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THE IMPACT OF REMITTANCES ON FORMAL EMPLOYMENT IN MEXICAN MUNICIPALITIES: A GENDER PERSPECTIVE

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A mi familia, sé que en cada paso que doy puedo contar con su amor y apoyo incondicional, incluso a la distancia. Mamá y Papá, ustedes siempre han sido una inspiración para mí, motivándome a ver el lado positivo en todo.

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This study examines the impact of remittances on the Mexican labor market, focusing on formal labor participation in municipalities from 2013 to 2023. The research aims to answer three key questions: First, how do remittances influence participation in the formal labor market within Mexican municipalities? Second, are these effects consistent across different genders and age groups? Finally, what mechanisms drive the impact of remittances on labor supply in these areas? Utilizing municipal data from the *Banco de México* and the *Instituto Mexicano del Seguro Social*, and employing instrumental variables in a two-stage least squares (2SLS) approach to address endogeneity, the research finds that remittances lead to a reduction in formal employment, with a more significant effect observed among women. Additionally, the research highlights the importance of considering gender and age differences in analyzing labor market dynamics influenced by remittance flows, emphasizing the sensitivity of young women and women in their 40s to 60s. The study explores mechanisms such as enhanced educational attainment, which delays entry into the labor market; and the growth of informal employment, which offers flexible income opportunities.

Contents

1. Introduction

It is well understood that individuals often migrate from one location to another seeking better opportunities to enhance their job prospects and, ultimately, improve the well-being of their families and close ones left behind. This improvement often comes through remittances sent back to their country of origin. According to the World Bank, in 2012, remittances in Mexico represented 1.8 percent of the GDP; a decade later, this number rose to 4.2% of the GDP. It is not surprising that such substantial amounts of money could have an impact on societal characteristics. The objective of this study is to analyze the impact of remittances on the Mexican labor market, specifically on formal employment. On the one hand, remittances can reduce labor force participation by increasing the reservation wage. On the other hand, remittances may allow recipients to overcome liquidity constraints that prevent the creation of new enterprises. Additionally, these transfers can also stimulate local economies by enhancing consumption and investment capabilities. As families receive remittances, their purchasing power improves, leading to increased demand for goods and services, which can boost employment.

According to the United Nations, as of 2020, 10,853,105 Mexicans were residing in the United States. The amount of remittances sent back to Mexico has shown considerable growth, increasing from about USD 23 billion in 2013 to about USD 63 billion in 2023, according to the *Banco de México*. This growth in remittances has become increasingly important, as it now represents the largest international flow of funds, surpassing Official Development Assistance and Foreign Direct Investment (World Bank, 2024); we can see these trends in Figure 11.1, located in the appendix.

Previous studies have analyzed how this huge amount of remittances can affect the labor market in Mexico, and while the majority of these studies suggest that remittances may decrease the labor supply, the results remain inconclusive, especially concerning gender differences. We contribute to this debate by addressing three key questions: First, how do remittances influence participation in the formal labor market within Mexican municipalities? Second, are these effects consistent across different genders and age groups? Finally, what mechanisms drive the impact of remittances on labor supply in these areas?

This research has its roots in studies conducted decades ago and continues to be relevant to this day. Our study employs municipal data over an 11-year period from 2013 to 2023, providing a

more current dataset. It is important to note that the data used in this study reflect a period of substantial growth in remittances. Consequently, studies using data from the 1990s or 2000s might not yield the same results due to the significant increase in remittances during our study period. Nonetheless, it is crucial to understand the results and methodologies of earlier research. The primary data sources for this study include quarterly remittance income data from *Banco de México* (Banxico) and formal employment variables from the *Instituto Mexicano de Seguro Social* (IMSS). The employment data includes the number of individuals working in the formal sector, disaggregated by gender and age, which serve as the dependent variables. These variables are adjusted on a per capita basis using population from the 2010 and 2020 Population and Housing Censuses, as well as the 2015 Intercensal Survey, all provided by the *Instituto Nacional de Estadística y Geografía* (INEGI).

We employ a two-stage least squares (2SLS) approach, which allows us to address the endogeneity issues in the relationship between remittances and the labor market. In the first stage, we use the unemployment exposure of Mexicans in the United States as an instrumental variable to predict remittances. In the second stage, we utilize the instrumented remittances to estimate their impact on the labor market. Our main findings indicate a causal relationship where an increase in per capita remittances leads to a decrease in employment within municipalities. Specifically, we found that a 1% increase in per capita remittance income causes a reduction in formal employment by between 0.27% and 0.37%, depending on the sample. These causal effects are particularly strong and statistically significant among women, with reductions in formal employment ranging from 0.46% to 0.69%. The results vary by age, showing stronger effects for young women (15-30 years old) and women in their 40s and 50s. However, while the effect observed for men is also negative, it is not statistically significant.

The remainder of this analysis is organized as follows: Section 2 presents the theoretical framework regarding the supply and demand of the workforce to explore the potential outcomes of our research. Section 3 examines various empirical studies, and their approaches to handling endogeneity in Mexican and international contexts. Section 4 describes the data used and the trends in remittances and employment throughout the period studied, as well as the descriptive statistics of the relevant variables for each municipality. Section 5 outlines the specification, including a description of the methodology employed and the dependent and independent variables, as well as

the controls used. Section 6 aims to present our findings, generally and across different demographics such as gender and age. Following this, we adjust our main regressions as part of robustness checks to confirm and validate our results, this is presented in section 7. Section 8 discusses various potential mechanisms that could explain our findings, based on regression analysis and prior empirical literature. Section 9 offers a brief summary of our results, followed by a discussion of our key findings. This section serves as a bridge to the conclusions of our research, which are presented in Section 10; here, we synthesize the insights gained from our analysis and highlight the implications of our study.

2. Links to Theory

2.2. The neoclassical model of labor-leisure choice

This section examines the theoretical frameworks central to the study of labor economics. It begins with exploring the neoclassical model of labor-leisure choice, as emphasized by Borjas (2010), to understand the determinants of labor supply behavior. This model serves as a key element to analyze the processes involved in how individuals make choices regarding employment and manage their time between work and leisure.

In this model, the representative person receives satisfaction both from the consumption of goods (C) and from the consumption of leisure (L), which the next utility function can represent:

$$U = f(C; L) \tag{2.1}$$

To understand the impact on an individual's utility from dedicating an additional hour to leisure or purchasing goods worth an additional dollar, Borjas employs the concept of marginal utility. By keeping the quantity of consumed goods constant, we define the marginal utilities of leisure and consumption as MU_L and MU_C, respectively.

An individual's choices regarding leisure and consumption are restricted by their available time and resources. A portion of their income might include transfers, remittances, property income, inheritances, dividends, and lottery winnings, and does not depend on the number of hours they work. This portion is referred to as 'non-labor income' and is symbolized by V. If h represents the hours allocated to work in the labor market within a given period, and w stands for the hourly wage, the individual's budget constraint is expressed by the equation:

$$\mathrm{C} = \mathrm{wh} + \mathrm{V} \tag{2.2}$$

where C represents total consumption expenditure, which must equal the sum of labor earnings (wh) and nonlabor income (V).[1]

[1] It is important to note that the budget constraint ignores savings. While this simplification is probably not very restrictive, it is worth considering the potential relevance and consequences of not accounting for savings. Ignoring savings means the model does not capture intertemporal choices, where individuals allocate resources over time, or the buffering role of savings against income shocks. Nevertheless, this model serves as an excellent starting point for analyzing labor supply behavior.

The individual has two possible uses for her time: work or leisure. The total time allocated to these activities must equal the total time available in the period, denoted as T hours per week. Therefore, we have T = h + L. Given this, we can reformulate the budget constraint as follows:

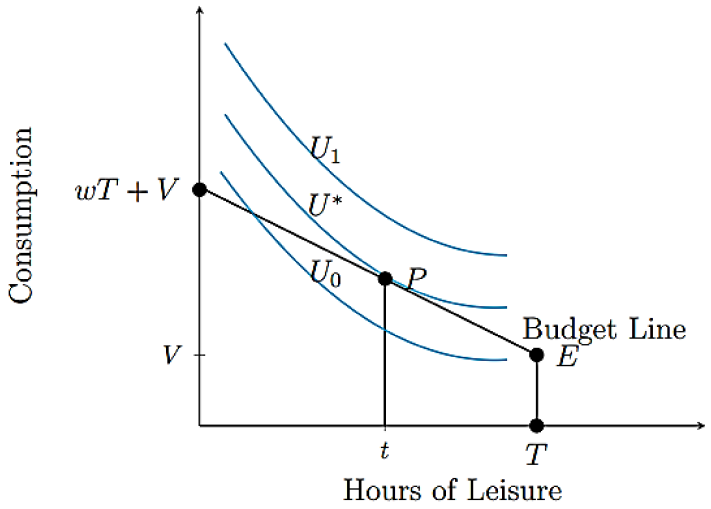
$$C = w(T - L) + V \tag{2.3}$$

or

$$C = (wT + V) - wL \tag{2.4}$$

The budget line and utility function are graphically depicted below, in figure 2.1:

Figure 2.1: An Interior Solution to the Labor-Leisure Decision



Source: Own elaboration based on Van den Borjas (2010)

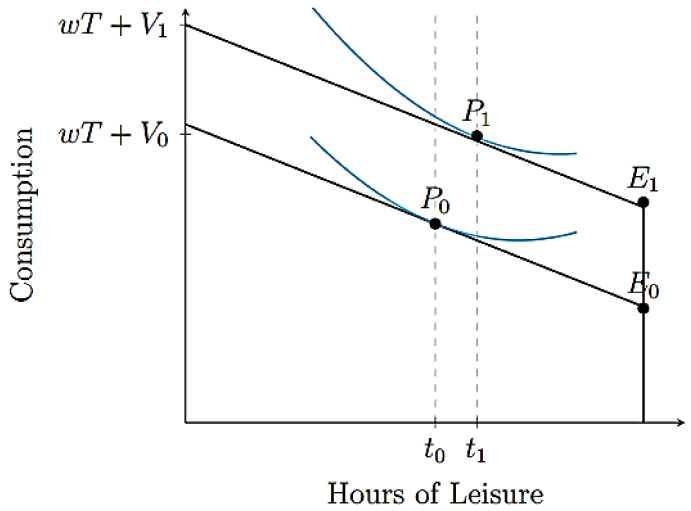
The representative agent will select the specific combination of goods and leisure that maximizes their utility, implying that the individual will opt for the levels of goods and leisure that yield the highest possible utility index, U, given the limitations imposed by the budget constraint.

Point P represents the optimal bundle of consumption goods and leisure hours chosen by the utility-maximizing worker. The highest attainable indifference curve places the individual at point P, awarding the worker U^* units of utility.

At this solution, the individual enjoys t hours of leisure per week and undertakes a T-t hour workweek. Ideally, the person would prefer a bundle on the higher utility-providing indifference curve U_1, but given the wage and non-labor income, such a consumption bundle remains unaffordable. Conversely, while the worker could opt for a point on the utility curve U_0 that intersects the budget line, she refrains from doing so as it yields lower satisfaction compared to higher curves. Thus, the optimal consumption of goods and leisure for the worker is identified at the point where the budget line tangentially meets the indifference curve, indicating an interior solution.

But what occurs when the amount of non-labor income, including remittances, rises while wages stay unchanged? This scenario leads us to the concept of the income effect, which is represented in the figure 2.2

Figure 2.2: The effect of a Change in Non-labor income on Hours of Work



Source: Own elaboration based on Van den Borjas (2010)

We consider leisure as a 'normal' good, which is one whose consumption increases with a rise in income, provided that the prices of all goods remain constant.[2] Therefore, an increase in non-labor income V naturally boosts the demand for leisure hours, reducing the hours dedicated to work. The

[2] On the contrary, the consumption of an inferior good declines as income increases, with prices held steady.

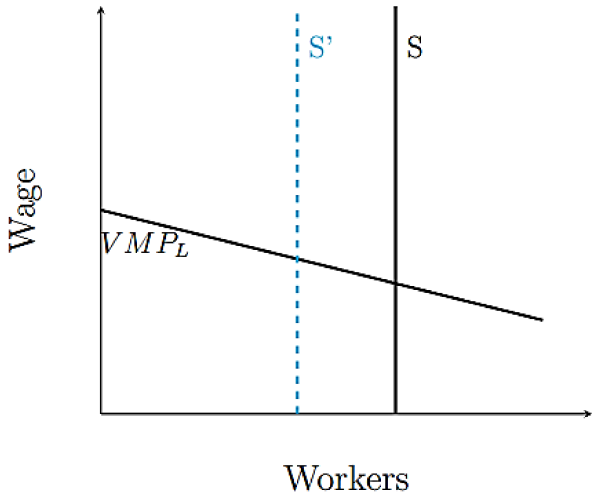
income effect, in essence, demonstrates that a rise in non-labor income, while maintaining a constant wage rate, leads to a decrease in work hours.

In alignment with Cahuc (2014), it is noted that the representative agent possesses a reservation wage—the minimum wage at which an individual becomes inclined to accept employment. This wage threshold is deduced from the consumer's utility function, particularly from the equilibrium point on the indifference curve, illustrating the balance between leisure and consumption. The introduction or augmentation of non-labor income influences this reservation wage. As non-labor income increases, so does the reservation wage, assuming leisure is treated as a normal good. Consequently, an increase in non-earned income, such as remittances, diminishes the likelihood of an individual's participation in the labor market, given that their financial necessities are met outside of traditional employment.

