NAFTA and Wage Inequality in Mexico:
An Analysis for Border Cities, 1992-2016*

TLCAN y desigualdad salarial en México:
Un análisis para las ciudades fronterizas, 1992-2016

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ABSTRACT

The purpose of this article is to evaluate the impact of the NAFTA on the labor market and wage inequality in border cities in the north of Mexico, emphasizing the variations among workers according to their qualifications and gender from 1992 to 2016. Using data from the National Survey of Urban Employment and the National Survey of Jobs and Employment, the micro-simulation methodology was applied. The results suggest that if the labor structure that existed before the consolidation of the commercial opening under NAFTA had stayed in place, the levels of wage inequality would have been lower than those observed in 2016.
    Keywords: 1. wage inequality, 2. work and gender classification, 3. NAFTA, 4. Mexico, 5. northern border.

RESUMEN

El propósito del artículo es evaluar el impacto del TLCAN sobre el mercado de trabajo y la desigualdad salarial en ciudades fronterizas del norte de México, enfatizando las variaciones entre trabajadores según su calificación y género durante el período que comprende de 1992 a 2016. Con datos de la Encuesta Nacional de Empleo Urbano y la Encuesta Nacional de Ocupación y Empleo, se aplica la metodología de microsimulaciones. Los resultados sugieren que, de haberse mantenido la estructura laboral que se tenía antes de la consolidación de la apertura comercial con el TLCAN, los niveles de desigualdad salarial serían inferiores a los realmente observados en 2016.
    Palabras clave: 1. desigualdad salarial, 2. calificación laboral y de género, 3. TLCAN, 4. México, 5. frontera norte.

INTRODUCTION

The North American Free Trade Agreement (NAFTA) allowed Mexico to achieve a level of openness of its economy above 50 percent, making it an important actor in global productive value chains, transforming the industrial structure, attracting greater flows of direct foreign investment, and positioning the United States as its main commercial partner. However, as a result of the expanded trade between both countries, the economic environment, and the current administration of our northern neighbor, the importance of NAFTA has come into question, as have its effects in the labor arena and the economic integration of the various entities of the Mexican republic. This is because not all the regions, cities, companies, and economic sectors have been able to effectively participate in international markets, and thus maximize job creation, improve wage levels, and reduce inequality in worker incomes (Garduño & Baylis, 2012; Tello & Ramos, 2012; de la Mora, 2015).

In accordance with the Heckscher-Ohlin neoclassical theory of international commerce and the Stolper-Samuelson theorem, it was expected that the liberalization of the Mexican economy would cause relative wages to increase for unskilled workers—its most abundant labor component—and also produce a reduction in inequality between workers with different skills (Stolper & Samuelson, 1941). Current scientific evidence suggests that foreign trade's effect on wages is unclear in the short term; consequently, these theoretical assumptions have not been fully validated. In this regard, the principal arguments involving the evolution of specific wage profiles of each state depend on the importance of territorial differentiation and the insufficiently lengthy time frame of the studies (Blecker, 2010; Pérez, 2014).

Given the above, the goal of this research is to evaluate the real impact of NAFTA on the labor market in the Mexican cities that traditionally have had a greater level of exposure to trade opening, that is, the cities or metropolitan areas in the states that share a border with the United States of America (U.S.A). Examined in particular will be the variations between workers according to their skill level and gender in the period between 1992 and 2016.

Using information from the National Survey of Jobs and Employment (Encuesta Nacional de Empleo Urbano, or ENEU) and the National Survey of Urban Employment (Encuesta Nacional de Ocupación y Empleo, or ENOE), the microsimulation methodology of Almeida dos Reis and Paes de Barros (1991) was applied. This method imposes survey data from a year before the entry into force of NAFTA on data from a year later to create a counterfactual scenario in which the signing of the treaty—and, ergo, this process of opening of the Mexican economy—

had not taken place. Through this method, it will be possible to identify whether this process had beneficial or adverse effects on the variables of labor supply and demand, income levels, and income inequality.

The main results show that in Mexico's northern border cities, the level of wage inequality fell in the long term, a product of a generalized deterioration in wages that mainly affected the most-skilled workers. Similarly, the results suggest that, in contrast with the theoretical predictions, the trade opening did not contribute to wage disparity reductions; had the labor market structure that existed before the economic liberalization process stayed in place, the levels of inequality would have been lower than those seen in 2016.

The rest of this document is organized as follows. It begins with the theoretical foundations that govern the relationship between trade openness and wage inequality, and the empirical evidence on the issue is analyzed. Subsequently, the micro-simulation methodology and the article's sources of information are described. Then a comparative evaluation of labor market indicators will be presented, as well as the effect of trade liberalization on the distribution of labor income for Mexico's northern border cities, followed by the conclusions.

