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# DECLINING WAGES FOR COLLEGE-EDUCATED WORKERS IN MEXICO: ARE YOUNGER OR OLDER COHORTS HURT THE MOST?<sup>1</sup>

*REDUCCIÓN DE LOS SALARIOS DE LOS  
TRABAJADORES CON EDUCACIÓN UNIVERSITARIA EN MÉXICO:  
¿SON LOS MÁS JÓVENES O LOS MÁS VIEJOS LOS MÁS PERJUDICADOS?*

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## ABSTRACT

A reduction in the wage premium for skilled labor –and a consistent reduction of overall wage inequality–has played an important role in explaining the fall of income inequality in Latin America during the 2000-2014 period. Consistent with that pattern, wage inequality declined in Mexico since 2000. This paper investigates the possible channels on why the wages of high-skilled workers have declined. Using data from Mexican labor surveys for the period between 2000 and 2014, we investigate if the decline was driven by wages declining more sharply for younger or older workers. We find that wages of older workers declined and the decline was more pronounced the older the cohort. This would seem to support the hypothesis that older workers' skills became obsolete.

*Keywords:* Education; College; Cohort; Inequality; Mexico.

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## RESUMEN

Una reducción en la prima salarial del trabajo calificado -y una reducción constante de la desigualdad salarial global- ha jugado un papel importante en la explicación de la caída de la desigualdad del ingreso en América Latina durante el período 2000-2014. En consonancia con ese patrón, la desigualdad salarial disminuyó en México desde el año 2000. Este trabajo investiga las posibles causas de por qué los salarios de los trabajadores altamente cualificados han disminuido. Utilizando datos de encuestas sobre el trabajo de México para el periodo 2000- 2014, se investiga si la reducción se debió a una disminución de salarios más acusada para los trabajadores más jóvenes o más viejos. Nos encontramos con que los salarios de los trabajadores de edad se redujeron y el descenso fue más pronunciado cuanto mayor es la cohorte. Esto parece apoyar la hipótesis de que las cualificaciones de los trabajadores de más edad se volvieron obsoletas.

*Palabras clave:* Educación; Universidad; Cohorte; Desigualdad; Méjico.

*JEL codes:* I24, I25, J20, J31, O54.



## 1. INTRODUCTION

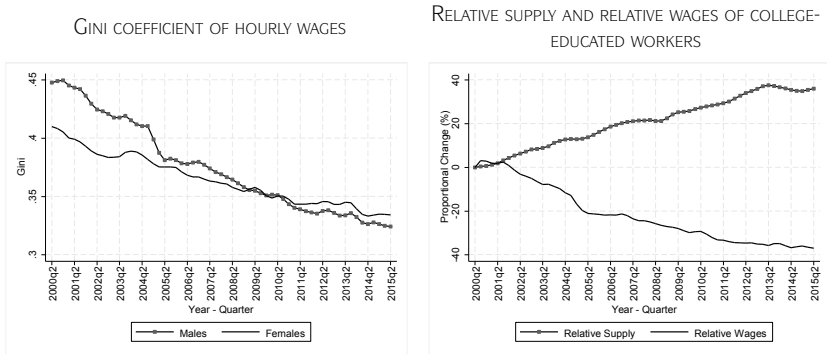
Unlike other regions in the world, Latin America went through an important period of reductions in income inequality at the dawn of the twenty first century (Lopez-Calva and Lustig, 2010; Lustig *et al.*, 2016). The fact that it also happened in a period of sustained growth –mildly interrupted by the global crisis of 2009–attracted the attention of analysts and policy makers to understand the factors associated with these trends. Researchers consistently found that there has been a process of wage compression, where the wage premium for skilled labor decreased in most countries (Rodriguez-Castelan *et al.*, 2016). The agenda was then advanced in order to delve into the drivers of the reduction in wage inequality and its sustainability, in an effort to disentangle its supply-side determinants from drivers related to the demand for different types of labor and the role played by institutional factors, such as minimum wages and unions.<sup>5</sup> This paper contributes to such agenda by exploring the heterogeneity of the changes in wages across age groups in Mexico and the factors associated to such dynamics.