2.2. A supply-demand analysis

Building on the previously discussed model, individuals in the source country exhibit reduced labor participation given an increase in non-labor income, such as remittances. This can be illustrated within a demand-supply graph as in figure 2.3.

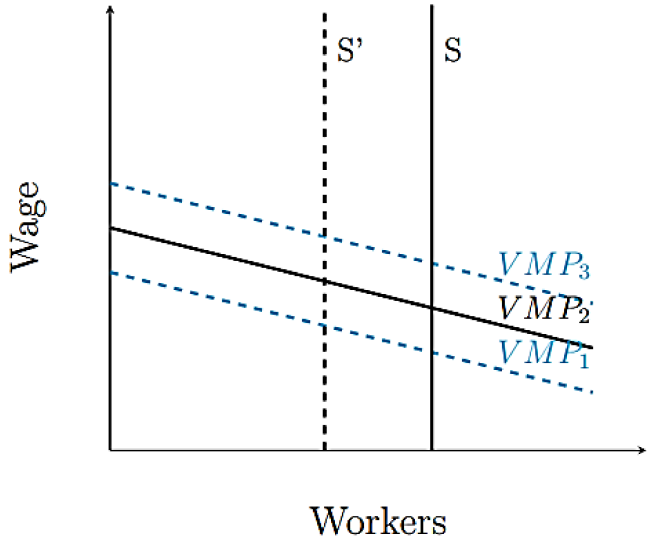
Figure 2.3: Reduction in Labor Participation: A Supply and Demand Analysis in the source country



Source: Own elaboration based on Van den Berg and Bodvarsson (2019)

The reduction in labor market participation is exacerbated by the number of people leaving the source country. However, it's crucial to consider the broader implications on the labor market as well. As suggested by Van den Berg and Bodvarsson (2009), a significant portion of immigrants' income earned in the destination country is often sent back to support families in the source country or saved for their eventual return. These remittances transfer income from the destination to the source country, influencing labor demand dynamics. Remarkably, if the remittances from the higher incomes in the destination country are substantial, they could potentially elevate the total labor demand in the source country, despite the outward migration. This phenomenon may arise as family members in the destination country alleviate financial constraints for those back home, enabling increased consumption, investment, and educational opportunities in the source country. Such economic activities can spur the demand for goods and services, prompting firms to seek more workers, thereby boosting labor demand in the source country. We can show the movement of the demand curve as in figure 2.4:

Figure 2.4: Demand for labor in the source country with remittances



Source: Own elaboration based on Van den Berg and Bodvarsson (2019)

If remittances surpass the loss in income resulting from the economic contraction after immigrants leave, the labor demand curve could, on balance, shift upwards instead of downwards. Figure 2.4

illustrates two distinct scenarios in the source country concerning labor demand following emigration. In the first scenario, without remittances, labor demand decreases from VMP_1 to VMP_2, leading to a decline in wages. In the second scenario, with remittances, labor demand escalates from VMP_1 to VMP_3, resulting in an increase in wages. It is important to note, however, that the portion of income remitted back to the source country needs to be significantly large for there to be an upward effect on wages.

Maimbo and Ratha (2005) provide a foundational understanding of the multifaceted impacts remittances have on the economies of source countries. They illustrate that even when remittances are primarily used for consumption, they generate multiplier effects, particularly beneficial in contexts of high unemployment. This suggests that remittances can stimulate economic activity and, by extension, labor demand. Similarly, Orozco (2013) explores into the specific uses of remittances, highlighting that apart from consumption, a significant portion is often invested in real estate and savings, which are subsequently used for critical areas such as education and health. These investments contribute to a ripple effect, enhancing demand for goods and services and potentially leading to job creation.

So far, we have identified two main ways in which remittances influence the labor market. Guided by the neoclassical model of labor-leisure choice, we observe that remittances can lead to a decrease in labor supply, as individuals opt for more leisure when remittances raise their reservation wage. Besides, there's an increase in labor demand driven by the higher demand for goods and services financed by remittances, which have eased the constraints that individuals had. However, if we look deeper and consider the role of remittances in education, as emphasized by Orozco (2013), the strategic allocation of remittances towards educational investment will change the market structure across generations. Following Cahuc (2014), it's clear that higher educational levels are correlated with an expansion in labor supply. This effect, indicated by a rightward shift in the labor supply curve, signifies another impact on labor market dynamics.

It is crucial for us to engage in more detailed research to fully understand the primary impact that remittances are having in Mexico, particularly on the labor market. Understanding this influence in depth is key to recognizing the complex role these financial contributions play in the country's economy, labor market, and in the everyday lives of its people.

3. Literature Review

The analysis of the impact of remittances on labor markets in developing countries is gaining relevance and is of critical importance. In these nations, the substantial flow of remittances represents a significant financial influx, potentially influencing individual decisions regarding workforce participation and working hours. The basic equation for our estimation would be:

$$Y_{nj} = \beta_0 + \beta_1 rem + \beta_2 X_n + \varepsilon_n$$

Where Y_{nj} represents outcomes in labor markets, such as the number of workers or hours worked, rem denotes the amount of received remittances, X_n is a vector of observed features, and ε_n is the error term. However, there is a concern with this specification. Remittances may be an endogenous variable due to two mechanisms: simultaneity and unobserved variables. Remittances can influence labor market outcomes, and conversely, the labor market can affect the amount of remittances sent by the diaspora. For example, if the labor market in the source country is depressed with high unemployment rates, networks in the destination country might send more money to assist. This indicates that the remittances variable is not completely exogenous; its value is partly determined by the dependent variable. The second mechanism involves unobserved factors that influence both remittances and labor market outcomes, not captured in X_n. For instance, the disposition of family members abroad could be related to the education of those left behind. If these factors are not measured and included in the model, the remittances variable could be correlated with the error term ε_n, leading to endogeneity.

Numerous studies have been conducted to empirically determine the effects of remittances on labor market outcomes and to address this issue. One of the methods used is Propensity Score Matching, which involves matching individuals who consistently receive remittances with similar individuals who do not, based on the likelihood of receiving remittances as determined by individual and household characteristics. Cox-Edwards and Rodríguez-Oreggia (2009) offer insight into Mexico, utilizing data from the National Quarterly Employment Survey (ENET) for the year 2002. Their findings reveal limited evidence of remittances impacting labor force participation and the hypothesis that remittances affect labor force participation is generally rejected. Also employing Propensity Score Matching but for other Latin American countries, Sousa and García-Suaza (2018) use household surveys from 2006 and 2014, as included in the Socioeconomic Database for Latin America and the Caribbean (SEDLAC), to estimate the impact of remittances on labor supply in

the Northern Triangle countries (El Salvador, Guatemala, and Honduras). Their findings indicate that remittances correlate with a decrease in labor force participation, especially among women, with the most pronounced effect observed in Salvadoran women (a 13 percentage-point reduction). Additionally, they conclude that the receipt of remittances is linked to a reduced likelihood of young adults either being employed or in education and that remittances might be bolstering small businesses and self-employment ventures in El Salvador and Guatemala. Along the same line, by combining the methodology of Propensity Score Matching and a bivariate discrete choice model that incorporates the educational participation decisions of youth into their labor decisions, Leasaski et al. (2013) obtain similar results for Peruvian youth. They mention that those who receive remittances have a greater inclination towards education and are less likely to work when they are younger, as well as a reduced likelihood of neither working nor studying.

On the other hand, Amarendra Sharma and Oscar Cárdenas (2018) analyzed the endogeneity bias using the Generalized Method of Moments, focusing on a single lag of exogenous variables. Their study, which utilized panel data from Mexican states and the National Survey of Occupation and Employment (ENOE), examined labor market outcomes such as unemployment rates, informal employment, and work hours. Their findings indicate that remittances lead to higher activity rates and lower median hours worked, affecting critical employment[3] and unemployment duration.

Complementing this, Ralph Chami et al. (2018) used data from international financial and labor organizations. Their research highlights that, remittances have a significant impact on both labor supply and labor demand in recipient countries. In terms of supply, remittances reduce labor force participation and increase labor market informality. In terms of demand, remittances reduce overall unemployment. at least on an aggregate level, the benefits of remittances primarily favor households associated with critical employment categories, with a noted decrease in the percentage of salaried individuals in these categories when additional incomes are received.

Probit and Logit models also have been employed by researchers to analyze data from various international contexts, including Nicaragua, Pakistan, and the Dominican Republic. For the first

[3] It means "the proportion of the employed population that works less than 35 hours per week involuntarily (i.e., in involuntary part-time employment), plus the proportion of employed persons who work more than 48 hours per week with earnings between one and two minimum wages, and those who work more than 35 hours per week with earnings below the minimum wage (i.e., in precarious employment)."

two countries, Funkhouser (1992) and Kamran-Khan (2009), respectively, conclude that remittances negatively impact labor participation. Additionally, Funkhouser (1992) finds that in Nicaragua, remittances have a positive effect on the self-employment rates of non-migrants. This finding contrasts with the results observed by Amuedo-Dorantes and Pozo (2006) in the Dominican Republic, where households receiving remittances are less likely to own businesses. This discrepancy may be attributed to remittances influencing budget constraints and increasing reservation wages, which in turn leads to higher consumption of leisure and other goods, such as housing and education. In the case of Mexico, Gordon Hanson (2007) employs a combination of two methods: Probit is used to estimate the probability of labor force participation, while Tobit is utilized to account for the numerous individuals reporting zero labor hours. Hanson finds that in households with migrants abroad, women are less likely to work outside the home, potentially due to an increase in family income through remittances.

Instrumental variables are also a great way to face the possible endogeneity of the remittances in the labor market. Much of the literature employs various instruments that are not correlated with the final outcome, namely labor force participation, yet are associated with remittances. This approach helps improve the robustness of causal inferences in the analysis and forms the basis of the econometric model used in this study.

Economic conditions in the remittance-sending country, such as per capita GNI, unemployment rates, real interest rates, and wage levels, including U.S. wage rates and their volatility, have been employed as instruments to directly relate to the economic circumstances that can influence the amount and frequency of remittances. This causal relationship has been explored in studies by SeyedSoroosh (2018), Cuadros-Menaca and Gaduh (2020), and Orrenius et al. (2010). The first two, find that receiving remittances leads to a decrease in the overall workforce. Specifically, Cuadros-Menaca examines the case of Colombia, while Seyed analyzes data from 122 developing countries, including both poor and middle-income nations, from 1990 to 2015. In line with these findings, Cuadros-Menaca additionally observes that child labor participation is significantly more negatively affected. Conversely, Orrenius et al., using data from Banxico and IMSS, finds that an additional USD 100 million in remittances per quarter increases formal-sector employment by 15 percent and decreases the unemployment rate by 2.78 percentage points.

Another type of instrument includes those that involve the physical presence of remittance channels. These measure the accessibility and ease of sending remittances, influencing how households might receive these funds. In one study, Amuedo-Dorantes and Susan Pozo (2006) use data from the 2002 National Survey of Household Income and Expenditure (ENIGH, its Spanish acronym) and analyze the number of Western Union offices in the state during the previous year. They discover that male labor supply does not significantly vary with changes in remittance income. In contrast, female labor supply decreases with changes in remittance income, especially in rural areas. With this research in mind, Al-Assaf (2016) employs the same instrument for the labor market in Jordan, but his findings are the opposite: women's likelihood of engaging in labor activity decreases, while for men, this likelihood reduces by four times more (5 vs 25 percentage points). Related to these instruments, Burgos-Davila (2008) uses a dichotomous variable indicating the presence of couriers and banks and finds that remittances do not significantly influence the decision of women in Ecuador to participate in the labor market.

In the existing literature, characteristics from the country of origin have been used as instruments. First, geographical and regional characteristics, such as the location of the *Eje Cafetero* region for Colombia (Mora, 2013) and socioeconomic data including a dummy for households with at least two adult men in Tajikistan, (including members currently abroad), which captures the family gender composition, used to predict the likelihood of living in a remittance-receiving household (Vadean & Teresa and Piracha, 2019); these variables are utilized to account for local economic conditions that influence remittance flows and labor decisions and both studies conclude that remittances increase the likelihood of not working. In the case of Mexico, infrastructure in the origin country, such as the railways in the country, has been linked to remittances due to their historical significance as a mode of transportation. In the past, these railways facilitated the movement of people from various Mexican states to the United States, leading to the eventual establishment of networks across the border. López-Feldman and Daniel Escalona (2017) explore this connection and conclude that the effects of remittances on labor market participation are heterogeneous by gender: while remittances significantly reduce both the likelihood of employment and the total working hours for men, they appear to have no impact on the labor participation of women. With similar findings and related to this, Nguyen and Purnamasari (Nguyen) use historical migration networks as instruments for migration and remittance receipts in Indonesia. Their findings are in line with those of López and Escalona, showing similar impacts

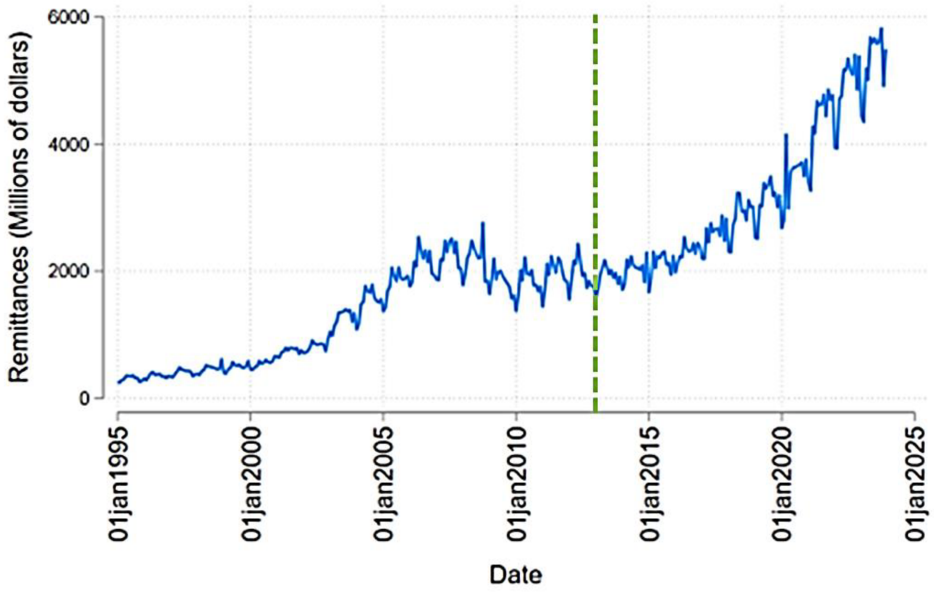
of remittances on labor market participation by gender. Additionally, they discovered that remittances from female migrants help reduce child labor. Conversely, Grigorian and Melkonyan (2011) , utilizing data from Armenia and employing the regional unemployment rate among men and the ratio of vulnerable individuals in the total regional population as instruments, find that households receiving remittances tend to work fewer hours and, additionally, spend less on their children's education.