WAGE INEQUALITY: THEORY AND EVIDENCE

As part of the main objectives of the new general policy, wages continue to be an important issue as they represent the main source of income for homes. The *Global Wage Report 2016/2017* of the International Labour Organization (ILO) says wages in developed economies constitute between 70 and 80 percent of household income, while in emerging and developing economies these range between 50 and 60 percent (ILO, 2017).

In this regard, the United Nations 2030 Agenda for Sustainable Development Goals expresses the need to control the trends in compensation, and for the application of policies that increase wage levels and assure a just distribution for work of equal value (ILO, 2016), with the aim of achieving a reduction in income inequality and poverty, as well as generating decent work for all women and men as a motor of inclusive growth.

The current labor picture shows that in recent decades, wage disparity has grown in various nations of the world, including in two-thirds of the member countries of the Organisation for Economic Co-operation and Development (OECD) and in some of the big emerging economies (OECD, 2017; ILO, 2017). The above

establishes the importance of countering wage inequality, seeing that it is an ongoing problem that has given the labor market adverse effects involving social cohesion, labor well-being, equality of opportunity, social mobility, aggregate demand, and economic growth in the medium and long term (OECD, 2016).

While the trends in wage inequality may be the result of a combination of factors related to changes in relative supply and demand for the workforce, as well as the weakening of labor market institutions (Cortez, 2001; Castro & Huesca, 2007; Pérez, 2014), in the Mexican case the evidence emphasizes that the changes in wage inequality respond to a large extent on transformations in the components of relative demand for labor (Cortez, 2004; Cuevas, 2013), of which two perspectives stand out.

The first refers to the hypothesis of technological change biased toward skills, oriented to capital and to knowledge. Of importance here are the liberalization of the flow of goods, investment, and financial markets, which provide access to new technologies and better forms of organization of production (Pérez, 2014). In accordance with what is theorized by experts on the issue (Autor, Katz, & Krueger, 1998; Berman, Bound, & Machin, 1998; Acemoglu, 1998 and 2002), technological advances—translated into greater productivity and innovations—will foster demand for and increased pay for skilled workers, propitiating an increase in wage gaps. The main criticisms for pointing to technology's role in causing the variations that occurred in the labor markets are that this conjecture lacks a solid analytical base in economic theory and because it is not possible to measure with precision at what point technological change and international trade are interrelated; the question is whether this a consequence of the opening or whether cause-effect relationships are produced between both (Sachs, Shatz, Deardorff, & Hall, 1994; de Hoyos & Lustig, 2009).

The second perspective is supported in the conventional Heckscher-Ohlin theory of international trade and the Stolper-Samuelson theorem. These approaches suggest that, with trade openness, relative prices and wages tend to level out, as nations specialize and export goods in which they have an advantage over other countries and import those goods where they have disadvantages, which leads to an increase in demand and relative wages of the abundant factor of production, that is, unskilled labor. Thus, a reduction in the wage gap between workers with various skills is assumed (Stolper & Samuelson, 1941).

The approaches of the Heckscher-Ohlin and Stolper-Samuelson theories have been questioned in recent contributions to international trade theory for assuming a complementarity in production between nations, which gives rise to inter-industrial

trade (exchange of products and services between different industries), which promotes specialization in countries that have a comparative advantage. In contrast, the empirical evidence (Hanson & Harrison, 1995; Martín-Montaner & Orts, 2002; Mayorga & Martínez, 2008) suggests a greater increase in the composition of the demand for labor tied to reciprocal trade of products pertaining to the same industry (intra-industrial trade). Therefore, in such a versatile world with differences in technological knowledge, if economies of scale, increasing yields, and product differentiation are added (which explain the intense intra-industrial trade), the expected variations in the relative prices of the goods and factors will not necessarily take place (Bhagwati & Dehejia, 1993).

In this context, Mexico is an appropriate case for study when it comes to its strategy of trade opening, which has crossed a series of stages from the mid-1980s. In particular, two key events can be seen in the process of deregulating foreign trade. The first came in 1986 with Mexico's integration into the General Agreement on Tariffs and Trade (GATT), known for the promotion of manufacturing exports, a significant reduction in tariffs, and a gradual reduction in restrictions on foreign investment.

The second event created one of the most important blocs in the world in 1994, with the entry into force of the North American Free Trade Agreement (NAFTA) between the United States of America, Mexico, and Canada. At that point, the trade liberalization strategy of Mexico was formally institutionalized, trade and investment flows increased, and manufactured exports increased their contribution more than 80 percent. Subsequently, the country joined the OECD and the World Trade Organization (WTO), and has signed 12 free-trade agreements that, to date, involve 46 countries (Subsecretaría de Industria y Comercio, 2009).

All this produced, beginning in the 1990s, various empirical studies that examined the relationship between trade and wage differences in Mexico (Ghiara & Zepeda, 2004; Meza, 2005). Nevertheless, there currently exists an open debate with respect to whether the relationship has been positive or negative.

