA (p, d, q)" model where:

p is the number of autoregressive terms,

d is the number of nonseasonal differences needed for stationarity, and

q is the number of lagged forecast errors in the prediction equation.

The forecasting equation is built as follows. First, y denotes the dth difference of Y, which means:

$$\text{If } d = 0\text{: } y_t = Y_t$$

$$\text{If } d = 1\text{: } y_t = Y_t - Y_{t-1}$$

$$\text{If } d = 2\text{: } y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Y_t - 2Y_t - 1 + Y_t - 2.$$

The general forecasting equation is:

$$\hat{y}_t = \mu + \phi_1 y_{t-1} + \cdots + \phi_p y_{t-p} - \theta_1 e_{t-1} - \cdots - \theta_q e_{t-q}.$$

The final result is presented in confidence intervals. This interval is a range of values calculated so that there is a certainty; that is, 80–95% of confidence that the real value of the forecast variable is found within such range.

On the other hand, once the forecasts are made, the correlation between remittances and exports will be measured through Pearson's correlation coefficient (r), a measure of linear association measure. It has two variables with values ranging from -1 to $+1$.

According to Hernández-Lalinde et al. (2018), the values of a Pearson's correlation coefficient close to zero indicate a low association between variables. In contrast, those close to -1 or $+1$ indicate a strong linear association between two variables.

Pearson's correlation coefficient r has no dimension and, if $|r|$ is close to 1, there is a strong correlation, but if it is close to zero, the variables are not correlated. That is, the positive values of the correlation coefficient indicate a variable has a trend towards increase or decrease along with another variable. Negative values of the correlation

coefficient indicate a trend where the values of a variable are linked to a decrease in the values of another one and vice versa (Encyclopedia of Public Health, 2008).

After studying the correlation between data, we developed a simple linear regression model containing a predictor, the variable with the highest correlation with the output response quality. Finally, we coded the variable region to introduce it to the regression model.

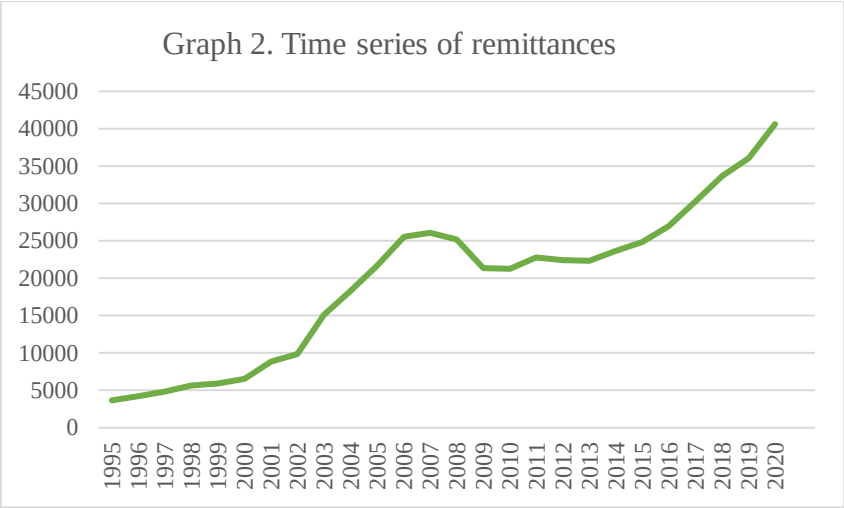
4. Results

In the first stage, the time series was completed to analyze the behavior of remittances during the period 1995–2020 using the data in Table 7. Then, time series and forecasts of remittances received in Mexico were obtained. To do so, the ARIMA method was used as described in the previous section. The method showed confidence levels of 80 and 95%, respectively.

Year	Amount	Increase %	Year	Amount	Increase %	Year	Amount	Increase %
1995	3,672.70	0	2004	18,331.70	21.09	2013	22,302.80	-0.6
1996	4,223.70	15	2005	21,688.30	18.31	2014	23,647.30	6.03
1997	4,864.80	15.18	2006	25,566.80	17.88	2015	24,784.80	4.81
1998	5,626.80	15.66	2007	26,058.80	1.92	2016	26,993.30	8.91
1999	5,909.60	5.03	2008	25,145.00	-3.51	2017	30,290.50	12.21
2000	6,572.70	11.22	2009	21,306.30	-15.27	2018	33,677.20	11.18
2001	8,895.30	35.34	2010	21,303.90	-0.01	2019	36,048.60	7.04
2002	9,814.40	10.33	2011	22,803.00	7.04	2020	40,606.60	12.64
2003	15,138.70	54.25	2012	22,438.30	-1.6	(1) 2021	6,471.39	0