With all this literature in mind, we recognize the heterogeneity in findings regarding both the sign and magnitude of effects. It is for this reason that it becomes necessary to gather more evidence about the impact of remittances on Mexico's labor force. We know that remittances have experienced significant growth in the second decade of the 2000s. Therefore, studies using data from the 1990s or early 2000s might not yield the same results. Nonetheless, it is crucial to understand the results and methodologies of earlier research, as this will provide a broader perspective and help us better contextualize our findings.

4. Data and Descriptive Statistics

To analyze the impact of remittances on labor force participation, we rely on several data sources. One of our primary data sources is the quarterly remittance income data for each municipality in Mexico, provided by the *Banco de México*, covering the period from 2013 to 2023. Figure 4.1 illustrates the trend of monthly remittances to Mexico from 1995 to 2023, highlighting substantial growth in remittances beginning around 2013 and continuing through 2023, as indicated by the green shaded line. Another fundamental data source is the quarterly formal sector employment data at the municipal level, provided by the *Instituto Mexicano del Seguro Social* (IMSS). This dataset categorizes employment details by age and sex, allowing us to explore demographic variations in labor market responses to remittance inflows. It is important to note that our variables and model account for the population in each municipality. We gather data from two Census of Population and Housing conducted in 2010 and 2020, as well as the Intercensal Survey of 2015; we employ constant growth rates for each municipality every five years to estimate the annual population throughout our study period.

Figure 4.1: Monthly Remittances to Mexico (1995-2023)



Source: Own elaboration using data from Banco de México. The period covered includes all monthly data from 1995 to 2023. Quantities are measured in USD.

Our instrument, Unemployment Exposure[4], is constructed using two resources. First, we calculate the distribution of Mexican migrants in the US by analyzing requests for consular documents, which include both the place of birth and the current state of residence for documented and undocumented migrants, obtained from *Instituto de los Mexicanos en el Exterior.* This distribution helps to understand and estimate the conditions to which Mexican migrants from each municipality are exposed in each state they arrive in the USA. Second, we utilize data from the U.S. Bureau of Labor Statistics, specifically the quarterly unemployment rates from each state, covering our study period from 2013 to 2023.

In addition to the main variables mentioned, we also consider other essential control variables, such as the number of ATMs per 1,000 people, with data obtained from the *Comisión Nacional Bancaria y de Valores* (CNBV), specifically, from the National Survey of Financial Inclusion (ENIF); this variable is available by municipality and for each quarter from 2013 to 2023. The migration intensity index, obtained from the *Consejo Nacional de Población* (CONAPO), and the proportion of individuals aged 15 or older with secondary education, obtained from the *Sistema Nacional de Información Municipal* (SNIM). The Per Capita Gross Census Value Added[5] and the presence of economic units per capita, both obtained from the *Instituto Nacional de Estadística y Geografía* (INEGI). The proportion of individuals in vulnerable situations due to social deprivation, provided by the *Consejo Nacional de Evaluación de la Política de Desarrollo Social* (CONEVAL). All the variables mentioned above were used as provided directly in the databases, and obtained for the year 2010, interacted with a trend. Population density was calculated by dividing the population of each municipality in 2010 by its area (where the population was obtained from the 2010 Population and Housing Census). All these variables are included to account for other factors that may influence the final outcome of the econometric model, allowing us to reduce omission bias and provide more precise and reliable estimates of the causal effect. Details of the control variables are provided in Table 10 of the Appendix.

[4] Which measures the extent to which individuals in different municipalities are affected by changes in unemployment rates in the destination country, the United States, depending on the state where the Mexican migrants are located.
[5] It is the value of production that is added during the work process through the creative and transformative activities of the employed personnel, capital, and organization, exerted on the materials consumed in the performance of the economic activity.

Table 1 displays the descriptive statistics for our two distinct samples: the Full Sample and the Restricted Sample. The Full Sample consists of 46,156 observations, covering 1,049 municipalities in each quarter from 2013 to 2023 (44 periods). The Restricted Sample contains 14,872 observations from the same period, but includes only municipalities with populations between 50 thousand and 1 million people, resulting in 338 municipalities. Mexico City is excluded from the analysis due to its status as an outlier in several dimensions, including size, mobility, and economic importance. Additionally, there is no representation for its municipalities in the IMSS database.

The mean for remittances per capita in the Full Sample is USD 88.3644 per capita per three-month period, with a standard deviation of 108.444, indicating considerable variability across municipalities. In contrast, the Restricted Sample has a slightly lower mean of USD 81.4523 and a standard deviation of 88.498, suggesting a more homogeneous concentration of data when excluding municipalities with either very small or very large populations. These variations in per capita remittances across municipalities can be seen in the map shown in the figure 4.2.

Figure 4.2: Municipal-level remittance income in Mexico (2023)

Source: Own elaboration using remittance data from Banco de México, considering the total sum of remittances for all quarters of the year 2023, and population data taken from the Census of Population and Housing 2020, provided by the *Instituto Nacional de Estadística y Geografía* (INEGI). This figure represents quintiles of remittance income per capita, ranging from very low to very high. White municipalities indicate either no data or zero remittances.

Formal employment for women per capita shows less pronounced differences between the samples, with means of 0.1156 and 0.1109 for the Full and Restricted Samples, and standard deviations of 0.099 and 0.085. In terms of education, the proportion of individuals aged 15 or older with secondary education shows a slight increase in the Restricted Sample (0.2246) compared to the Full Sample (0.2217), both with low dispersion (0.039 and 0.0398 respectively). Finally, population density displays extreme variability in both samples, with a mean of 1620.496 and a standard deviation of 3016.715 in the Full Sample, compared to 1413.014 and 2531.81 in the Restricted Sample. This indicates a high dispersion in population density, which could be an influential factor in other economic and social variables analyzed.

Table 1: Data and Descriptive Statistics

	Full Sample		Restricted Sample	
Variable	Mean	SD	Mean	SD
Remittances per Capita	88.3644	108.444	81.4523	88.498
Formal Employment for Women per Capita	0.1156	0.099	0.1109	0.085
Formal Employment for Men per Capita	0.1944	0.155	0.1895	0.136
Total Formal Employment per Capita	0.1548	0.125	0.15	0.109
Formal Employment for Women as a Proportion of Women Aged 15-65	0.1848	0.145	0.1693	0.125
Formal Employment for Men as a Proportion of Women Aged 15-65	0.2871	0.224	0.2808	0.198
Total Formal Employment as a Proportion of Women Aged 15-65	0.2421	0.183	0.2265	0.159
Unemployment Exposure Rate for Mexicans in the U.S.	5.3614	1.96	5.3235	1.927
ATMs per 1,000 People	5.7751	3.926	5.8996	3.71
Migration Intensity Index	30.1738	1.703	30.3313	1.611
Per Capita Gross Census Value Added	0.0432	0.148	0.0493	0.182
Economic Units per Capita	0.0351	0.012	0.0351	0.011
Percentage of the Vulnerable Population	28.4573	7.082	28.2943	6.741
Population Density	1620.496	3016.715	1419.014	2531.81
roportion of Individuals Aged 15 or Older with Secondary Education	0.2217	0.039	0.2246	0.0398
Observations	46,156		14,872	

SD denotes standard deviation. Each value under the "Mean" and "SD" columns represents the mean and standard deviation for the respective samples. Each value is calculated considering all quarters from 2013 to 2023.

5. Specification

To address endogeneity, many studies have utilized instrumental variables associated with shocks in the destination country. For example, Cuadros-Menaca and Gaduh (2020) employed instrumental variables from the remittance-sending country by analyzing the monthly unemployment shock of the destination country. This shock was quantified by the deviation from its average over the previous 12 months compared to its pre-crisis unemployment rate. Similarly, Orrenius et al. (2010) used migrant-weighted measures of U.S. wages, derived from the Current Population Survey (CPS) and the Covered Employment and Wages (CEW) data, which also reflect economic shocks in the destination country.

Continuing along these lines, Ambrosius et al. (2021) implemented an instrumental variable (IV) method that uses U.S. unemployment rates—adjusted by the Mexican migrant distribution—as an instrumental variable for remittances. This approach can be represented as follows:

$$Unemexp_{it} = \sum_{k=1}^{K} Unem_{k,t} \times D_{i,k}$$

This equation emphasizes the consistent theme of utilizing shocks in the destination country's economy as instrumental variables across various studies. It is also the method adopted in our analysis. In this context, $Unemexp_{it}$ reflects the weighted rate of unemployment exposure for Mexican individuals from municipality i in the US at time t, where t represents each distinct quarter-year period from 2013 to 2023. $Unem_{k,t}$ represents the unemployment rate in US state k at time t, and $D_{i,k}$ indicates the share of migrants from municipality i residing in US state k. This migrant proportion is derived from the stock of consular registrations accumulated in each US state from 2002 to 2022[6]. While we know that not all Mexican migrants obtain the consular registration, the stock of these registrations provides a good estimate of the distribution of migrants in each U.S. state from each Mexican municipality i.

[6] The consular registration is a document issued by Mexican Consular Offices. It not only certifies a person's nationality and identity but also officially records their presence as a Mexican national living abroad.

Following the approach used by Ambrosius et al. and other researchers, this analysis employs the logarithm of the shock instead of the direct shock value. Wooldrige (2018) points out that linear relationships are often insufficient for capturing the complexities of economic dynamics. Fortunately, integrating non-linearities into regression analysis can be effectively achieved by redefining dependent and independent variables to include logarithmic transformations. A significant advantage of using logarithms for the dependent variable is that it enables the interpretation of regression coefficients as elasticities, especially when the independent variable is also expressed in logarithmic terms. This transformation means that a percentage change in one variable will lead to a proportional percentage change in another, thereby simplifying the understanding of how one variable influences another.

This method is applied in the first stage of our specification, which is outlined as follows:

$$log(rempc_{it}) = \alpha_0 + \alpha_1 log(Unemexp_{it}) + \alpha_2 X_i * Trend_t + \alpha_3 A_{it} + \delta_i + \delta_t + \mu_{it}$$

where $log(rempc_{it})$, is the natural logarithm of the remittances per capita sent by individuals from municipality i at time t, serving as the dependent variable. α_0 is the intercept of the regression. $log(Unemexp_{it})$ is the natural logarithm of the weighted unemployment exposure in the U.S. for migrants from municipality i at time t; this variable serves as a crucial independent variable, capturing the economic conditions affecting migrants and, consequently, likely influencing remittances. The matrix X_i contains time-invariant control variables, such as economic units, population density, migration intensity index, proportion of people in poverty, and the proportion of individuals attending secondary school. Additionally, the number of ATMs per 10,000 people, denoted as A_{it}, is included as control variable. This variable varies each quarter-year throughout the entire period but is not interacted with the trend. Parameters δ_i and δ_t refer to municipality and year–quarter fixed effects. The first accounts for unobserved characteristics that are constant over time for each municipality, while the second addresses effects that impact all municipalities simultaneously, such as macroeconomic factors that vary seasonally. This approach ensures that the observed variations in our dependent variable, $logrempc_{it}$, can be directly attributed to the study's variables of interest, thereby eliminating potential noise caused by unrelated external factors.

In the second stage of the 2SLS estimation, we relate the instrumented variable $log(rempc_{it})$, which is instrumented by shocks in the destination country, with its impact on the labor market:

$$Y_{it} = \beta_0 + \beta_1 \log \text{rempc}_{it} + \beta_2 X_i * \text{Trend}_t + \alpha_3 A_{it} + \delta_i + \delta_t + \varepsilon_{it}$$

In this model, the dependent variable Y_{it} represents the labor market outcome in Mexico. Generally, it denotes the proportion of employed individuals relative to the total population of a specific municipality i at time t. Additionally, estimates are also made by gender and age. The main independent variable is the logarithm of per capita remittances $log(rempc_{it})$, which is also utilized in other studies (see Ahamada et. al (2013); Fayissa et. al. (2010); Adams (2005)). The model controls for individual and time fixed effects, and trends are considered in the same manner as in the first stage.