On the one hand, authors such as Vos and De Jong (2000), Cañonero and Werner (2002), Ros and Bouillon (2002), Galiani and Sanguinetti (2003), Arbache, Dickerson, and Green (2004), Betrán, Ferri, and Pons (2007), Burgos and Mungaray (2008), Hasan and Jandoc (2010), Cuevas (2013), Mamoon and Murshed (2013), and López (2015) provide evidence on whether foreign trade increased demand and relative wages of skilled workers, and, thereby, increased wage dispersion.

Other authors such as Chiquiar (2004), Robertson (2004), Airola and Juhn (2005), Borraz and López-Córdova (2007), Vos and Sánchez (2010), Garduño and Baylis

(2012), and Mishra and Kusum (2013) show that after the entry into force of NAFTA in 1994, changes were seen in the relative prices of factors that favored unskilled labor, as well a better wage distribution with trade liberalization.

A review of the literature shows the importance of examining this issue in various spatial scales as it is unlikely that the same results would be obtained in studies of the overall national economy—which is differentiated by geographic areas—because the acceleration in global processes has affected the country's different regions, entities and cities in heterogeneous ways (Chiquiar, 2004; Hanson, 2005; Garduño & Baylis, 2012; Tello & Ramos, 2012; de la Mora, 2015).

In order to focus on the areas that reflect the greatest dynamism and ties with the export sector, the analysis presented here is confined to cities in states along Mexico's northern border. Because of their geographical location neighboring the United States, productive characteristics, and focus on exports, the entities in the country's north have maintained a strategic and beneficial position in NAFTA (Hernández, Soto, & Vázquez, 2008). To identify the effect of the trade opening on the level of wage inequality, the microsimulation methodology described in the next section is applied.

METHODOLOGY AND DATA

The measurement of the effect of the trade opening on wage inequality will be made through the microsimulation methodology, developed by Almeida dos Reis and Paes de Barros (1991) and formally expanded by Ganuza, de Barros, and Vos (2002). For Mexico, the traditional approach of the method has been national and regional (Bouillon, 2000; Ros & Bouillon, 2002). Nevertheless, for this study we adapted and expanded it to a scale of self-represented urban cities.

The methodological tool consists of performing simulation exercises in which base and counterfactual scenarios are compared, modifying the parameters of the labor market, to determine what would be the level of income inequality in the hypothetical situation in which a political reform, in this case trade liberalization, had never taken place.

In other words, the microsimulation analysis simulates the pattern of indicators that represent the labor market, that is, the economic participation of the population, unemployment, the employment structure, and general levels of pay. Thus, the labor market structure of a counterfactual year is imposed on the data of a base

year. In accordance with the original specification of Ganuza et al. (2002), the structure of the labor market in the year is expressed by the function:

$$\lambda = f(P, U, S, O, W_1, M)\qquad\qquad(1)$$

Where $P = [p_j]$ represents the vectors of the participation rate of the workforce of the individual type j; $U = [u_j]$ are the vectors of the unemployment rate of the individual type j; the employment structure is determined by the sector of economic activity S and the occupational category O of individuals type j in the segment k; W_1 indicates the wage compensation that would correspond in the base year, respecting the structure of the counterfactual year for the worker j in segment k, and the matrix M has the different sociodemographic characteristics of each individual type j.

The working age population can be classified in individuals j according to gender, age, education, or skill level. Meanwhile, the employed workforce diversifies in accordance with segment k, identified by the sector of economic activity and/or occupational category. The income of an individual is defined as:

$$yl_i^* = f(\lambda, c_i)\qquad\qquad(2)$$

Where c_i is a function of sociodemographic characteristics such as gender, age, skill level, position in the job market, and other personal attributes. In each simulation, the conditions of employment of an individual i can be modified as a result of variations in labor market conditions. Therefore:

$$yl_i^* = f(\lambda^*, c_i)\qquad\qquad(3)$$

Where λ^* represents a labor market structure of counterfactual employment, determined by:

$$\lambda^* = f^*(P^*, U^*, S^*, O^*, W_1^*, M^*)\qquad\qquad(4)$$

In the application of the microsimulation methodology, the variables of the labor market of the year t can be substituted by those of the year t^*, that is, the effects can be evaluated through the alteration of the variables P, U, S, O, W_1 and M (Bouillon, 2000).

The distribution of income of the individual (yl) in the year t will be a function of the variables of the labor market previously mentioned, the distribution of the individual attributes represented by c, and other factors captured by a parameter a:

$$D\,(yl_i) = D\,(P,\,U,\,S,\,O,\,W_1,\,M,\,c,\,a) = F\,(\lambda,\,c,\,a) \tag{5}$$

While the distribution of income of the individual (yl) in the year t^* is defined as:

$$D^*\,(yl_i) = F\,(\lambda^*,\,c^*,\,a^*) \tag{6}$$

Assuming that the other factors a are constant and do not influence the distribution, the changes in labor income between two years can be established as a function of changes in the six variables of the labor market and individual attributes (c):

$$\Delta D\,(yl_i) = D\,(P^*,\,U^*,\,S^*,\,O^*,\,W_1^*,\,M^*,\,c^*) - D\,(P,\,U,\,S,\,O,\,W_1,\,M,\,c) \tag{7}$$

The transformation in the structure of the labor market can be carried out changing each parameter in an independent way, or in sequential and accumulative order. Thus, the values of the parameters before liberalization (first year) will be the data of the survey after liberalization, in a way that in each scenario a new structure of the labor market and distribution of income is obtained.