Indeed, consistent with the regional pattern, since 2000 wage inequality in Mexico declined (Figure 1). This has taken place during a period of significant educational upgrading of the labor force and declining relative wages, especially for workers with tertiary education. Campos *et al.* (2014) decompose the change observed in wage inequality into changes in *returns* to human capital (formal education and work experience) and changes in human capital *endowments*. Their findings suggest that the endowment effect has been unequalizing while the wage structure effect is equalizing and larger.<sup>6</sup>

<sup>5</sup> Recent research has focused on disentangling supply, demand, and institutional factors (Azevedo *et al.*, 2013; Lustig, *et al.*, 2016; Messina, *et al.* 2016; Levy and Lopez-Calva, 2016).

<sup>6</sup> Even though there was significant educational upgrading and the distribution of the education stock became more equal, these changes were unequalizing because of the so-called “paradox of progress” (see Bourguignon *et al.* 2005). Depending on the convexity of returns and the point of the education equalization process at which the country finds itself, a reduction in the inequality of educational attainment may lead to a rise in earnings inequality. Indeed, as Gasparini *et al.* (2011) point out, the ‘paradox of progress’ has been a pervasive phenomenon in Latin American labor markets in the last couple of decades.

FIGURE 1. WAGE INEQUALITY OF ALL WORKERS



Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2015. Estimations consider all individuals with a positive number of hours worked and valid wages, ages 23-65. Panel B shows the proportional change with respect to 2000:2 of the relative supply of workers (share of individuals with college) and relative wages (log of hourly wage of workers with college education) with respect to rest of workers. This paper aims to establish whether there is evidence in support of a degraded tertiary effect. Sample includes men and women.

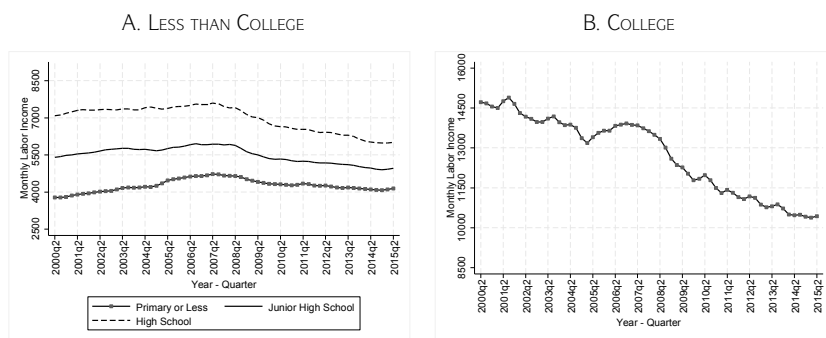
A decline in the relative wages of skilled workers can occur if one or more of the following situations exists: the wages of the low-skilled grow faster than the wages of the skilled; the wages of the low-skilled increase while the wages of the skilled workers decline; or the wages of the low-skilled workers decline more gradually than the wages of skilled workers. In Mexico, relative wages declined as a result of the last two, depending on the period. As illustrated in Figures 2 and 3, the average hourly wage of college-educated workers declined during the entire period while the wages of the rest of workers rose up to 2008. As a result of the global financial crisis, all wages declined from 2009 onwards but those of college-educated workers fell at a faster pace (Figure 3). This result contrasts with what the literature finds in more advanced countries, which shows an increase in inequality mainly due to wage increases of high-skilled workers (Autor *et al.* 2008; Goos and Manning, 2007). Hence, we investigate the possible channels on why the wages of high-skilled workers have declined.