In econometric analysis, the validity of an instrument must fulfill two critical conditions as outlined by Angrist and Pischke (2009). The first, the relevance condition, requires that the instrument, Unemexp_{it}, is statistically correlated with the causal variable, $\log(\text{rempc}_{\text{it}})$. This stipulates that changes in unemployment exposure should correspond with variations in the logarithm of per capita remittances. Such a correlation is essential to demonstrate that the instrument effectively influences the variable of interest. The second condition, known as the exclusion restriction, asserts that the instrument should not be correlated with any unobserved variables that affect the dependent variable, which in formal terms is represented as $Cov(\epsilon_{it}, Unemexp_{it}) = 0$. This condition ensures that the instrument affects the outcome solely through its interaction with the identified causal variable.

Intuitively, labor market conditions in the U.S., particularly unemployment rates, directly influence the earnings potential and job stability of Mexican emigrants. These economic pressures, in turn, shape their ability and decisions regarding the remittance of funds back to Mexico. Empirical research additionally supports this theory. Studies indicate that fluctuations in the unemployment rates among U.S. immigrants significantly and adversely affect their remittance behaviors (Bidawi wt. al (2022); Bunduchi et. al (2019)). While empirical testing can often verify the relevance of the instrument, confirming the exclusion restriction is inherently more challenging. This difficulty arises because the error term ϵ_{it} remains unobservable (2017). Despite this limitation, there is a potential that unobserved sociodemographic variables could correlate with the instrument, thus

confounding the analysis. To address this issue and strengthen the robustness of our findings, the current study incorporates additional control variables previously discussed.

6. Findings

In this section, we present the key findings from our empirical analysis. Having adjusted the models to control for potential endogeneity biases, we explore how variations in per capita remittances impact formal employment in Mexican municipalities. First, we perform an OLS analysis, the results of which are presented in Table 13 in the appendix. The OLS estimates indicate a negative effect, although this effect is insignificant in some samples. Given the limitations of these results, as previously discussed, we now present our 2SLS results below.

Table 2: First Stage. Elasticity of remittances with respect to unemployment exposure. Municipal-level regressions

US unemployment	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Coefficient	-0.638***	-0.668***	-0.574***	-0.928***	-1.019***	-0.914***
(Std. Error)	(0.230)	(0.236)	(0.220)	(0.332)	(0.337)	(0.300)
Observations	46,156	46,156	46,156	14,872	14,872	14,872

The data covers each quarter from 2013 to 2023. Robust standard errors, clustered at the municipal level, are shown in parentheses. All results include fixed effects for municipality and time. Specification I contains no controls; specification II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; specification III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. Levels of significance are denoted as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2 indicates the First Stage of our model, where we explore the elasticity of remittances in relation to unemployment exposure. The data clearly show that each coefficient is negative, signifying a robust relationship between our instrument, U.S. unemployment exposure, and per capita remittances (both variables expressed in logarithmic form). The findings from our dataset reveal that an increase in the unemployment rate among exposed Mexicans implies a decrease in remittances per capita sent to Mexico. The coefficients for the full sample range from -0.574 to -0.668, indicating a substantial elasticity of remittances with respect to U.S. unemployment exposure; this means that a 1% increase in unemployment exposure in the U.S. is associated with

a decrease of approximately 0.57% to 0.67% in per capita remittances. When focusing on the restricted sample, the coefficients are even more pronounced, ranging from -0.914 to -1.019. This indicates that a 1% increase in unemployment exposure in the U.S. is associated with a decrease of approximately 0.91% to 1.02% in per capita remittances, reflecting the increased sensitivity of remittances in these municipalities to U.S. labor market conditions.

When comparing these results with existing literature, such as the study by Ambrosius et al. (2021), who also examine the effects at the municipality level and use a similar instrument (U.S. unemployment exposure) focusing on total remittances rather than per capita measures, we observe similar patterns of sensitivity to economic conditions, though on a different scale. They found that a 1% increase in unemployment exposure in the U.S. results in a 0.58% to 0.98% decrease in total remittance flows to the source country, depending on the sample and the period considered. This aligns with our findings, highlighting the consistent negative impact of U.S. economic downturns on remittance flows, whether measured per capita or in aggregate.

The robustness of our results is additionally emphasized by the inclusion of various control variables in specifications II and III. These controls, which account for factors such as the availability of ATMs, economic activity, population density, and education levels, do not substantially alter the magnitude or significance of the unemployment exposure coefficients. This suggests that the observed relationship between U.S. unemployment and remittances is not confounded by these factors.

The results of the Second Stage are reported in Table 3. At first glance, in panel A, we observe that the estimates suggest a negative causal effect between remittances and formal employment. When considering the specification that includes all controls, we observe a significant and negative impact of remittances on formal employment. In the specification III of the full sample, we note that a 1% increase in remittance per capita in a municipality decreases total formal employment by 0.0599 percentage points, with a significant coefficient. This coefficient can be interpreted as a percentage: a 1% increase in per capita remittance income in a municipality reduces formal

employment by 0.38%[7]. Regarding the restricted sample, a 1% increase in remittances per capita reduces formal employment by 0.0404 percentage points, which can be translated as 0.26%.

In the case of women, we also observe in panel B that, depending on the sample considered, a 1% increase in per capita remittance income in a municipality results in a reduction in formal employment ranging from 0.0793 percentage points to 0.0511 percentage points, which can be represented as 0.46% to 0.69%. However, for men in panel C, although a negative effect is observed, it is not statistically significant.

In our analysis, we reported the Anderson-Rubin Wald Test for each specification, following the recommendations of Andrews, Stock, and Sun (2019) for cases using only a single instrument to ensure the validity of our findings. Our results indicated high Chi-square values across all specifications, strongly suggesting a rejection of the null hypothesis under the assumption of correct model specification and valid instruments. Additionally, the corresponding P-values were extremely low ($p<0.05$), reinforcing the statistical significance of our findings in formal employment and in women's employment.[8]

Previous literature has found similar results in terms of both sign and significance. Using data from 122 developing countries, including Mexico, SeyedSoroosh (2018) suggests that, on average, a 1% increase in per capita remittances will lead to a 0.017% decrease in labor force participation, a minor effect that is smaller than the one observed in our study. The results of gender-specific effects indicate that while remittances have no statistically significant effect on male labor force participation, they do reduce female labor force participation; on average, a 1% increase in per capita remittances leads to a 0.03% decline in female labor force participation. The negative impacts on female labor force participation, are observed across different regions. For instance, in the Northern Triangle, Sousa (2018) discusses similar trends. In Colombia, Mora (2013) examines how the likelihood of women entering the labor market decreases when they receive remittances.

[7] To convert the estimates into percentages, we divide the resulting coefficient by the mean of the population in the formal sector for the respective group. For example, to estimate the effect on total employment (considering employment per capita), using the means described in Table 1, we calculate $\frac{-0.0599}{0.1548} = -0.38$

[8] Additionally, we can perform more tests to generate additional instrumental variables (IVs) by using higher-order terms of the available instrument. In this case, we present in the appendix, specifically in Tables 15 and 16, the regressions where the instrument is utilized as the squared weighted exposure to unemployment. The results are similar to those presented in this section, indicating that the relationship between the instrument and the endogenous variable is robust and not sensitive to the specific functional form of the instrument.

In the case of Mexico, using data from the ENIGH (2002), Amuedo-Dorantes and Pozo (2006) found a reduction in female labor participation in terms of hours worked, with the effect being more pronounced in rural areas. Similarly, Airola (2008) using the same survey data from 1992 to 2002, collected biennially, identifies a negative impact on the number of hours worked by women.

Orrenius et al. (2010) found a positive relationship between remittances and formal-sector employment, specifically reporting that "an additional USD 100 million in remittances in a quarter will increase formal-sector employment by 15%." However, our results show the opposite relationship: we found that a general reduction of 0.32% (an average of 0.38% and 0.26% from our full and restricted samples) implies that remittances would need to decrease by USD 2.13 million to observe a similar effect.[9] This highlights a significant difference in findings, as while Orrenius et al. find that remittances increase formal employment, our results suggest that a decrease in remittances is associated with a reduction in formal employment. It is important to note that although both studies use instrumental variable (2SLS) specifications to address the endogeneity of remittances, certain differences may influence the results. While we use unemployment rates in each state as shocks in the destination country, Orrenius et al. use wage shocks. They analyze data from 2003 to 2007, whereas our study focuses on the period from 2013 to 2023, emphasizing that the study period is relevant. As mentioned, our choice of period is crucial because remittances grew substantially during this time. This more recent period in our study could capture contemporary effects and recent changes in remittance and employment trends. Additionally, Orrenius et al. analyze data at the state level, whereas we focus on the municipal level.

[9] This value is calculated by taking the general percentage reduction (0.32%) and converting it into the equivalent dollar amount based on the effect size found by Orrenius et al. (2010). Specifically, we used $\frac{0.32\% \text{ x USD } \$100}{15\%}$ to determine that remittances would need to decrease by USD 2.13 million to observe a similar effect.

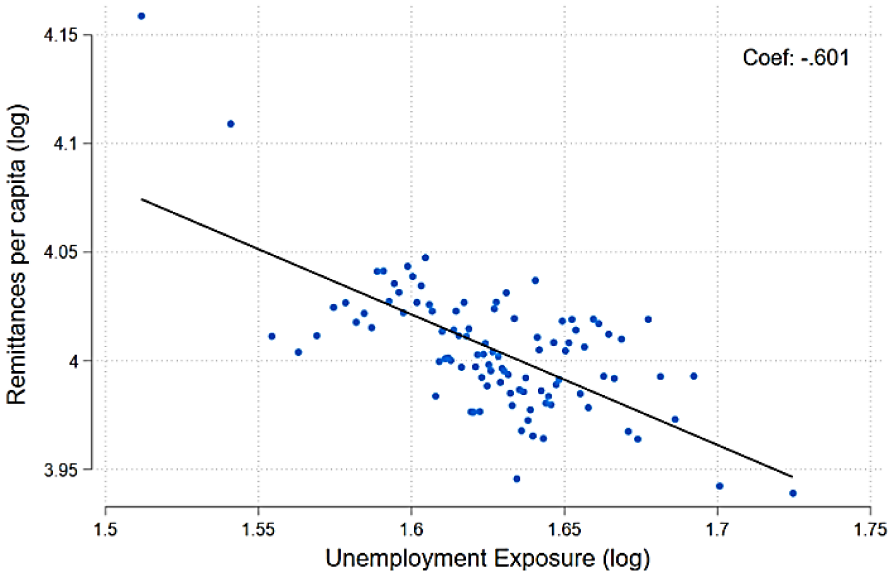
Table 3: Effect of Remittances on Employment: A 2SLS Analysis

	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Panel A: Formal employment (per capita)						
Coefficient	-0.0655**	-0.0584**	-0.0599**	-0.0471**	-0.0381**	-0.0408**
Std. Error	(0.030)	(0.025)	(0.029)	(0.021)	(0.017)	(0.019)
F-stat.	9.3	12.29	12.47	10.1	11.99	11.71
Observations	46,156	46,156	46,156	14,872	14,872	14,872
Anderson-Rubin Wald test						
Chi-sq(1)	11.05	10.62	8.22	7.62	6.43	5.83
P-val	0.0009	0.0011	0.0041	0.0058	0.0112	0.0158
Panel B: Women's formal employment (per capita)						
Coefficient	-0.0848**	-0.0773**	-0.0793**	-0.0606***	-0.0502***	-0.0511***
Std. Error	(0.036)	(0.031)	(0.036)	(0.022)	(0.016)	(0.018)
F-stat.	10.26	12.67	12.18	9.72	10.85	10.59
Observations	46,156	46,156	46,156	14,872	14,872	14,872
Anderson-Rubin Wald test						
Chi-sq(1)	23.56	23.89	19.5	25.36	21.89	18.91
P-val	0	0	0	0	0	0
Panel C: Men's formal employment (per capita)						
Coefficient	-0.0486	-0.0418*	-0.0444	-0.0341	-0.0273	-0.0333
Std. Error	(0.029)	(0.025)	(0.030)	(0.026)	(0.021)	(0.025)
F-stat.	10.49	14.92	15.07	11.58	13.63	13.19
Observations	46,156	46,156	46,156	14,872	14,872	14,872
Anderson-Rubin Wald test						
Chi-sq(1)	3.63	3.18	2.57	1.89	1.6	1.88
P-val	0.0567	0.0745	0.1092	0.1694	0.2062	0.1707

The data covers each quarter from 2013 to 2023. Robust standard errors clustered at the municipal level are in parentheses. I contains no controls; II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. Panel A presents the total number of jobs affiliated with the IMSS, divided by the total population. Panel B shows the same for women, relative to the total female population, and Panel C for men, relative to the total male population. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1.

We can visualize the results in a graphical manner, which provides a clearer and more intuitive understanding of the relationships between the variables. The first stage regression depicted in panel a) of Figure 6.1, explores the relationship between remittances per capita (logarithm) and Unemployment Exposure from Mexicans in the U.S. (logarithm). A clear negative trend is observed, as indicated by the regression line with a coefficient of -0.601. This suggests that an increase in unemployment exposure is associated with a decrease in remittances per capita, which is intuitive, since a higher unemployment rate for Mexicans would imply that they generate less money and therefore send less to their home countries. The implications of these findings are critical for the subsequent 2SLS estimation, where the validity of the instruments hinges on the robustness of this first stage.