Hence, it is possible to estimate any indicator of inequality to determine its level in the hypothetical situation that trade liberalization had not been implemented. In this case, it was decided to utilize the Gini coefficient, an index of inequality with values between 0 and 1, where zero corresponds to perfect equality and 1 means total inequality (Torre, 2000).

Because random components are used, each simulation exercise is replicated 100 times through the *bootstrap* method in order to establish confidence intervals of 95 percent in the estimate of the indicators of inequality. If the simulated value is above the observed one, the results indicate that liberalization contributed to reduce inequality; in cases where the value is lower, it can be concluded that liberalization increased income disparity.

DATA

Given the short periods of study involved in the literature, a long-term scenario is presented here in which the parameters of the 1992 labor market, which henceforth we consider as a counterfactual year and previous to the economic liberalization, are imposed on the structure of 2016, a base year following the opening, and the current situation, to simulate a new distribution of income and determine what the level of wage inequality would have been had NAFTA never been signed.

Urban area data were used from the National Survey of Urban Employment (ENEU) and of the National Survey of Jobs and Employment (ENOE), published by the National *Institute* of Statistics and Geography (Instituto Nacional de Estadística y Geografía, or INEGI); in order to obtain representativeness of the population, the expansion factor that each survey provides was applied. The sample includes the wage-earning population of both genders whose age ranges between 15 and 65.[1] The observation variable is the real wage per hour in August 2016,[2] an intermediate month of the quarter evaluated.

Demographic groups are formed using a function of labor skill level following the classification of Aguilera and Castro (2017), who catalogue three types of workers: unskilled (U) who have between 0 and 9 years of schooling, semi-skilled (SS) with 10 to 14 years of schooling, and skilled (S) with 15 or more years of schooling.

In accordance with this, the employment structure will be integrated by the classified population in each segment in accordance with the sectors: manufacturing industry; construction; electricity, gas and potable water; businesses, restaurants, and hotels; transportation, warehousing, and communications; financial services, insurance, real estate activities, and rentals; and communal, social, and personal services.[3]

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[1] The minimum age to work in Mexico, and the legal age for retirement, respectively, according to Article 162 of the Social Security Law.

[2] The monthly deflated wage will be divided by 4.3 (weeks in a month) and in turn by the usual number of hours worked per week.

[3] Given that the sample only takes into consideration metropolitan areas, it was decided not to include agricultural and mining activities because of the reduced number of observations they involve.

PERFORMANCE OF THE LABOR MARKET IN MEXICO'S NORTHERN BORDER CITIES

In this section the composition of the labor market is contextualized for each of the cities in Mexico's northern border, namely: Tijuana, Hermosillo, Chihuahua, Saltillo, Monterrey, and Tampico. Specifically, the labor force participation and unemployment rates are analyzed according to the skill level of the population, composition of work in terms of skills, and variations in pay.

On the supply side, most notable is that in the year 2016 more than 62 percent of the population of working age in border cities was economically active (participation rate), a figure above that observed in 1992, which had a range of 53 to 55 percent (Table 1). This pattern assumes pressure on the labor market in the long term, involving an increase in the number of people who are working or seeking work.

TABLE 1. Mexican Northern Border Cities Participation Rate
by Sex and Labor Skill, 1992-2016 (Percentages)

City	Total	Men			Women		
		S	SS	U	S	SS	U
				1992			
Tijuana	53.2	85.5	69.8	79.1	56	39.3	26.9
Hermosillo	54.3	82.5	69.5	79.8	59.6	40.1	28.3
Chihuahua	53.1	78.6	64.4	79.9	50.9	37.2	31.8
Saltillo	53.6	82.5	67	79.3	49.6	40.3	26.8
Monterrey	55	83.6	72.7	80.9	51.6	39.3	27.8
Tampico	53.7	78.6	62.4	77.4	59.8	39.5	30.6
				2016			
Tijuana	63	91.7	71.9	80.8	71.3	48.9	42.5
Hermosillo	67.1	91.3	75	76.1	73.9	52.6	48.6
Chihuahua	65.1	85.6	74.4	78.6	70.8	49.8	45.1
Saltillo	65.7	89.5	81.6	82.3	74.6	46.9	41.1
Monterrey	63.9	89.4	77.2	78.7	67.9	45.1	41.2
Tampico	62.7	83.6	71.5	79.3	69.8	47.1	41.4