The average hourly wage for college-educated workers declined at a rate of approximately 2 percent per year between 2001 and 2014. Given that during this period the share of college graduates in the workforce rose from 14 to 18 percent, the decline in relative (and absolute) wages may be a simple matter of supply outpacing demand. An alternative explanation (and not mutually exclusive) could be that the fall in returns to college education is the outcome of a process intrinsic to a particular age group. Younger workers, for example, could be experiencing a decline in their average wage because—as a result of the large expansion of tertiary education institutions since 1995—their ter-



tertiary education is not of the same quality on average as that of younger workers in previous cohorts. For example, in the period 1984 – 1994, university enrollment increased by 1.95 percent per year, while during the 1994-2000 period, it increased by 5.4 percent per year. The skills acquired through tertiary education could have become of lower quality, either because the new post-secondary institutions are of lower quality and/or because the marginal student has lower abilities. We call this the “degraded tertiary effect”.<sup>7</sup> Another possibility (again, not mutually exclusive) is that older workers in recent cohorts receive lower wages than their counterparts in previous cohorts because their skills no longer match what the markets demand or because there was a skilled-labor-saving technical change. We call this the “skills-obsolescence effect.”

FIGURE 2: AVERAGE MONTHLY EARNINGS



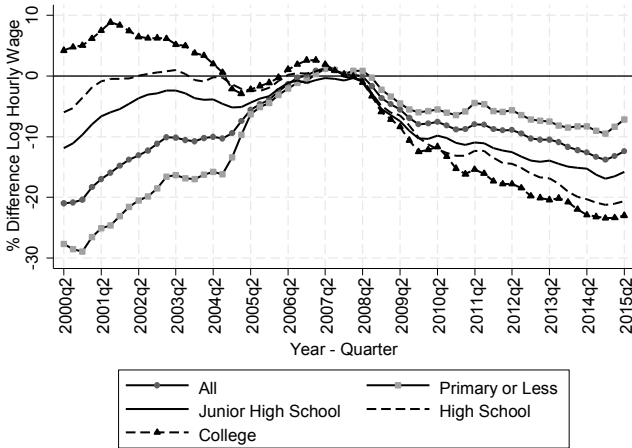
Notes: Authors’ calculations using quarterly Labor Force Surveys from 2000 to 2015. Earnings are in constant Mexican Pesos 2014:1. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. It includes all workers (men and women): salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.

In this paper, we analyze whether there is evidence of a degraded tertiary education effect, a skills-obsolescence effect, or both. We do this by examining a series of results and assess their consistency with the presence-or absence of either effect. We posit that if the decline in returns to the college-educated is the result of the deterioration of the quality of new entrants (or a mismatch in demand and supply that affects the younger workers in recent cohorts in particular), this should be reflected in a skewing of the wage distribution towards lower-wage earners among those with tertiary. In order to verify this, we apply the classic Datt-Ravallion decomposition method that disaggregates

<sup>7</sup> See Lustig, Lopez-Calva and Ortiz-Juarez (2013) and Camacho *et al.* (2016).

changes in the proportion of people below the poverty line into growth and redistribution effects (Datt and Ravallion, 1992). We use the average wage of the college-educated in the base year *in lieu* of the poverty line.

FIGURE 3: DIFFERENCE IN LOG HOURLY WAGE. BASE PERIOD 2008:1.



Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2015. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. It includes all workers (men and women): salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.

We also examine the evolution and distribution of wages of workers by cohort and experience (measured by age). The degraded tertiary effect (or a demand-supply mismatch among younger cohorts) should show as a decline in the average hourly wage of younger workers in recent cohorts vis-à-vis workers of the same experience level in older cohorts. In particular, workers who have entered the job market after the large surge in institutions of tertiary education, should show a more pronounced decline in their average wage than other age groups. Given that the surge took place in the 1990s, this should have affected workers who were born after 1975. In particular, if the decline in the average wage of younger workers results from an increase in the proportion of younger workers with a degraded tertiary degree, one would expect an increase in inequality of the younger group of workers over time.

Disentangling unambiguously the degraded tertiary and cohort effects from the pure supply quantity effect is not possible with the data used in this paper. Younger and older cohorts are participating in the same market and



could affect each other's wages. Camacho *et al.* (2016) have explored the degraded tertiary effect in Colombia, using data that allows them to identify the college of origin of specific workers, and do not find support for the hypothesis that deterioration of quality explains the reduction in returns.