Figure 6.1: First Stage: Remittances per capita (log) vs Unemployment Exposure (log)

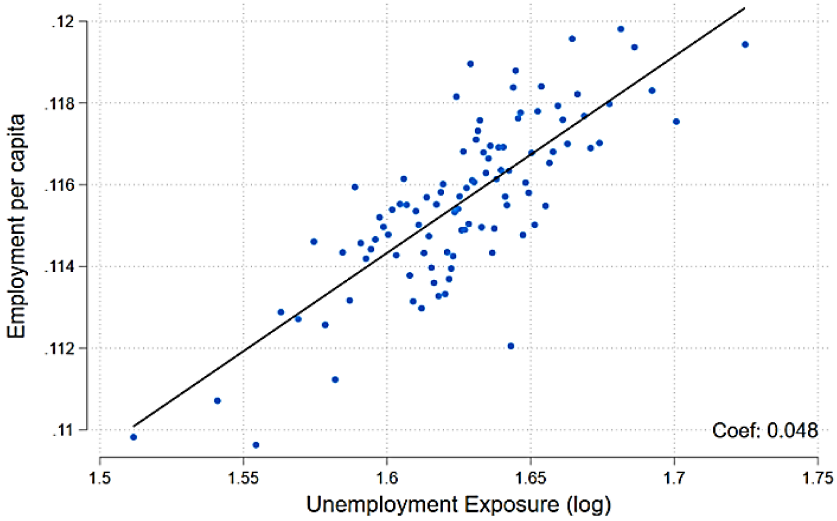


Source: Own elaboration with primary data from remittances by *Banco de México*, calculated per capita using population data from INEGI's Population and Housing Census of 2010 and 2020, as well as the intercensal survey of 2015. Data for all quarters and years without specific data were estimated using the same growth rate between each period from the main sources. Figures generated using a binscatter approach with 100 bins, each representing the mean of its respective quantile in the data. The coefficients depicted in each graph correspond to the slope of the linear fit within each bin. We include controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), the migration intensity index from Mexico to the United States, the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. We incorporate fixed effects for both time and municipality. These figures are constructed using data from each quarter between 2013 and 2023.

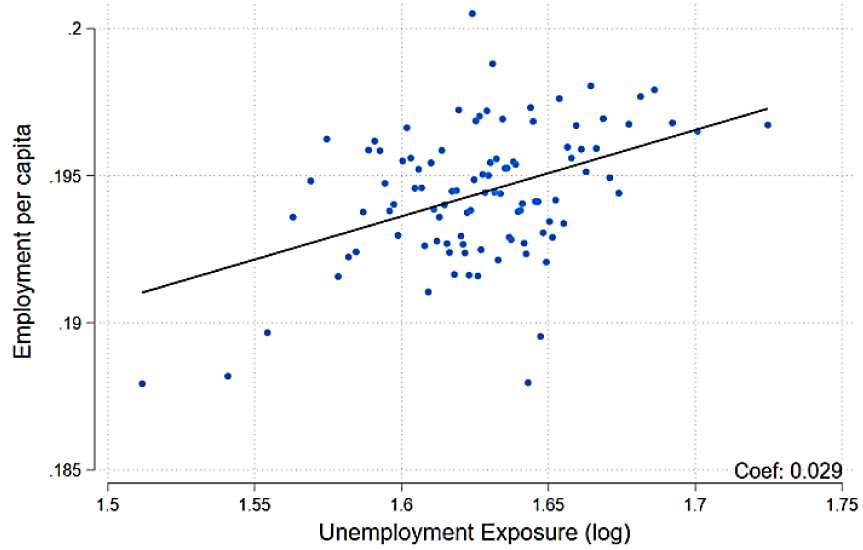
Reduced form regressions are generated for both genders. As depicted in panel A) of Figure 6.2, the analysis examines the relationship between Employment per Capita for Women (logarithm) and Unemployment Exposure (logarithm). This analysis demonstrates a positive correlation, evidenced by a regression coefficient of 0.048, indicating that an increase in unemployment exposure is associated with an increase in women's formal employment per capita. Conversely, panel B) of Figure 6.2 explores the same relationship but for Men. This analysis also reveals a positive correlation, but with a more modest coefficient of 0.029.

Figure 6.2: Reduced Form

Panel A): Employment per Capita for Women vs Unemployment Exposure (log)



Panel B): Employment per Capita for Women vs Unemployment Exposure (log)



Source: Own elaboration with primary data from remittances by *Banco de México*, calculated per capita using population data from INEGI's Population and Housing Census of 2010 and 2020, as well as the intercensal survey of 2015. Data for all quarters and years without specific data were estimated using the same growth rate between each period from the main sources. Figures generated using a binscatter approach with 100 bins, each representing the mean of its respective quantile in the data. The coefficients depicted in each graph correspond to the slope of the linear fit within each bin. We include controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), the migration intensity index from Mexico to the United States, the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. We incorporate fixed effects for both time and municipality. These figures are constructed using data from each quarter between 2013 and 2023.

This suggests that an increase in unemployment exposure among Mexicans in the US correlates with a slighter increase in men's employment per capita, compared to that observed for women. Additionally, the data points are more dispersed, which may indicate a less significant relationship.[10] It is important to note that although these correlations suggest a relationship between unemployment exposure and formal employment per capita for both genders, they do not imply a direct causal link between these two variables. A critical assumption of the two-stage least squares (2SLS) method used in this analysis is that the observed relationship is indirect, operating through the mechanism of remittances. This means that while higher unemployment exposure among Mexicans in the US appears to correlate with increases in formal employment per capita for both women and men in Mexico, the 2SLS framework posits that this effect is mediated by remittance flows. Therefore, remittances likely play a crucial role in translating the economic conditions of Mexican migrants in the US into employment outcomes in Mexico.

Our results imply that formal employment among women decreases due to an increase in remittances. However, it is important to investigate deeper into these results to understand whether there are heterogeneous effects across different age groups. Analyzing the impact of remittances on employment by age group could reveal some insights into how different segments of the population respond to changes in non-labor income. Thus, these results can lead us to explore various mechanisms.

[10] In the context of instrumental variables (IV), dividing the reduced form coefficient by the first stage coefficient directly yields the structural coefficient,

$$\rho = \frac{\text{Coef. of the instrument in the reduced form}}{\text{Coef. of the instrument in the first stage}}$$

This result demonstrates how IV exploits the relationships among the equations to identify precise causal effects . As we can observe, the coefficients meet this criterion as evidenced by the calculation. For example, for woman: $\rho = \frac{0.048}{-0.601} = -0.079$, which represents the coefficient adjusted for all controls.

Table 4: Effect of Remittances on Women's Employment by Age

	I	II	III	IV
First Stage: Level of remittances per capita (log)				
Unemployment exposure (log)				
Coefficient	-0.601***	-0.929***	-0.638***	-0.928***
Std. Error	(0.223)	(0.309)	(0.230)	(0.331)
Second Stage. Dependent Variable: Women's employment (per capita)				
Remittances per capita (log)				
15 to under 20	-0.0688**	-0.0571***	-0.0686**	-0.0593***
	(0.031)	(0.019)	(0.030)	(0.021)
20 to under 25	-0.1602**	-0.1101**	-0.1637**	-0.1213**
	(0.072)	(0.045)	(0.073)	(0.052)
25 to under 30	-0.1623*	-0.0848**	-0.1701**	-0.1098**
	(0.085)	(0.042)	(0.086)	(0.053)
30 to under 35	-0.1128	-0.0269	-0.1234	-0.0489
	(0.081)	(0.022)	(0.080)	(0.029)
35 to under 40	-0.1324	-0.0590*	-0.1327	-0.0728*
	(0.084)	(0.033)	(0.081)	(0.039)
40 to under 45	-0.1177**	-0.0686**	-0.1191**	-0.0831**
	(0.058)	(0.032)	(0.055)	(0.037)
45 to under 50	-0.0998**	-0.0829**	-0.1098**	-0.1041**
	(0.047)	(0.037)	(0.048)	(0.044)
50 to under 55	-0.1622**	-0.1124***	-0.1671**	-0.1239***
	(0.071)	(0.040)	(0.069)	(0.046)
55 to under 60	-0.1185**	-0.0847***	-0.1270**	-0.0978***
	(0.049)	(0.028)	(0.051)	(0.033)
60 to under 65	-0.0065	-0.0074*	-0.0101	-0.0108**
	(0.009)	(0.004)	(0.009)	(0.005)
65 to under 70	-0.0023	-0.0026	-0.004	-0.0041
	(0.003)	(0.003)	(0.003)	(0.003)
70 to under 75	0.0024	0.0013	0.0012	0.0003
	(0.003)	(0.003)	(0.002)	(0.003)
75 and over	0.0019	0.0013	0.0015	0.0009
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	46,156	46,156	14,872	14,872
Full sample	✓		✓	
Restricted Sample		✓		✓
Controls	Yes	Yes	No	No

The data covers each quarter from 2013 to 2023. Robust standard errors clustered at the municipal level are in parentheses. Municipal regressions are run on 1049 municipalities for the full sample and 338 municipalities for the restricted sample. Each row represents a regression analysis with the dependent variable being the number of IMSS-affiliated jobs held by women in each age range, divided by the total number of women in that age group. This model includes all controls added in the third specification, as shown in the previous tables. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the same regressions as before, now focusing on data for women, with each row detailing a regression by age range. The columns display different specifications, both with and without controls. Our findings reveal heterogeneity across age groups, suggesting that although employment is impacted, it does not affect all women equally. Young women experience a significant impact from an increase in remittances, leading to a decrease in female employment in the first three age ranges. Specifically, as shown in Column I for the full sample with controls, a 1% increase in remittances results in a reduction of 0.0688 percentage points in employment for women aged 15-20, which translates to a 1.91%[11]. For women aged 20-25, the reduction is 0.1602 percentage points or 0.93%. For women aged 25-30, there is a marginally significant reduction of 0.1602 percentage points, translating to 0.66%. Women in their 30s are unaffected; however, for women in their 40s and 50s, a 1% increase in remittances per capita corresponds to a significant reduction in employment ranging from 0.1177 to 0.1622 percentage points, or 0.52% to 1.09%.

We couldn't find previous literature that mentions these heterogeneous changes in the effect of remittances among different age ranges of women in Mexico as explicitly as we see here. This adds significant value to this research.

[11] To estimate the effect on women's employment in percentage (considering employment per capita for the age group 15-20), we calculate $\frac{-0.0688}{0.0361} = -1.91$ using the means described in Table 1.

7. Robustness Checks

One possible limitation of our study is that it covers the period from 2013 to 2023. This period includes the beginning of the COVID-19 pandemic, during which there was an extremely large downturn in formal sector employment. Therefore, there is some uncertainty as to whether the effects found in the results of Section 6 also stem from this event. Consequently, we conducted the same estimations excluding the period from the second quarter of 2020 and all of 2021, as this was the time with the most significant negative shock.

In our analysis, the descriptive statistics for the periods excluding the pandemic are presented in Table 14 in the appendix. A key observation from the data is that the average values, when the pandemic years are excluded, remain largely consistent with those observed during the entire 2013 to 2023 period.

As evidenced by the regressions conducted during these periods, which are detailed in Table 5, the first stage of our analysis consistently maintains its statistical significance, similar to the results obtained for the full period as discussed in the previous section. The magnitudes of these effects are similar to those observed earlier. This consistency not only substantiates the robustness of our model but also reinforces the reliability of our findings across different time frames.

Table 5. First Stage. Elasticity of remittances with respect to unemployment exposure. Municipal-level regressions

	Full Sample			Restricted Sample		
US unemployment	I	II	III	I	II	III
Coefficient	-0.661**	-0.744***	-0.650***	-0.932***	-1.081***	-0.978***
Std. Error	(0.279)	(0.285)	(0.265)	(0.387)	(0.390)	(0.353)
Observations	38,813	38,813	38,813	12,506	12,506	12,506

The data covers each quarter from 2013 to 2023, excluding the second quarter of 2020 and all quarters of 2021. Robust standard errors, clustered at the municipal level, are shown in parentheses. All results include fixed effects for municipality and time. Specification I contains no controls; specification II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; specification III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. Levels of significance are denoted as *** p<0.01, ** p<0.05, * p<0.1

Table 6 displays the regression results as presented in Table 3. The results are significant only for women, with effect magnitudes comparable to the coefficients reported in the main results.

Specifically, a 1% increase in per capita remittance income causes a reduction in formal employment for women by between 0.0731 and 0.0841 percentage points, translating to 0.66% and 0.73% for the full sample. For the restricted sample, the reduction ranges from 0.0483 to 0.0504 percentage points, or 0.43% to 0.56%. Here, the Anderson-Rubin Wald Test clearly indicates that the high Chi-squared value and the very small P-value ($P<0.01$) strongly suggest rejecting the null hypothesis, assuming correct model specification and valid instruments. Additionally, this highlights the statistical significance of our findings regarding women's employment.

Similar results to previous ones are obtained when we examine the coefficients by age after excluding the pandemic period. In Table 7 we note that the coefficients in the first row of the Second Stage are significant in all four specifications, both with and without controls. The impact of a 1% increase in remittances ranges between 0.0631 and 0.0742 percentage points. This implies that an increase in remittances of this magnitude can reduce the labor force participation for women aged 15 to 20 by 1.91% to 2.06%. Comparing the results for these ages with the table from the previous section, which included all periods, we realize that the values here, which omit the period with the strongest shock caused by the pandemic, likely indicate that remittances have a larger effect on the economy when extreme events like the pandemic are excluded. This suggests that the positive effects of remittances on economic variables may be underestimated for this age range during crisis periods. We can say that the analysis excluding the pandemic period provides a clearer focus on the long-term impact of remittances by eliminating extreme temporary fluctuations and focusing on trends that we might consider more consistent.

The values for the second age group are also significant and negative. However, with controls, our coefficients become marginally significant. We can conclude that a 1% increase in remittances per capita can decrease formal employment for women by between 0.1357 and 0.1055 percentage points, or 0.64% and 0.89% for ages 20 to 25.