Note: S = skilled, SS = semi-skilled, and U = unskilled.
Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

The significant increase in the participation rates in 2016 stems from variations in the intervention of the female skilled and unskilled female population in urban areas. The cities that showed the most changes were Saltillo, where the proportion of skilled women increased more than 25 percentage points, and Hermosillo, where the unskilled female population was more than 20 percentage points greater than in 1992. In the case of male labor, the semi-skilled increased their participation by more than 10 percentage points in Saltillo and Chihuahua. These changes could be the result of the demand for workers with high educational levels by the export industries, and, on the other hand, corroborate the emphasis on education that has been seen in the literature (Ramírez, 2000) and suggest that the federal entities most involved with the export sector are moving toward providing a greater supply of skilled workers.

On the labor demand side, the unemployment rate registered a heterogeneous pattern among the cities. While in Saltillo, Monterrey, and Tampico the unemployment rate fell between 1992 and 2016, it increased in Tijuana, Hermosillo, and Chihuahua (Table 2). It is important to highlight that, both in 1992 and in 2016, Saltillo and Tampico had the greatest percentage of unemployment (5 percent and 6.9 percent in 2016) that particularly affected female workers.

It should be noted that in times of economic slowdown negative effects in labor markets are exacerbated. The financial crisis of 2008 had adverse effects on the Mexican economy because of its dependence on the United States, which caused a deterioration in industrial activity and increased informal employment and self-employment (Villarreal, 2010).

The contrast between demographic groups indicates that unemployment in the cities studied increased notably for the skilled men (4.3 percentage points in Tijuana and 5 percentage points in Tampico) in 2016 compared with 1992. In terms of women, the highest unemployment rate is found in semi-skilled labor, with a figure close to 8 percent in Hermosillo and Tampico. In contrast, the lowest unemployment rate was found in unskilled women and men (Table 2); this could be because Mexico does not have an unemployment insurance system, which makes it hard for the population to sustain itself without income and work for a long time.

TABLE 2. Mexican Northern Border Cities Unemployment Rate
by Sex and Labor Skill, 1992-2016
(Percentages)

City	Total	Men			Women		
		S	SS	U	S	SS	U
				1992			
Tijuana	8	1.5	8	5	2.5	1.6	8
Hermosillo	3.3	2.6	3.1	2.7	3.1	4.5	4.2
Chihuahua	2.7	3.8	1.4	2.6	3.9	3.3	2.6
Saltillo	6.5	6.1	6.5	4.3	11.2	10.3	8.9
Monterrey	5.1	3.3	4.7	4.4	4.9	8.6	5.9
Tampico	7.2	2.7	7.2	5.8	16.4	14.3	5.5
				2016			
Tijuana	3.7	5.8	2.9	3.3	2.8	5.1	3.5
Hermosillo	4.9	4.6	4.2	4.5	4.9	7.9	3.8
Chihuahua	4	4.1	3.6	4.8	4.8	3.9	2.9
Saltillo	5	6.1	5.2	3.6	4.6	6.6	5.6
Monterrey	4.6	3.7	4.8	3.7	5.7	5.1	5.9
Tampico	6.9	8.7	7.9	6.7	5.8	7.8	4.7

Note: S = skilled, SS = semi-skilled, and U = unskilled.
Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

The dynamic of the occupations according to the various profiles of the workers allows us to establish that during the period of study there was growth in the participation of skilled workers, both men and women, in all the cities, which is expected given the growing trend of higher levels of schooling, although the degree of all this varies; Hermosillo and Chihuahua stand out as the most dynamic cities (Table 3). In the case of women, the pattern can be associated with a tendency of positive selection in their decision to participate in the labor market, although it also could be a reflection of greater levels of schooling of the women compared with the men.

This performance could suggest favorable effects in the reduction of labor inequalities between men and women, a product of the efforts realized at the global level to achieve gender inequality, and in the case of Mexico, as a result of the set

of legal reforms approved since 2012 that, among other things, seeks to push the young and female labor force into the formal sector.

TABLE 3. Mexican Northern Border Cities Employment Distribution
by Gender and Labor Skill, 1992-2016
(Percentages)

City	Men				Women			
	S	SS	U	Total	S	SS	U	Total
1992								
Tijuana	8.7	20.3	71	100	10.8	30.9	58.3	100
Hermosillo	15.6	25.5	58.9	100	16	39.4	44.6	100
Chihuahua	15	20.8	64.2	100	13.7	31.9	54.5	100
Saltillo	18.4	17.6	64	100	14.7	32.3	53	100
Monterrey	17.6	24	58.4	100	15.7	35.4	48.9	100
Tampico	19.1	19.4	61.5	100	15.4	30.8	53.7	100
2016								
Tijuana	15.1	30.9	54.1	100	19.6	31.4	49	100
Hermosillo	28.6	32.6	38.7	100	32.4	33.6	34	100
Chihuahua	27.7	30.5	41.8	100	33	28.4	38.6	100
Saltillo	19.6	31.5	48.9	100	27.9	28.3	43.9	100
Monterrey	24.7	31	44.2	100	27.8	31.4	40.8	100
Tampico	25	32.2	42.8	100	30.7	32.2	37.1	100