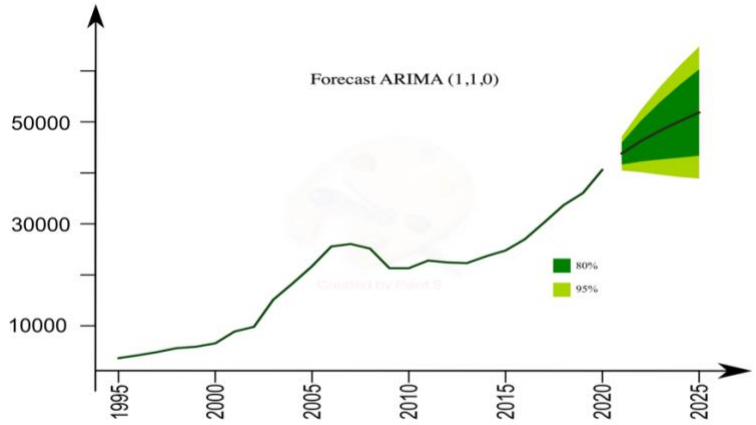
Table 7. Total family remittances. Period 1995-2020. Billions of dollars. Source: Prepared by the authors based on the information published by Banco de Mexico, Sistema de Informacion Economica. Retrieved from: https://www.banxico.org.mx/SieInternet/
(1) Remittances by February 2021.

To generate forecasts and result reports we used *R* free software (The *R* Project for Statistical Computing), a common tool for time series (Development Core Team, 2013). After applying the analysis of time series, the patterns found in a certain period of time (year 2025 in this case) are projected. The time series of the remittances is shown in Graph 2.



Graph 2. Time series of remittances received in Mexico. Period 1995-2020. Millions of dollars. Source: Source: prepared by the authors based on the information published by Banco de Mexico, Sistema de Informacion Economica. Retreived from: https://www.banxico.org.mx/SieInternet/

It must be noted that the graph in this analysis is growing and shows a dramatic drop from 2020. The remittance projection is shown in Graph 3.



Graph 3. Remittances in Mexico projected to 2025.

Time series that show the evolution and projection to year 2025, with confidence levels of 80 and 95%, respectively.

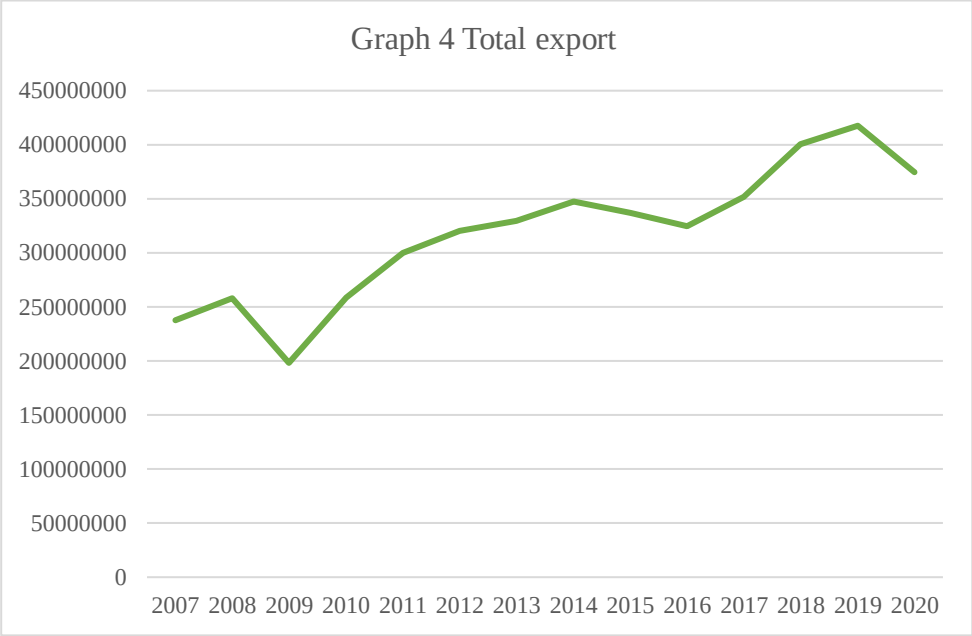
The results of the forecast are shown in Table 8 (2021–2025).