Table 6: Effect of Remittances on Employment: A 2SLS Analysis

	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Panel A: Formal employment (per capita)						
Coefficient	-0.0593*	-0.0474*	-0.0506*	-0.0441*	-0.0317*	-0.0359**
Std. Error	(0.035)	(0.025)	(0.029)	(0.024)	(0.018)	(0.021)
F-stat.	9.45	12.77	12.7	10.59	12.76	12.44
Anderson-Rubin Wald test						
Chi-sq(1)	5.26	4.82	4.43	4.62	3.18	3.25
P-val	0.0218	0.0281	0.0354	0.0317	0.0743	0.0715
Panel B: Women's formal employment (per capita)						
Coefficient	-0.0841**	-0.0731**	-0.0765**	-0.0640***	-0.0483***	-0.0504***
Std. Error	(0.043)	(0.032)	(0.037)	(0.027)	(0.018)	(0.020)
F-stat.	9.65	12.41	11.93	10.04	12.61	12.06
Anderson-Rubin Wald test						
Chi-sq(1)	15.97	15.87	14.91	21.68	16.11	14.63
P-val	0.000	0.000	0.000	0.000	0.001	0.001
Panel C: Men's formal employment (per capita)						
Coefficient	-0.0331	-0.0251*	-0.03	-0.0252	-0.0173	-0.0255
Std. Error	(0.035)	(0.028)	(0.032)	(0.030)	(0.025)	(0.029)
F-stat.	12.33	16.5	16.48	12.56	14.95	14.6
Anderson-Rubin Wald test						
Chi-sq(1)	0.97	0.78	0.84	0.7	0.45	0.76
P-val	0.3251	0.3778	0.3592	0.4032	0.5011	0.3818
Observations	38,813	38,813	38,813	12,506	12,506	12,506

The data covers each quarter from 2013 to 2023, excluding the period from the second quarter of 2020 through all quarters of 2021. Robust standard errors clustered at the municipal level are in parentheses. I contains no controls; II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. Panel A presents the total number of jobs affiliated with the IMSS, divided by the total population. Panel B shows the same for women, relative to the total female population, and Panel C for men, relative to the total male population. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Effect of Remittances on Women's Employment by Age

	I	II	III	IV
First Stage: Level of remittances per capita (log)				
Unemployment exposure (log)				
Coefficient	-0.651**	-0.929***	-0.661**	-0.9232**
Std. Error	0.268	0.362	0.279	0.387
Second Stage. Dependent Variable: Women's employment (per capita)				
Remittances per capita (log)				
15 to under 20	-0.0704**	-0.0631***	-0.0742**	-0.0675***
	(0.035)	(0.023)	(0.039)	(0.028)
20 to under 25	-0.1357*	-0.1055**	-0.1522*	-0.1251**
	(0.074)	(0.051)	(0.085)	(0.063)
25 to under 30	-0.1378	-0.0652	-0.1603	-0.1049*
	(0.089)	(0.023)	(0.095)	(0.031)
30 to under 35	-0.0932	-0.0039	-0.1166	-0.037
	(0.089)	(0.023)	(0.095)	(0.031)
35 to under 40	-0.1374	-0.0499	-0.1428	-0.0694
	(0.099)	(0.034)	(0.102)	(0.044)
40 to under 45	-0.1208	-0.0697*	-0.1266*	-0.0906*
	(0.066)	(0.036)	(0.069)	(0.047)
45 to under 50	-0.1083*	-0.0883**	-0.1292**	-0.1200**
	(0.053)	(0.042)	(0.063)	(0.057)
50 to under 55	-0.1786**	-0.1201**	-0.1948**	-0.1390**
	(0.084)	(0.047)	(0.092)	(0.059)
55 to under 60	-0.1327**	-0.0950***	-0.1529**	-0.1159**
	(0.059)	(0.034)	(0.069)	(0.046)
60 to under 65	-0.0122	-0.0092*	-0.0186	-0.0142**
	(0.012)	(0.005)	(0.013)	(0.007)
65 to under 70	-0.0042	-0.0025	-0.0075	-0.0047
	(0.005)	(0.003)	(0.005)	(0.004)
70 to under 75	0.0021	0.0025	0.0002	0.0014
	(0.003)	(0.004)	(0.003)	(0.004)
75 and over	0.0026	0.0018	0.0019	0.0013
	(0.002)	(0.001)	(0.002)	(0.001)
Observations	38,813	38,813	12,506	12,506
Full sample	✓		✓	
Restricted sample		✓		✓
Controls	Yes	Yes	No	No

The data covers each quarter from 2013 to 2023, excluding the period from the second quarter of 2020 through all quarters of 2021. Robust standard errors clustered at the municipal level are in parentheses. Municipal regressions are run on 1049 municipalities for the full sample and 338 municipalities for the restricted sample. Each row represents a regression analysis with the dependent variable being the number of IMSS-affiliated jobs held by women in each age range, divided by the total number of women in that age group. This model includes all controls added in the third specification, as shown in the previous tables. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

In these findings, we do not observe a significant causal effect in the 40-45 age range as previously noted. However, significant effects are found for the subsequent age ranges. Considering the results from the full sample with controls, we can conclude that a 1% increase in remittances per capita reduces formal female employment by 0.0883 percentage points or 0.63% for ages 45-50, 0.1201 percentage points or 1.2% for ages 50-55, and 0.0950 percentage points or 1.13% for ages 55-60.

With all these results in mind, we can say that even excluding the pandemic period from our analysis confirms the stability of our results and enhances the credibility of our conclusions. By accounting for potential anomalies introduced by the COVID-19 pandemic, we ensure that our findings regarding the effects of remittances on employment are robust and indicative of consistent patterns across different economic conditions.

8. Possible Mechanisms

Is it possible that the estimated effects are simply due to supply reasons, where an increase in migration is observed, and the relationship is solely due to women and men who are no longer in the market because they moved to the USA? By including the migration intensity index in our analysis, we adjust for variations in migration levels between municipalities, considering both departing and returning migrants who can influence the local labor market. This approach helps us better capture potential bias and ensure that the observed differences in results are due to the factors of interest, like remittances, rather than just the movement of working-age individuals in and out of the country. This control reduces bias associated with the labor supply, compensating for decreases due to individuals moving from Mexico to the USA.

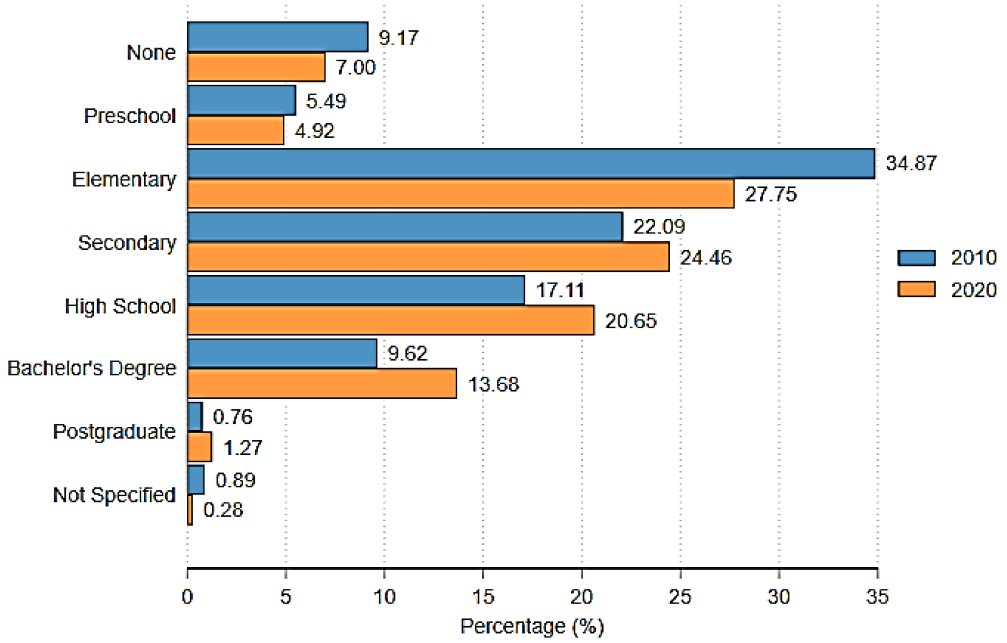
Additionally, the effects we estimate are weighted by the population reported in the 2010 and 2020 population and housing censuses, as well as the intercensal survey 2015, imputing missing values using the same growth rate. This weighting also accounts for changes in population, providing an approximation of the influences that changes in this distribution might have. We will analyze two mechanisms that have been highlighted in the literature, allowing us to determine if there is more to the relationship between remittances and the formal labor market than simply a supply shift due to workers moving to another country.

If there is a significant impact of remittances on education or the informal labor market, we can infer that the results reflect effects on those who remain and receive remittances, as they are the ones who would engage in educational activities or work in the informal market.

8.1. Increase in Educational Level

One contributing factor to the increasing trend of women exiting the labor market upon receiving remittances may be that these financial resources enable young women to pursue further education. Utilizing population and housing census data from 2010 to 2020 for the municipalities, we observe in Figure 8.1 a clear trend: women are becoming more educated. Over this decade, there has been a decline in the percentage of women with no education, or only preschool and elementary education. Conversely, there has been a significant increase in the proportion of women attaining higher educational levels, including secondary school and beyond, extending through high school and into undergraduate and postgraduate studies.

Figure 8.1: Educational Level of the Female Population



Source: Own elaboration based on data from the Population and Housing Census (2010; 2020), INEGI. The bars represent the total number of women aged 15-25 at each educational level, expressed as a percentage of the total female population within this age group.

To investigate whether remittances are facilitating educational advancement, we conducted a panel regression analysis using the two most recent INEGI population and housing censuses, covering the years 2010 and 2020. Here, we employ the average cumulative educational attainment as the dependent variable for women aged 15 to 25.[12] The independent variable is the per capita remittances received by each municipality in each of the two years, with both variables expressed in logarithmic form. This approach allows us to interpret the relationship between these variables as an elasticity. It is important to note that we do not use our instrument in this case because it is weak when applied to the shorter two-year period, as opposed to the original eleven years.

In the full sample, remittances have a positive and statistically significant effect on education, both when other variables are not controlled for (Model I) and when they are (Model II). In other words,

[12] We use the variable ESCOACUM, which classifies the educational level achieved based on the number of grades completed, ranging from "no schooling" (0 grades completed) to "doctorate" (24 grades completed).

an increase in remittances is associated with an increase in education. In the restricted sample, the effect of remittances on education, while still positive, is not statistically significant. This means that in this subset of the sample, it cannot be stated with a high level of confidence that remittances have a positive or negative impact on education. It is possible that the restricted sample has specific characteristics that affect the relationship between our two variables, remittances and education. We know that the full sample includes a larger variety of municipalities, from very small to very large (population less than 50,000 and greater than 1,000,000), while in our restricted sample, we remove these municipalities. In municipalities with intermediate populations, access to educational services may be different compared to very small or very large municipalities. Regions with populations greater than 50,000 people may have more resources and better educational infrastructure, while rural areas may rely more on remittances to finance education. Therefore, when these are removed, the impact becomes non-significant.

Table 8: Effect of Remittances on Education: Panel Data Regression Analysis for Different Age Groups

	Average cumulative educational attainment			
	Full Sample		Restricted Sample	
	I	II	I	II
Coef	0.0306***	0.0145***	0.0219	0.0066
Std. error	(0.005)	(0.008)	(0.015)	(0.011)
R-squared	0.723	3.57	0.722	0.793
Observations	2,310	2,310	664	664
Controls	No	Yes	No	Yes

We consider the population and housing census data for the years 2010 and 2020. For the first year, remittance data from 2013 (the first available year for municipalities) is matched. For the second year, data from 2020 is matched. This table presents the estimated coefficients from four regression models, with and without control variables. The specification with controls includes ATMs per 10,000 adults each quarter of the period and, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area, the migration intensity index from Mexico to the United States, and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. Robust standard errors clustered at the municipal level are in parentheses. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

We must interpret our regression results with caution due to potential endogeneity among the variables analyzed. Additionally, the instrument employed to address this issue in our previous

analyses may not be sufficiently robust given the brief two-year period under study (P-value=0.483 for the full sample; P-value=0.376 for the restricted sample).[13]

Empirically, some literature supports this mechanism, as Arif and Raza et al. (2019), using data from 1994 to 2013 and focusing on the top eight middle-income countries receiving remittances (Bangladesh, India, China, Egypt, Pakistan, the Philippines, Nigeria, and Mexico), conclude that remittances play a significant role in the development of tertiary education. Employing a Pooled Mean Group (PMG) estimator, the study finds that remittances have a positive and significant impact on the development of higher education in the long run. Similarly, SeyedSoroosh Azizi (2018) demonstrates that remittances have a positive and statistically significant impact on education across 122 developing countries, including Mexico. The study's findings reveal that, on average, a 10% increase in per capita remittances results in a 3.5% rise in primary enrollment rates, a 0.7% increase in secondary enrollment rates, and a 1.1% increase in tertiary enrollment rates. Notably, the same 10% increase in per capita remittances leads to a 1.3% increase in girls' tertiary enrollment rates, while it shows no statistically significant effect on boys' tertiary enrollment rates.