Note: S = skilled, SS = semi-skilled, and U = unskilled.
Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

Finally, while the figures show a positive relationship between workers' skills and the compensation they receive, as seen in Table 4, the poor performance of the labor market in Mexico also was seen in a decline in the quality of income in 2016. In the long term there was a generalized drop in real average wages whose main impact was on skilled male labor, falling more than 22 pesos in Hermosillo, Chihuahua, and Monterrey from 1992 to 2016. The contraction for the unskilled labor force was 5.5 pesos, with the exception of Tijuana, where it fell 20 pesos, and Saltillo, where it rose 6 pesos.

In the case of the women, the most impacted were those with higher skill levels, who saw their wages drop more than 14 pesos during the period in question, a situation found in all the cities studied except Saltillo (Table 4).

TABLE 4. Mexican Northern Border Cities Average Wage
by Sex and Labor Skill, 1992-2016
(pesos at 2016 levels)

City	Men			Women		
	S	SS	U	S	SS	U
1992						
Tijuana	101.79	68.58	51.84	87.44	56.03	39.29
Hermosillo	110.81	56.47	40.57	84.52	51.88	33.37
Chihuahua	93.09	48.10	34.94	76.42	40.58	26.52
Saltillo	82.54	42.92	27.92	70.87	42.95	28.01
Monterrey	104.59	48.62	35.99	91.08	46.58	32.27
Tampico	72.97	38.20	33.56	69.45	44.15	28.07
2016						
Tijuana	82.24	36.67	31.84	62.65	36.91	32.09
Hermosillo	67.99	37.79	35.96	68.42	39.00	33.83
Chihuahua	63.86	38.14	31.40	62.15	32.47	28.73
Saltillo	80.49	38.39	33.94	72.12	39.15	30.94
Monterrey	81.96	41.28	34.06	74.30	39.03	31.88
Tampico	60.35	38.47	28.23	54.81	30.87	26.94

Note: S = skilled, SS = semi-skilled, and U = unskilled.
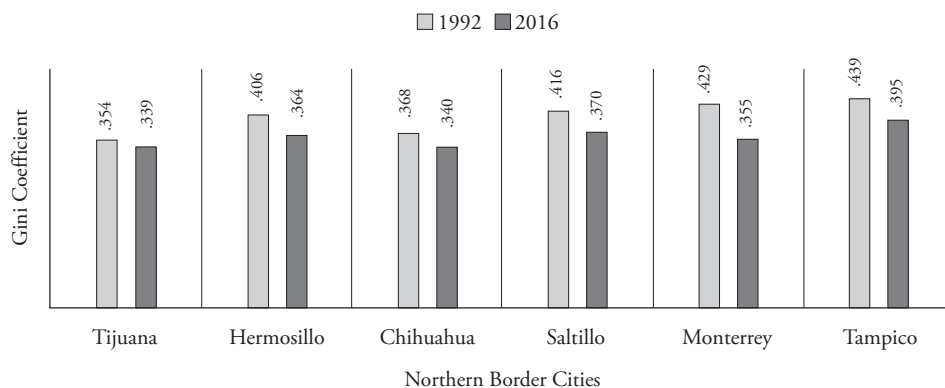Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

Until now, the pattern of the labor market suggests a drop in the salary gaps by sex and among groups according to skill level, a product of a fall in pay for the most skilled workers. It should be noted that the trends observed at the global level indicate that real-wage growth experienced a severe drop in the period following the international crisis of 2008 and 2009, recovered in 2010 and, beginning in 2012, began to contract (ILO, 2017).

MICROSIMULATIONS: EFFECT OF THE TRADE OPENING ON WAGE INEQUALITY IN NORTHERN BORDER CITIES

This section begins showing the pattern of wage inequality observed in the cities in 1992 and 2016. Subsequently, the findings applying the microsimulation methodology in a long-term scenario are shown, with the aim of determining what the level of disparity in incomes would be if the composition of the labor market in 2016 had not changed with respect to that observed in 1992, when the economy was not completely open to foreign trade. The results are presented after altering the parameters of the labor market individually, distinguishing six phases: participation rate, unemployment rate, employment structure by economic sector, changes by occupational category, distribution of workers by skill level, and wage income.

In Graph 1 the value of the Gini coefficient is shown as a function of wage income. The information shows that disparities in labor income from 1992 to 2016 have been declining in the cities located in the north of the country. It should be noted that at a OECD level, Mexico is one of the nations with the greatest wage inequality, only below Chile, in accord with the latest reports from the OECD (2017).