year	Forecast point value	Lo 80	Hi 80	Lo 95	Hi 95
2021	43,798.61	41,616.84	45,980.39	40,461.87	47,135.35
2022	46,249.27	42,238.12	50,260.42	40,114.75	52,383.79

2023	48,297.58	42,626.81	53,968.34	39,624.89	56,970.26
2024	50,127.51	42,976.03	57,278.99	39,190.27	61,064.76
2025	51,838.94	43,364.55	60,313.32	38,878.48	64,799.39

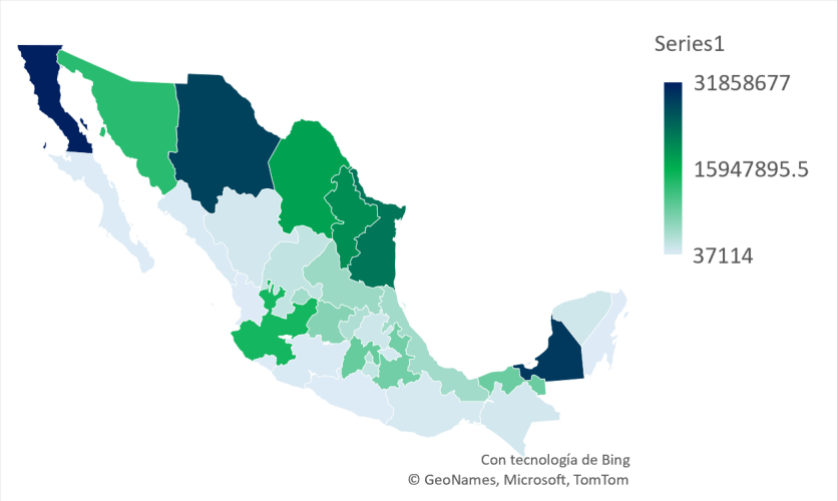
Table 8. Total family remittances forecast. Period 2021–2025. Billions of dollars

The total exports in the period 2007–2020 are shown in Graph 4.



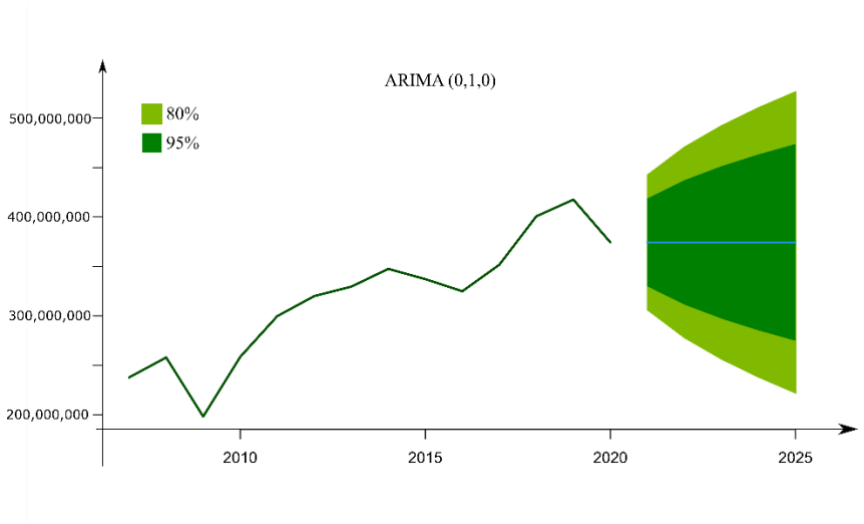
Graph 4. Total export.

Exports by state are shown in Graph 5 below.



Graph 5. Exports by state.

Graph 6. Projection of Mexican exports to 2025. The time series shows the evolution and projection to 2025, with confidence levels of 80 and 95%, respectively.



Graph 6. Projection of Mexican exports to 2025.

The results of the forecast are shown in Table 9 (2021–2025).

Year	Forecast point value	Lo 80	Hi 80	Lo 95	Hi 95
2021	374,310.57	329,820.41	418,800.72	306,268.75	442,352.38
2022	374,310.57	311,391.99	437,229.14	278,084.91	470,536.23
2023	374,310.57	297,251.36	451,369.77	256,458.68	492,162.45
2024	374,310.57	285,330.26	463,290.87	238,226.93	510,394.20
2025	374,310.57	274,827.56	473,793.57	222,164.44	526,456.69

Table 9. Total exports forecast. Period 2021–2025. Billions of dollars.