This paper, however, contributes to our understanding of the factors explaining the reduction in wage inequality in Mexico by showing that, indeed, there are heterogeneous patterns across workers in terms of change in wages, which implies that the recent increase in supply has not affected equally workers of different cohorts, even though they are alike in terms of other observable characteristics. Moreover, these patterns do not seem to be consistent with the "degraded tertiary" effect, given that wage levels decreased relatively less and their dispersion decreased among younger workers. The pattern does seem to align with the "skills-obsolescence effect", with wages falling more for older workers.

The paper is organized as follows. Section 2 introduces the data analyzed in this paper as well as some descriptive statistics. Section 3 presents the analysis of the evidence. Section 4 summarizes the results. Section 5 concludes.

## 2. DATA

We use the Labor Force Survey for each quarter starting in the second quarter of 2000. The Mexican labor force surveys are very similar to the Current Population Survey applied in the United States or other labor force surveys around the world. From 2000 to 2004 the survey used is the "*Encuesta Nacional de Empleo*", and from 2005 to 2014 it is the "*Encuesta Nacional de Ocupación y Empleo*".<sup>8</sup> Even though the questionnaire is slightly different, most of the key labor questions are the same across surveys: earnings, hours of work, occupation, etc; while the sampling is the same in both. The labor force surveys are representative at the national and state level as well as by metropolitan area. In each quarter, approximately 120,000 households are interviewed. The surveys include socioeconomic and demographic information, but do not include any information on consumption or assets at the household level.

Given that our focus is on college graduate workers, we restrict the sample to individuals aged 23-65 years old (inclusive). For employment patterns, we use the full sample and define 'work' as the positive number of weekly hours of work in the week of reference. For the wage sample, we use full-time earnings defined as earnings of those with more than 30 hours of work in the week of reference. When calculating hourly wages, we divide the monthly earnings by hours of work times 4.33. We drop earnings below and above the 1st and 99<sup>th</sup>

<sup>8</sup> Both surveys have the same sample design. Although it is not common to employ the two surveys, we use them to provide a complete picture of wages in Mexico since 2000. Other studies that use both surveys are Campos, Hincapie and Rojas (2012) and Calderon (2014).

percentile within education groups from the sample.<sup>9</sup> To calculate the hourly wage statistics for all workers, we use the expansion factor in the survey times hours of work.

Table 1 shows the descriptive statistics for three years in the data: 2000, 2007 and 2014. Panel A includes the full sample and Panel B includes only the working sample (those with positive hours of work in the week of reference). This distinction is important due to the selection into the labor force mainly by women. There are three large changes in the Mexican population and workforce in the 2000-2014 period. First, there is a substantial increase in the female labor force participation. From 40 percent in 2000, it increased to 48 percent by 2014. This increase has been on hold since the macroeconomic crisis in 2008. Second, the proportion of individuals with a university diploma has increased, while at the same time the proportion of individuals with primary or less has declined substantially. This is satisfied both in the full and the working samples. In the case of women, there is positive selection into the workforce by education. Higher educated women are more likely to enter the labor force than less educated women. Third, average incomes declined substantially after the macroeconomic crisis of 2008. In the results that follow, we explore the role of different explanations on the decline of wages of higher-educated workers. We present our results for both men and women in order to analyze whether there are important changes by gender in labor market outcomes.

TABLE 1: DESCRIPTIVE STATISTICS

	2000			2007			2014		
	All	Male	Female	All	Male	Female	All	Male	Female
A. Full Sample									
N	853,078	400,306	452,772	806,406	372,734	433,672	409,152	191,897	217,255
Age	39.1	39.2	39.1	40.3	40.4	40.1	40.9	40.9	41.0
% Work	62%	87%	40%	64%	86%	46%	65%	84%	48%
% Married	75%	78%	71%	73%	77%	70%	71%	75%	69%
% Rural	35%	35%	34%	34%	34%	34%	34%	35%	34%
% Primary or less	54%	51%	56%	45%	43%	48%	36%	34%	37%
% Junior High School	19%	21%	18%	23%	25%	22%	28%	29%	27%
% High School	16%	14%	17%	17%	16%	18%	21%	20%	21%
% College	11%	13%	9%	14%	16%	12%	16%	17%	15%

<sup>9</sup> This restriction does not affect the trend of the results. Without this restrictions the results are noisier each year. The literature on wage inequality generally follows this convention, see Katz and Autor (1999), and Autor *et al.* (2008).