Additionally, Antman (2012) uses data from Mexico to examine how international parental migration differentially affects sons and daughters in terms of education. She finds that the father's migration has a notable impact on increasing the likelihood that daughters continue their studies beyond the secondary level, particularly in contexts where women have traditionally had less access to education. These results suggest that the marginal dollars from US migrant remittances appear to enable families to further educate their daughters. Additionally, in the context of Mexico, Cuecuecha (2009) employs three instruments: the 1997 state migration rate, the 2000 municipality migration rate, and the 2000 municipality fraction of households receiving remittances. The study demonstrates that the combined effect of migration and remittances on households with recent migrants (those who left less than five years ago) is both positive and significant. Specifically, migration and remittances contribute to an increase of 5.7 years in the educational attainment of individuals aged 12 to 19, compared to a counterfactual scenario in which these individuals would not have access to remittances or have migrant family members.

[13] The instrument generated for our previous results is not ideal and significant to estimate the first stage for this only two-year period.

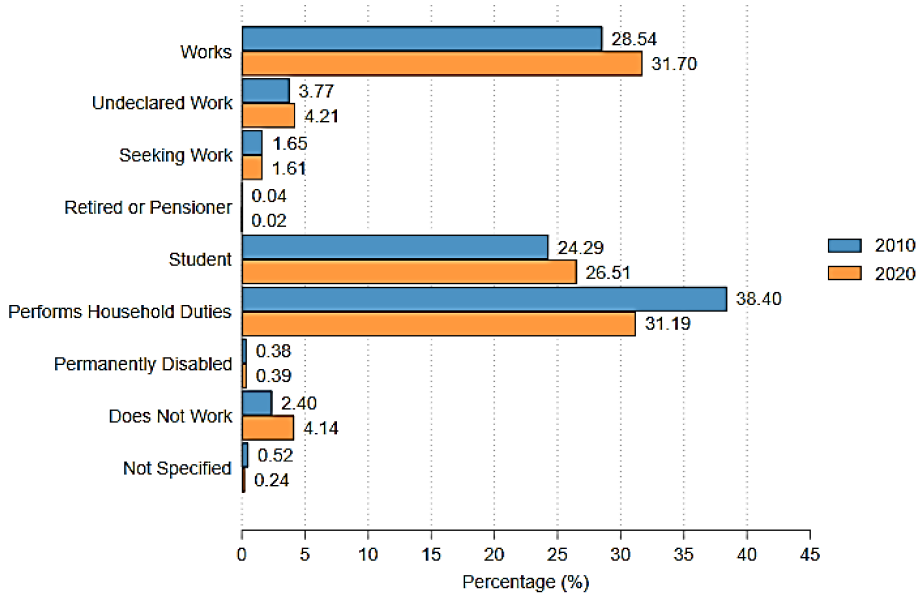
8.2. Informality

Using the same data as before, the last two population and housing censuses from 2010 and 2020 can be used to observe how the activity conditions of women have changed by age groups in municipalities with higher remittances per capita. For the first age range, as shown in figure 8.2a, the proportion of women participating as students has increased, suggesting that women are becoming increasingly educated in the fifteen municipalities with more remittances per capita. This is consistent with our previous finding that remittances are contributing to higher educational attainment among women.

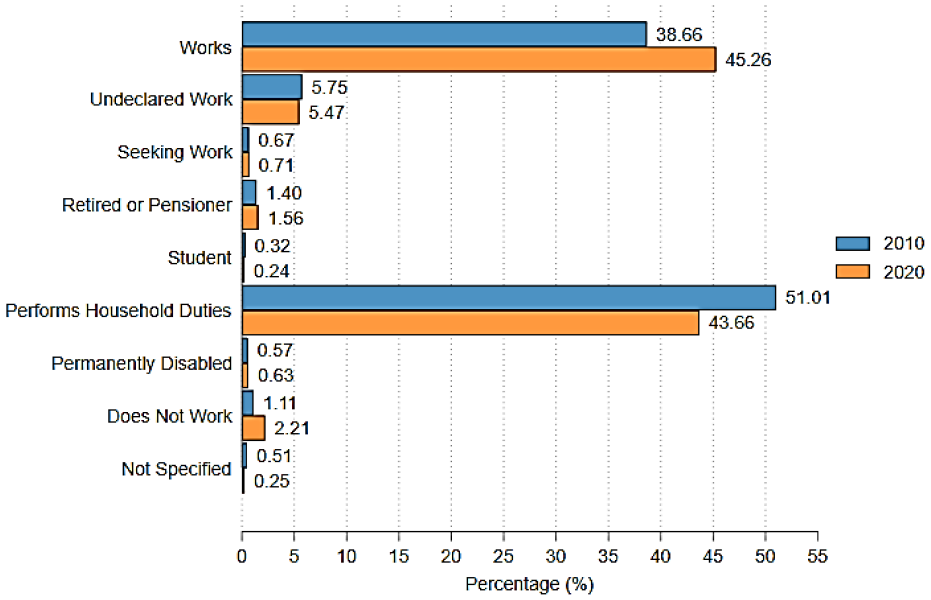
Additionally, the proportion of women who report having worked has increased across all age ranges, although this does not provide information about the (in)formality of the work. These activities include working at least one hour the week prior to the survey, participating in the production and sale of agricultural or manufactured products, providing services across various sectors, working in construction, receiving any type of payment, and getting involved in businesses or undertaking professional internships and social services. They encompass both paid and unpaid work. Moreover, undeclared work has been increasing among women aged 15 to 30. This type of work is typically viewed as "not work" because it is conducted for a brief part of the day and is considered a secondary activity. It involves tasks such as helping in a business, whether family-owned or not; selling products; manufacturing goods for sale; assisting in agricultural or livestock tasks; performing services in exchange for payment, such as laundry or childcare; or participating as an apprentice or in social service activities. Although the category "Does not work" is not one of the main categories, the proportion of women in this condition has also grown when comparing these two years.

Figure 8.2: Activity Condition of Females

a) Women aged 15-30



a) Women aged 31-60



Source: Own elaboration based on data from the Population and Housing Census (2010; 2020), INEGI. The bars represent the total number of women in each age group. expressed as a percentage of the female population in the respective age group.

It is possible that women are leaving formal employment because they are entering informal jobs or creating their own family micro-enterprises, for which they likely will not receive social security initially. To investigate this further, we use the 2010 and 2020 census data to run a panel regression, maintaining fixed effects for time and individuals. In this analysis, our dependent variable is the proportion of women who work but do not have social security. As in the first mechanism, it is important to highlight that we do not use our instrument in this instance because it proves to be weak when applied to the shorter two-year period, compared to the original eleven years.

The findings of these regressions, presented in Table 9, indicate that for the full sample, there is no significant effect. However, this is not the case for the restricted sample (municipalities with more than 50,000 people and less than 1,000,000), where the coefficients are significant at the 1% level and have a positive impact. This is observed in both age ranges: for women aged 15 to 60, representing the typical working age group, and for women aged 40 to 60, the age range significant in our previous results, (as indicated in Table 7) excluding young women who also show a positive effect on education. We found similar results in both age ranges.

Table 9: Effect of Remittances on Informality: Panel Data Regression Analysis for Different Age Groups

	Full Sample		Restricted Sample	
	I	II	III	IV
Panel A: Mujeres de 15 a 60 años				
Coef	0.0011	-0.0001	0.0115***	0.0098***
Std. error	(0.001)	(0.001)	(0.004)	(0.004)
R-squared	0.311	0.339	0.306	0.328
Panel B: Mujeres de 40 a 60 años				
Coef	0.0024*	0.0007	0.0129***	0.0101**
Std. error	(0.001)	(0.001)	(0.004)	(0.004)
R-squared	0.210	0.238	0.218	0.252
Observations	2,310	2,310	664	664
Controls	No	Yes	No	Yes

We consider the population and housing census data for the years 2010 and 2020. For the first year, remittance data from 2013 (the first available year for municipalities) is matched. For the second year, data from 2020 is matched. This table presents the estimated coefficients from four regression models, with and without control variables. The specification with controls includes ATMs per 10,000 adults each quarter of the period and, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), the migration intensity index from Mexico to the United States, the percentage of the population over 15 years old with secondary education, and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. Robust standard errors clustered at the municipal level are in parentheses. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

The differences depending on the sample selected can occur because municipalities within the restricted sample may have more resources and better infrastructure than smaller municipalities, which could amplify the positive effects of remittances on informal employment. In larger municipalities, remittances might be used to support small businesses or entrepreneurial activities that fall within the informal sector. Conversely, in smaller municipalities, the relationship between remittances and informal employment might be diluted by other economic factors or less significant due to lower population density and economic activity. Excluding very small regions, we can say that larger municipalities might have more dynamic labor markets where informal employment is more prevalent due to a higher demand for flexible labor. Remittances could provide the capital needed for individuals to participate in these informal opportunities. Moreover, in municipalities with higher populations, the cost of living might be higher, making remittances more crucial for sustaining livelihoods. This necessity can drive individuals towards informal employment, where they can quickly generate income. Larger municipalities might offer better access to informal networks and markets, making it easier for remittance recipients to engage in informal economic activities. These networks can provide support and opportunities that are less accessible in smaller municipalities (population<50,000).

Empirical research has established a positive relationship between informality and the remittances received by households. Woodroff and Zenteno (2001) observed that remittances imply a positive and significant impact on business ownership across genders. They also discovered that the level of invested capital is higher in states with greater migration to the U.S., whether measured by migration rates or remittance levels. In the same line, Massey and Prado (1998) found that at the household level, an increase in the logarithm of current migradollars boosts the likelihood of business investment by 16%. Typically, the businesses established are small retail enterprises that generate limited employment. Wholesale activities, however, are more likely chosen by households owning land and led by current U.S. migrants, particularly when these households include educated family members. In a model estimated by Cox and Rodríguez (2009), a notable effect of remittances was observed among urban women in states with low migration rates. They suggest that remittances may improve labor market opportunities for women in these regions, possibly through the initiation of family enterprises.

9. Summary of findings

In this section, we discuss the key findings from our empirical analysis. Our models have been carefully adjusted to control for potential endogeneity biases, improving the robustness of our results. Our analysis reveals a significant negative causal relationship between remittances and formal employment. Specifically, a 1% increase in per capita remittance income leads to a reduction in formal employment by 0.27% to 0.38%. This effect is more pronounced for women, with reductions ranging from 0.46% to 0.69%, while for men, the negative effect is observed but not statistically significant. These findings suggest that remittances might provide financial support that reduces the necessity for formal employment, particularly among women. We observed heterogeneity in the impact of remittances across different age groups. Young women (aged 15-30) experienced significant reductions in formal employment due to increased remittances. Specifically, employment reductions were 0.19% for women aged 15-20, 0.93% for those aged 20-25, and 0.66% for women aged 25-30 with a marginal significance. Women in their 40s and 50s also showed significant reductions in employment, ranging from 0.52% to 1.09%. These results suggest that remittances may enable young women to pursue further education or other activities outside formal employment, while middle-aged women may be using remittances to support household or informal economic activities.

The relationship between remittances and formal employment is strong and consistent across different specifications, representing the validity of our findings. By excluding the pandemic period, we ensured that our results were not excessively influenced by the economic disruptions caused by COVID-19. This allows us to reinforce the reliability of our conclusions.

Although our results are not directly comparable with some previous studies from Mexico due to differences in outcome measures (such as the probability of working or hours worked instead of formal employment measured by labor force participation), we can compare the signs, methodologies, and periods.

Starting with López-Feldman et al. (2017), both studies employ an instrumental variable (2SLS) approach to address the endogeneity of remittances. They use early 20th-century railway lines as their instrument, while we use Mexican unemployment exposure in the destination country. Both

studies examine labor market outcomes and separately analyze the effects of remittances on men and women. López-Feldman et al. found that a MXN 1000 increase in remittances decreases men's annual work hours by 334 hours, significantly reducing both the likelihood of men working and their total work hours. For women, they found no significant impact on labor participation. In contrast, our findings show that remittances significantly reduce formal employment, especially for women. López-Feldman et al. utilize 2007 data from the Mexico National Rural Household Survey, focusing on rural communities, whereas our study covers a broader range of Mexican municipalities.

Amuedo-Dorantes and Pozo (2006) also use an instrumental variable approach, utilizing the number of Western Union offices in the previous year as their instrument, compared to our use of unemployment shocks in the U.S. Both studies analyze labor market outcomes by gender. Using data from the ENIGH 2002 and applying an IV-Tobit model, they found that remittances can either reduce or increase work hours depending on gender, household location, and job type. Women in rural areas reduce informal and unpaid work, while men shift from formal to informal employment. Our study finds that remittances reduce formal employment overall, with a more pronounced negative effect on women's employment.

As we mentioned before, Orrenius et al. (2010) found a positive relationship between remittances and formal-sector employment. They employ wage shocks and analyze data from 2003 to 2007 at the state level, whereas we focus on the municipal level, providing a more detailed view of the impacts.

Comparing all the previous periods, our study spans a longer and more contemporary period from 2013 to 2023. This allows us to capture more recent effects and changes in remittance patterns and their impacts on employment, reflecting contemporary trends in the labor market.

10. Conclusions

The level of remittances received in Mexico has risen to record levels since 2013. Have these resources impacted the labor market in Mexico's municipalities? This study investigates how remittances per capita can influence the proportion of people in formal employment. Using instrumental variables to address endogeneity and a quarterly panel dataset from 2013 to 2023, we conclude that labor force participation has changed due to this increase in remittances. In particular, women's employment has been affected. The next question is why women leave their jobs as a result of remittances. It is likely that some leave formal employment to pursue higher education, particularly young women. Additionally, both young and adult women might leave formal jobs to enter the informal sector and start their own businesses, as suggested by previous literature from Mexico and other developing countries. Both mechanisms indicate that remittances can alleviate the financial constraints faced by women, highlighting a need for further investigation into this phenomenon.