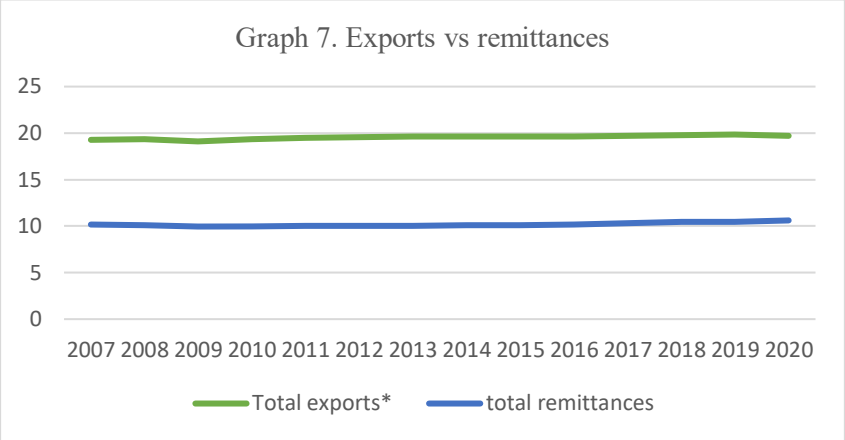
Graph 7 compares data on exports and remittances at logarithmic scale, using the data in Table 10.

year	Exports	Remittances
2007	237,809.74	26,058.8
2008	257,967.78	25,145
2009	198,234.12	21,306.3
2010	258,504.75	21,303.9
2011	299,732.52	22,803
2012	320,014.16	22,438.3
2013	329,562.71	22,302.8
2014	347,559.68	23,647.3
2015	337,170.19	24,784.8
2016	324,901.42	26,993.3
2017	351,726.06	30,290.5
2018	400,710.00	33,677.2

2019	417,579.83	36,048.6
2020	374,310.57	40,606.6

Table 10. Total exports and remittances. Billions of dollars.

Graph 7 is a comparison of the total exports and remittances in Mexico at a logarithmic scale from 2007 to 2020 with the data in Table 10.



Graph 7. Total exports and remittances in México.

As inferred from Graph 7, if the remittances increase, the exports do so as well; therefore, we will determine Pearson's correlation coefficient. The graph analysis indicates there is a marked relationship between remittances and exports, and the tentative consideration of the linear model seems reasonable. We found that the value of Pearson's correlation coefficient is 0.70. It is known that values between 0.50 and 0.70 indicate variables that can be considered moderately correlated.

On the other hand, the value of the determination coefficient r^2 is 0.49, which means 49% of the variability of the exports can be attributed to a linear relation with remittances.

5. Conclusion

This study contributes to understanding the relationship between remittances and export growth as well as that of the population index and the border states of Mexico and the United States. Our results are strongly supported by the symmetric relation of the trend. Specifically, remittance transfers are directly related to the livelihood and lifestyle improvement of families who receive them (OECD, 2010). To a certain extent, this agrees with the work by Ekanayake & Moslares (2020) who have discussed the decrease in the poverty indicator during this period.

As Vargas-Silva (2009) concludes, the results suggest that the increases in remittances affect the families' internal demand as another source of income for other disposal ends. We also detected a bidirectional relationship between remittances and exports and thus, in collection.

Immediate collection is affected by the participation in economy with acts of asset and services disposal that families in the country of origin do, as Vargas-Silva (2009) also indicates, and the dollar as currency exchange versus the Mexican peso. The value added tax is collected based on what is effectively paid and charged; this only happens when goods and services are purchased.

Furthermore, residents in the host country directly affect the fiscal policy of that country when they consume and the country itself. The value added tax is the second most important tax and it is effectively collected in Mexico, which indicates an immediate revenue for the public finances of the treasury.

With this study we dispel the fallacy that remittances are a key component of the Mexican economy. We know they are important for some families but certainly not for the public finances of the country given that they are eminently private and are not part of the fiscal revenue (Ley de Ingresos de la Federacion, 2019) or the payment balance. They are an analysis point with a private nature in economic terms. Financial transfers evidence the independence of family remittances (Ekanayake & Moslares, 2020) and their destination.

Finally, based on neoliberal theory and globalization, our study confirms that only the countries involved in the USMCA (United States, Mexico, and Canada) have formalized an economic-contractual system. This scheme combines a trade agreement with capital mobility and an employment regime that have been reconciled between the three nations (Meyer, 2000; Rosenblum, 2004), respecting the sovereign rights of each country to control its border states.

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