## B. Working sample

N	536,771	345,765	191,006	530,018	320,346	209,672	268,357	160,115	108,242
Age	38.5	38.8	37.8	39.7	40.0	39.1	40.3	40.4	40.0
% Full-time work	85%	92%	73%	82%	89%	71%	82%	88%	72%
Monthly Earnings	\$6,133	\$6,449	\$5,330	\$6,937	\$7,386	\$6,003	\$5,714	\$6,018	\$5,116
Hourly Wage	\$29.3	\$30.0	\$27.1	\$32.5	\$33.5	\$30.0	\$26.8	\$27.4	\$25.6
% Married	72%	80%	57%	71%	79%	58%	70%	77%	58%
% Rural	33%	36%	28%	32%	34%	28%	33%	36%	28%
% Primary or less	49%	51%	46%	41%	42%	38%	32%	34%	30%
% Junior High School	20%	22%	18%	25%	26%	22%	29%	30%	26%
% High School	17%	14%	22%	18%	16%	22%	21%	20%	23%
% College	14%	13%	15%	16%	15%	18%	18%	16%	21%

Notes: Authors' calculations using quarterly Labor Force Surveys. Each year uses information from all available quarters: 2000 uses quarters 2-4, 2007 uses quarters 1-4, 2014 uses quarters 1-2. Full sample uses all individuals ages 23-65, and working sample uses all individuals with positive hours of work ages 23-65. Monthly earnings and hourly wages are restricted to full-time workers (at least 30 weekly hours of work) and are in constant Mexican Pesos of the first quarter of 2014. Married includes cohabitation. Rural refers to individuals living in localities with less than 15,000 inhabitants. Primary or less refers to individuals with less than 9 years of schooling, Junior High School refers to individuals with at least 9 years but less than 12 years of schooling, High School refers to individuals with at least 12 but less than 16 years of schooling, and College refers to individuals with at least 16 years of schooling.

## 3. RESULTS

Our results can be summarized as follows. The Datt-Ravallion decomposition (Table 2) shows that most of the change in the proportion of workers below the baseline wage is due to a shift in the distribution rather than to a change in its shape. The skewing towards the lower end of the wage distribution exists but it is very small. Based on this result, there does not seem to be evidence consistent with a degraded tertiary effect or demand-supply mismatch of skills for the younger workers in particular. However, this exercise is not sufficient to rule out the presence of labor market dynamics that hurt the younger age group in particular. This is because the Datt-Ravallion decomposition is anonymous in the sense that we are not able to track who is losing relative to other workers. For example, it is possible that changes in the age composition of the workforce are such that although younger workers are increasingly receiving lower wages, their share in the workforce is declining.

TABLE 2: DATT-RAVALLION DECOMPOSITIONS: LOG HOURLY WAGE. RESTRICTED TO WORKERS WITH COLLEGE.