GRAPH 1. Evolution of Wage Inequality in Cities Along
the Northern Border, 1992-2016

Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

The figures using the Gini coefficient (Graph 1) show that even among the cities that make up the northern border region, the levels of wage inequality have not been homogeneous. The comparison between cities showed the following: In 1992, Tampico and Monterrey were the areas that exhibited the greatest rates of inequality (0.439 and 0.429). Tijuana and Chihuahua showed the lowest (0.354 and 0.368).

In 2016, wage disparities were seen in all the urban areas, although the working population of Monterrey fared better, as wage inequality fell more than 17 percent there (Gini coefficient of 0.355). In contrast, even though Tijuana exhibited the smallest decline in inequality from 1992 to 2016, it still had the greatest wage equality (0.339) in the latter year.

In this context, the figures suggest that Tampico, Monterrey, Saltillo, and Hermosillo were the areas with the greatest disparity in work income in 1992 and 2016, while Tijuana and Chihuahua were the most equitable cities.

Two additional elements to highlight are the inequality of the cities studied: *1)* there is a greater convergence among cities; and *2)* there is little variability in the order they occupy, indicating a certain synchronization in their patterns over time.

With the objective of identifying what would have been the level of wage inequality had NAFTA not been enacted, the microsimulation methodology was applied for each of the main urban cities belonging to the northern border states. The simulated scenarios shown in Table 5 exhibit three statistically significant phases. This suggests that with the coming into force of NAFTA, the changes in the occupational category, the distribution of work by skill level, and the income effect intervened in the variations of wage inequality. At the global level, the economic downturn has been linked to the generation of informal work, the precariousness of work, and a fall in real wages (ILO, 2017).

In light of the results, some important aspects are highlighted. First, changes in the occupational category with significant reductions in the Gini coefficient are only found in Hermosillo. The above shows that from the beginning of the process of trade liberalization, the loss of wage-earning jobs, and, as a counterpart, the rise in self-employment, contributed to increase the level of wage inequality; it would have been 3.02 percent lower than that actually seen in 2016 (Table 5) if the same occupational distribution that existed in 1992 had stayed in place.

It should be noted that, according to figures from INEGI, Sonora reached a rate of labor informality of 45 percent in 2016. From an international perspective, the informal sector performs a fundamental role in the reduction of poverty; nevertheless, it is associated with a deterioration in the quality of work because its employment

opportunities offer lower incomes and less access to social security coverage and labor benefits. In the case of Mexico, the incidence of informal work is very high, now that today nearly six of every 10 workers are employed informally (OECD, 2017).

In the same vein, the parameter of greatest impact involves the change in the composition of employment by labor skills, which adversely affected income disparities (Table 5). The simulation exercises indicate that the distribution of occupations, by skills of the individuals, most strongly impacted Monterrey. In the hypothetical situation where workers continued to have the same level of skills as workers in 1992 (in a partially open economy), the level of inequality would be 7.21 percent lower than in 2016, while in Saltillo, Tampico, and Tijuana it would be 6 percent less. One explanation for the above is that these entities have specialized in the most complex industries in Mexico,[4] and consequently the demands for specific skills and abilities have increased. Additionally, it could come from the wide range of offerings by the education, training and skill development systems, directly related to an increase in demand for skilled female workers and skilled and semi-skilled male labor, as well as the contraction in unskilled labor of both sexes.

In contrast, the compensation effect increased inequality instead of reducing it. That is, if the structure of worker income corresponding to the various segments into which the labor market was divided had been that of 1992, with a partly open economy, the disparities in all the cities would have increased (Table 5). This pattern suggests that the trade opening contributed to reduce inequality in the long term; nevertheless, in contrast with the theoretical predictions, this was not a product of an improvement in the income of wage-earning workers, but rather came from a generalized decline in the average real salary, which particularly impacted workers with the highest skill levels.

The generalized reduction in average wages seen in the period of economic opening, which particularly affected the more skilled workers, facilitated the drop in disparities in the cities of Chihuahua, Tijuana, and Monterrey. This is because —had the economy remained closed—wage inequality would be more than 7 percent greater in the first two cities, and 6.5 percent in Monterrey, in relation to the level registered in 2016.

[4] Such as the manufacturing of aerospace equipment in Baja California and Nuevo León; manufacturing of electronic components in Baja California and Tamaulipas; manufacturing of electronic goods for domestic use in Coahuila and Nuevo León; and manufacturing of automobiles and trucks in Coahuila, among others, according to information from the *Atlas de Complejidad Económica para México* (CID, SHCP & CIDE, no date).