The existing literature generally finds varied impacts on labor market outcomes, both overall and by gender, in Mexico. It is important to note that our study, which uses data from 2013 to 2023, may yield different results due to the substantial growth in remittances during this period. Our findings indicate a significant overall reduction in formal employment, particularly for women, who may be entering the informal sector or delaying their departure from school.

The findings of this study can have significant implications for policymakers. If the shift from formal to informal employment among women occurs, or if women are becoming entrepreneurs, it could impact the overall structure of the labor market. The informal sector often lacks the protections and benefits associated with formal employment, which could result in a precarious economic situation for those who transition to informal work, despite the immediate alleviation of financial constraints provided by remittances. On the other hand, if women pursue higher education, it can lead to personal and economic growth. The movement of women into higher education suggests a potential long-term benefit for the economy and better opportunities for this gender. However, this also raises questions about whether the job market can later accommodate a more highly educated workforce. Both mechanisms present open questions that future investigations in Mexico can address.

Lastly, we would like to point out that one of the limitations of this study concerns the mechanisms involved. It is important to note that our main dependent variable, measured by the proportion of workers in formal employment, faced the problem of endogeneity. To address this issue, we used instrumental variables. However, for the analysis of mechanisms, which used the accumulated school grades and the proportion of people working in the informal market (both of which can also have endogeneity problems) we did not use the instrument because it was weak for these two specific and annual periods. Future research is recommended to utilize alternative datasets or methods that can better support these results.

11. Appendix

Table 10: Data Description and Sources

Variable	Description of Variable	Source
Remittances	Income for remittances	Banco de México www.banxico.org.mx
Formal Employment	Jobs affiliated with IMSS (insured jobs or insured associated with a job).	Instituto Mexicano del Seguro Social www.imss.gob.mx
Unemployment Rate in the U.S.	Unemployment Rate (Not Seasonally Adjusted) at the State Level in the U.S.	Bureau of Labor Statistics www.data.bls.gov
Proportion of individuals in poverty	Percentage of people vulnerable due to social deprivation in 2010	Consejo Nacional de Evaluación de la Política de Desarrollo Social www.coneval.org.mx
Presence of economic units	An establishment (ranging from a small shop to a large factory) that is permanently located in a place and defined by fixed constructions and facilities.	Instituto Nacional de Estadística y Geografía www.inegi.org.mx
Portion of people with secondary education	Percentage of people aged 15 or older with secondary education in 2010, relative to the total population within this age range	Sistema Nacional de Información Municipal www.snim.rami.gob.mx
Migration intensity index	Index of migration intensity between Mexico and the United States per municipality in 2010.	Consejo Nacional de Población www.conapo.segob.gob.mx
Number of ATMs per 1,000 people	Measurement of financial infrastructure by the number of ATMs per 1,000 people. Data is updated quarterly.	Comisión Nacional Bancaria y de Valores www.gob.mx/cnbv

Note: All variables at municipality level unless otherwise noted

Table 11: Average Portion for Women's Employment by Age

Age Group	I	II	III	IV
15 to under 20	0.0361	0.0331	0.0359	0.033
	(0.038)	(0.033)	(0.038)	(0.034)
20 to under 25	0.1719	0.1648	0.1709	0.1643
	(0.148)	(0.128)	(0.147)	(0.127)
25 to under 30	0.2448	0.2372	0.2444	0.2374
	(0.206)	(0.177)	(0.205)	(0.177)
30 to under 35	0.2394	0.2333	0.2388	0.2333
	(0.204)	(0.179)	(0.204)	(0.179)
35 to under 40	0.2257	0.2199	0.225	0.2196
	(0.197)	(0.174)	(0.197)	(0.175)
40 to under 45	0.2083	0.2034	0.2081	0.2036
	(0.181)	(0.160)	(0.181)	(0.161)
45 to under 50	0.1915	0.1853	0.1912	0.1853
	(0.168)	(0.147)	(0.169)	(0.148)
50 to under 55	0.1486	0.1408	0.1478	0.1401
	(0.133)	(0.112)	(0.133)	(0.112)
55 to under 60	0.1173	0.1094	0.1168	0.1089
	(0.104)	(0.085)	(0.104)	(0.086)
60 to under 65	0.0514	0.0474	0.0516	0.0477
	(0.044)	(0.035)	(0.045)	(0.036)
65 to under 70	0.0191	0.0177	0.0192	0.0177
	(0.018)	(0.015)	(0.018)	(0.015)
70 to under 75	0.0088	0.0079	0.0089	0.008
	(0.010)	(0.008)	(0.011)	(0.009)
75 and over	0.0042	0.0034	0.0042	0.0034
	(0.008)	(0.005)	(0.009)	(0.005)
Observations	46156	14872	38813	12506
Full Period	✓	✓		
Excluding Pandemic Years			✓	✓
Full Sample	✓	✓		
Restricted Sample			✓	✓

This table shows the percentage of women in the formal labor force, categorized by age range.

Table 13: Effect of Remittances on Women's Employment: An OLS Analysis

	Women's employment (per capita)					
	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Coefficient	-0.0011**	-0.0009*	-0.0003	-0.0018**	-0.0020**	-0.0011
Std. Error	(0.0004)	(0.0005)	(0.0005)	(0.0008)	(0.0008)	(0.0009)
F-stat.	11.69	13.83	14.29	12.12	12.81	12.62
R-squared	0.39	0.41	0.44	0.39	0.41	0.44

The data covers each quarter from 2013 to 2023. Robust standard errors clustered at the municipal level are in parentheses. Municipal regressions are run on 1049 municipalities for the full sample and 338 municipalities for the restricted sample. Specification I contains no controls; specification II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; specification III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

Table 13: Effect of Remittances on Women's Employment: An OLS Analysis
Restricted period considering the pandemic

	Women's employment (per capita)					
	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Coefficient	-0.0011**	-0.0010*	-0.0003	-0.0019**	-0.0021**	-0.001
Std. Error	(0.0004)	(0.0005)	(0.0005)	(0.0008)	(0.0008)	(0.0009)
F-stat.	12.14	12.97	13.43	13.45	14.13	13.35
R-squared	0.4	0.43	0.46	0.4	0.42	0.46

The data covers each quarter from 2013 to 2023, excluding the second quarter of 2020 and all quarters of 2021. Robust standard errors clustered at the municipal level are in parentheses. Municipal regressions are run on 1049 municipalities for the full sample and 338 municipalities for the restricted sample. Specification I contains no controls; specification II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; specification III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1

Table 14: Data and Descriptive Statistics Excluding the COVID-19 Pandemic Period

	Full Sample		Restricted Sample	
Variable	Mean	SD	Mean	SD
Remittances per Capita	84.4383	105.19	78.3468	87.452
Formal Employment for Women per Capita	0.115	0.099	0.1105	0.085
Formal Employment for Men per Capita	0.1937	0.155	0.1888	0.137
Total Formal Employment per Capita	0.1543	0.126	0.1496	0.109
Formal Employment for Women as a Proportion of Women Aged 15-65	0.1838	0.146	0.1689	0.125
Formal Employment for Men as a Proportion of Women Aged 15-65	0.2861	0.225	0.2798	0.198
Total Formal Employment as a Proportion of Women Aged 15-65	0.2409	0.183	0.2261	0.159
Unemployment Exposure Rate for Mexicans in the U.S.	4.9251	1.349	4.8977	1.33
ATMs per 1,000 People	5.6662	3.859	5.7845	3.637
Migration Intensity Index	30.1728	1.704	30.331	1.612
Per Capita Gross Census Value Added	0.0434	0.149	0.0495	0.183
Economic Units per Capita	0.0352	0.012	0.0353	0.012
Percentage of the Vulnerable Population	28.4519	7.081	28.2937	6.739
Population Density	1617.772	3017.34	1415.474	2527.115
Proportion of Individuals Aged 15 or Older with Secondary Education	0.2217	0.039	0.2245	0.039
Observations	38813		12506	

SD denotes standard deviation. Each value under the "Mean" and "SD" columns represents the mean and standard deviation for the respective samples. Each value is calculated considering quarters from 2013 to 2023, excluding the second quarter of 2020 and all quarters of 2021.

Table 15: First Stage. Elasticity of remittances with respect to unemployment exposure. Municipal-level regressions

US unemployment (squared)	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Coefficient	-0.319***	-0.334***	-0.287***	-0.464***	-0.509***	-0.456***
(Std. Error)	(0.115)	(0.118)	(0.110)	(0.166)	(0.168)	(0.150)
Observations	46,156	46,156	46,156	14,872	14,872	14,872

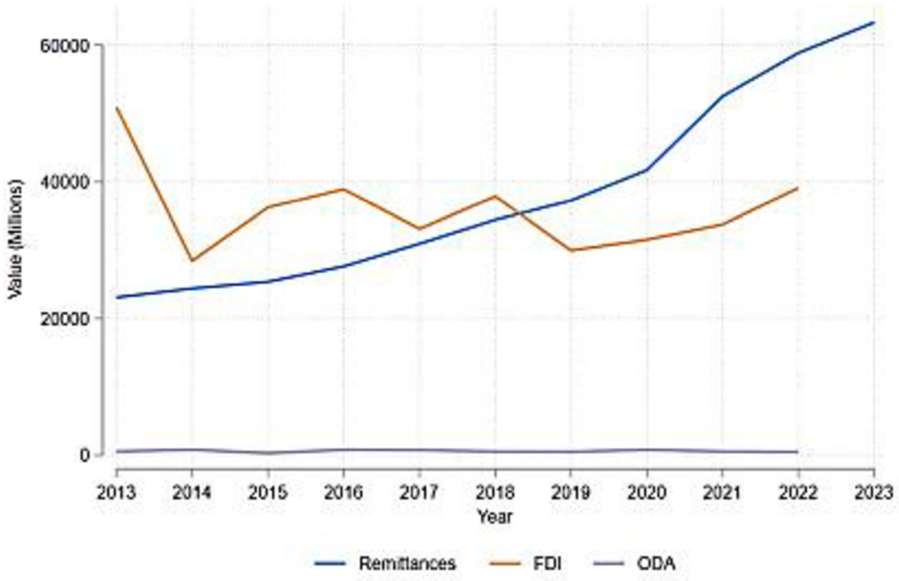
The data covers each quarter from 2013 to 2023. Robust standard errors, clustered at the municipal level, are shown in parentheses. All results include fixed effects for municipality and time. Specification I contains no controls; specification II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; specification III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. All variables, except for population density, were used as provided directly in the databases. Levels of significance are denoted as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: Effect of Remittances on Employment: A 2SLS Analysis (Instrumental Variable: US unemployment squared)

	Full Sample			Restricted Sample		
	I	II	III	I	II	III
Panel A: Formal employment (per capita)						
Coefficient	-0.0655**	-0.0584**	-0.0599**	-0.0441*	-0.0381**	-0.0471**
Std. Error	(0.030)	(0.025)	(0.029)	-0.024	(0.016)	(0.021)
F-stat. Anderson-Rubin Wald test	9.30	12.29	12.7	10.59	11.99	10.10
Chi-sq(1)	11.05	10.62	4.43	4.62	6.43	7.62
P-val	0.0009	0.0011	0.0354	0.0317	0.0011	0.0058
Panel B: Women's formal employment (per capita)						
Coefficient	-0.0848**	-0.0773**	-0.0793**	-0.0603***	-0.0502***	-0.0511***
Std. Error	(0.035)	(0.031)	(0.036)	(0.022)	(0.017)	(0.018)
F-stat. Anderson-Rubin Wald test	10.26	12.67	12.18	9.72	10.85	10.59
Chi-sq(1)	23.52	23.89	19.50	25.36	21.89	18.91
P-val	0.000	0.000	0.000	0.000	0.000	0.000
Panel C: Men's formal employment (per capita)						
Coefficient	-0.0485	-0.0418*	-0.044	-0.0340	-0.0173	-0.0274
Std. Error	(0.029)	(0.025)	(0.030)	(0.025)	-0.025	-0.021
F-stat. Anderson-Rubin Wald test	10.49	14.92	16.48	11.58	14.95	13.63
Chi-sq(1)	3.63	2.57	0.84	1.89	0.45	1.60
P-val	0.0567	0.1092	0.3592	0.1694	0.5011	0.2062
Observations	38,813	38,813	38,813	12,506	12,506	12,506

The data covers each quarter from 2013 to 2023, excluding the period from the second quarter of 2020 through all quarters of 2021. Robust standard errors clustered at the municipal level are in parentheses. I contains no controls; II includes controls for ATMs per 10,000 adults each quarter of the period, and adds, interacted with the trend, the number of economic units in the municipality, population density (calculated by dividing the population of each municipality in 2010 by its area), and the migration intensity index from Mexico to the United States; III adds to these controls (interacted with the trend) the percentage of the population over 15 years old with secondary education and the percentage of people vulnerable due to social deprivation. Panel A presents the total number of jobs affiliated with the IMSS, divided by the total population. Panel B shows the same for women, relative to the total female population, and Panel C for men, relative to the total male population. All results include municipality and time fixed effects. Level of significance denoted as *** p<0.01, ** p<0.05, * p<0.1.

Figure 11.1: Dynamics of Monetary Flows to Mexico: Remittances vs. FDI vs. ODA



Source: Own elaboration using data from the World Bank. The orange line represents the value of Foreign Direct Investment, the lavender line represents Official Development Aid, and the blue line represents total remittances in Mexico (each flow in dollars). The period considered is from 2010 to 2023 (with the latter year not yet published in the data source for ODA and FDI).

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