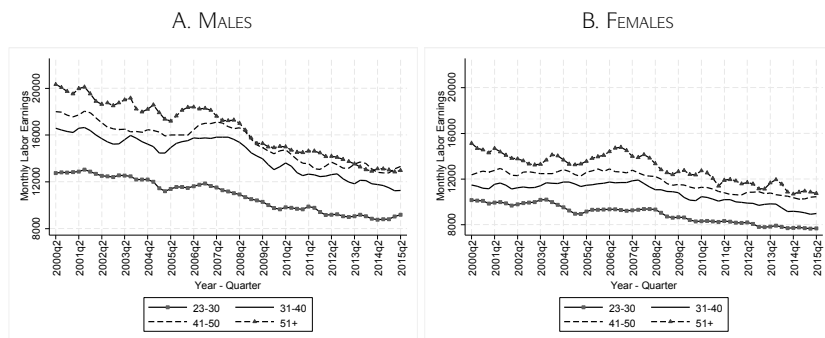
	2000	2007	2014	
A. Males				
% less than mean in 2000	0.5088	0.5375	0.6655	
		2000-2007	2007-2014	2000-2014
Difference		-0.0286	-0.1279	-0.1567
		[0.003]	[0.004]	[0.004]
Growth Effect		-0.022	-0.136	-0.1486
		[0.002]	[0.003]	[0.003]
Redistribution		-0.0065	0.008	-0.008
		[0.002]	[0.002]	[0.002]
B. Females				
% less than mean in 2000	0.5115	0.5049	0.6094	
		2000-2007	2007-2014	2000-2014
Difference		0.0066	-0.1045	-0.0979
		[0.005]	[0.005]	[0.005]
Growth Effect		0.02	-0.116	-0.1073
		[0.003]	[0.003]	[0.003]
Redistribution		-0.014	0.012	-0.009
		[0.003]	[0.003]	[0.003]

Notes: Authors' calculations using quarterly Labor Force Surveys. Each year uses information from all available quarters: 2000 uses quarters 2-4, 2007 uses quarters 1-4, 2014 uses quarters 1-2. Sample restricted to individuals working full-time (at least 30 weekly hours of work) age 23-65 and college education. Log hourly wage in constant Mexican Pesos of the first quarter of 2014. Standard errors in brackets.

What does the evolution of wages and wage inequality by cohort and age group tell us? Figure 4 shows that the wages of college-educated workers declined for all ages but they declined faster for the oldest group (51+) and slower for the youngest one (23-30). This is more evident for males than for females. If the degraded tertiary hypothesis is the only channel to explain changes in wages, then we should expect a decline in wages for younger workers. However, as Figure 4 shows, this did not happen for Mexican workers. This is another piece of evidence against the degraded tertiary hypothesis. The observed pattern would be more consistent with the skills-obsolescence explanation. It could be that both hypothesis are playing a role in determining

wages, but insofar as these results show, the degraded tertiary hypothesis has a secondary role in explaining large wage changes over the period for college educated workers.

FIGURE 4: EARNINGS BY AGE GROUP AND GENDER: 2000-2015. RESTRICTED TO WORKERS WITH COLLEGE.

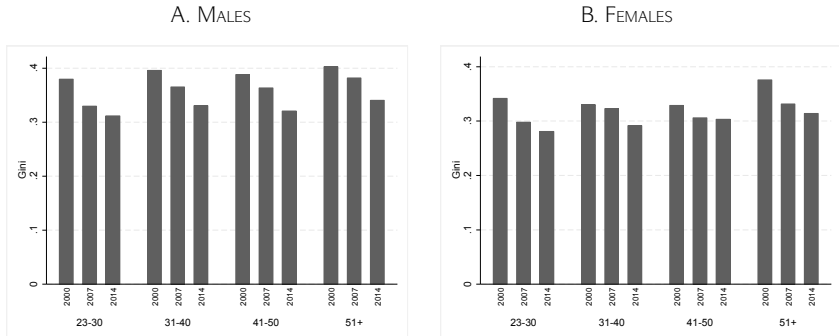


Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2015. Earnings are in constant Mexican Pesos 2014:1. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. Includes workers with college education: salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.

As discussed, if a degraded tertiary effect is taking place, we would expect that inequality among younger workers would increase more (or decrease less) than for workers of other age groups. However, as shown in Figure 5, wage inequality among the younger age group declined. There is no clear difference in the pattern of inequality change among workers of different ages (whether males or females). Figure 5 shows a decline in inequality for all workers, including college-educated older workers. Skill-obsolescence (or lower relative demand for older workers in recent cohorts) might imply that high-wage college-educated older workers are earning a lower wage and, hence, inequality for this group would decline. Thus, Figure 5 is more consistent with the skills-obsolescence effect than with the degraded tertiary education hypothesis.<sup>10</sup>

<sup>10</sup> In a degraded tertiary effect we expect that some workers (those with higher education but lower skills) to have lower wages while the rest of workers can maintain or increase their wages. This should cause an increase in inequality. On the other hand, skill-obsolescence should decrease inequality as high-wage workers are substituted by capital or younger workers.