TABLE 5. Microsimulations: Individual Effects on the Distribution of Wage Income in Border Cities, 1992-2016

Border Cities	Real income 1992	Real income 2016	Simulated income Phase 1	Change %	Simulated income Phase 2	Change %	Simulated income Phase 3	Change %	Simulated income Phase 4	Change %	Simulated income Phase 5	Change %	Simulated income Phase 6	Change %
Tijuana	0.3544	0.3393	0.3370	-0.68	0.3402	0.26	0.3450	1.68	0.3305	-2.6	0.3183	-6.19	0.3631	7.01
			[0.3157 0.35694]		[0.3170 0.3633]		[0.3211 0.3658]		[0.3049 0.3475]		[0.2957 0.3372]			
Hermosillo	0.4062	0.3638	0.3618	-0.54	0.3668	0.84	0.3675	1.01	0.3528	-3.02	0.3545	-2.55	0.3733	2.62
			[0.3468 0.3746]		[0.3515 0.3782]		[0.3544 0.3838]		[0.3398 0.3612]		[0.3361 0.3617]			
Chihuahua	0.368	0.3401	0.3333	-2.00	0.3394	-0.20	0.3426	0.74	0.3403	0.06	0.3226	-5.15	0.3646	7.19
			[0.319 0.3458]		[0.3276 0.3512]		[0.3329 0.3555]		[0.3264 0.3509]		[0.3084 0.3351]			
Saltillo	0.416	0.3703	0.3708	0.13	0.3703	-0.01	0.3676	-0.73	0.3619	-2.27	0.3461	-6.54	0.3898	5.26
			[0.3493 0.3942]		[0.3532 0.3870]		[0.3540 0.3878]		[0.3421 0.3750]		[0.3258 0.3617]			
Monterrey	0.4293	0.3547	0.3514	-0.92	0.3549	0.06	0.3593	1.31	0.3484	-1.77	0.3291	-7.21	0.3777	6.5
			[0.3333 0.3704]		[0.3389 0.3687]		[0.3443 0.3703]		[0.3332 0.3598]		[0.3151 0.3404]			
Tampico	0.4395	0.3954	0.3957	0.09	0.3946	-0.19	0.3979	0.65	0.395	-0.09	0.3696	-6.52	0.4072	2.99
			[0.3730 0.4183]		[0.3739 0.4152]		[0.3783 0.4196]		[0.3760 0.4141]		[0.3474 0.3813]			

Notes: Each phase corresponds to values in case of change of: 1. participation rate; 2. unemployment rate; 3. employment structure (sectors); 4. occupational category; 5. employment structure (skilled) and 5. pay structure.

The income corresponds to the actual salary per hour expressed in 2016 pesos.

The values in brackets represent 95 % confidence intervals.

The values in bold and highlighted in a darker gray indicate a significant statistical difference.

Source: Prepared by the authors using data from INEGI (1992, 2016), third quarter of each year.

What has been discussed in this article corroborates what has been suggested by international organizations, that is, the need to monitor wage trends and to implement inclusive wage policies, which help to increase worker pay and assure a just distribution, reduce wage disparities, and buttress consumption as a key pillar of sustainable economies (ILO, 2016).

GENERAL CONCLUSIONS

The performance of the process of trade opening in the Mexican economy through NAFTA has been satisfactory in terms of economic integration, export growth, attraction of direct foreign investment, and stimulating production complexity. Nevertheless, it is important to determine the effect it has had on the labor market, mainly in the level and distribution of worker income.

An approach utilizing the microsimulation methodology with information from the ENEU and the ENOE suggests that, contrary to the predictions of the conventional theories of international trade, the process of trade opening produced changes that, in the long term, led to an increase in wage inequality, with a generalized deterioration in the average real wage in 2016.

More specifically, the findings indicate that the change in occupational composition, which brought about an increase in work informality, as well as changes in the skill level of the employed population, acted to increase wage disparities. If the same structures that existed in 1992 (when there was an economy that was not completely open to the export sector) had stayed in place, the level of wage inequality would have been less than that actually seen in 2016.

The differentiated results between the various cities located on Mexico's northern border corroborate that inequality can be strongly conditioned by the productive structure and the region's own characteristics. Nevertheless, a more precise conclusion involves evaluating in detail other indicators of the labor market that were left out of this analysis, such as the quality of work, gender equality, and access to jobs for potentially disadvantaged groups, among others.

On the other hand, it is important to signal that if the methodological exercise developed in this document constitutes an instrument of analysis to assess the implementation of certain public policies or economic strategies, such as is the case of the trade opening, it can also present some limitations, mainly tied to assuming that the total effect of the changes over time is the product of the policy being evaluated—for even when the policy is an important factor, it is not the only one—

and because of the absence of the effects and impact of the variation in the parameters in the final results.

Keeping in mind the above considerations, and in light of the evidence that emerges in this study, it is suggested that for progress toward equality to continue, it is imperative that policy proposals and initiatives be formulated to strengthen the external sector in accordance with the regional profiles, identify areas of opportunity, protect groups of vulnerable workers, resolve wage differences, promote formal employment, and assure improvement in the parameters of the labor market and in sustainable wage growth.

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