FIGURE 5: INEQUALITY EARNINGS (Gini) BY AGE GROUP AND GENDER: 2000, 2007 AND 2014. RESTRICTED TO WORKERS WITH COLLEGE.



Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2014. Earnings are in constant Mexican Pesos 2014:1. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. Includes workers with college education: salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.

In order to analyze the roles of the degraded tertiary and skill-obsolescence hypotheses, we calculate earnings over time by cohort. This calculation is important because it depicts how wages have changed over time for the same type of workers.<sup>11</sup> The degraded tertiary hypothesis implies that wages for recent cohorts should decline due to increased competition for the same jobs and that the quality of those workers is inferior to that of previous graduates. The skill-obsolescence hypothesis implies that older cohorts experience a decline in their wages over time.

TABLE 3: MEAN LOG HOURLY WAGE BY COHORT. MALES WITH COLLEGE EDUCATION.

Cohort	Year									
	2000	2002	2004	2006	2008	2010	2012	2014	2015	
1950-1954	4.29	4.28	4.19	4.25	4.16	4.14	3.99	3.93	3.85	
1955-1959	4.17	4.22	4.18	4.16	4.15	4.01	4.00	3.89	3.95	
1960-1964	4.11	4.13	4.11	4.16	4.17	4.03	3.96	3.96	3.94	

<sup>11</sup> We cannot follow the same workers as the database employed is not a panel. However, we can use synthetic panels following the same age group over time. If the sampling is random and there is no change in labor force participation (or at least it is random) then wages come from the "same" type of workers.



1965-1969	4.12	4.14	4.08	4.13	4.09	3.97	3.95	3.93	3.97
1970-1974	3.96	4.06	4.01	4.05	4.07	3.98	3.96	3.93	3.92
1975-1979	3.75	3.83	3.86	3.92	3.97	3.86	3.89	3.87	3.87
1980-1984				3.74	3.75	3.72	3.77	3.77	3.74
1985-1989						3.56	3.54	3.59	3.68

Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2015. Earnings are in constant Mexican Pesos 2014:1. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. Includes workers with college education: salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Sample restricted to male workers between 23-65 years old.

Table 3 shows the results for male earnings with college education. There are several important aspects to highlight. First, the oldest cohort (1950-1954) shows declines in wages since the beginning of the period. The earnings of that cohort have declined close to 40 percent. This is the largest decline in earnings for any cohort. Second, the cohorts 1955-1959, 1960-1964, and 1965-1969 show stagnant earnings between 2000 and 2008; nevertheless, their earnings all decline after the macroeconomic crisis. This decline is largest for the oldest cohort in this group, 1955-1959. Third, mid-age cohorts, 1970-1974 and 1975-1979, show the largest gains in earnings between the period 2000 and 2008. Their earnings increase between 11 and 22 percent. However, after the macroeconomic crisis, their earnings fall, arriving at the same level as in 2000-2002. Fourth, the younger cohorts, 1980-1984 and 1985-1989 do not show a decline in earnings even after the macroeconomic crisis. However the gains of this cohort are modest, 5 and 2 percent between the first and final year observed. These gains are substantially lower than for older cohorts.

Is there evidence that workers of newer cohorts are receiving a lower wage when they enter the workforce? This phenomenon could be interpreted as evidence consistent with the hypothesis that new entrants are, on average, of increasingly lower quality than new entrants in the preceding cohorts. As Table 3 shows, there is no evidence that this is occurring in the Mexican labor market. In fact, the younger cohorts are the only ones that show an increase in their earnings over time.

However, ideally we would like to compare earnings at the same age across cohorts when they enter the labor force. This is not possible given that the length of the panel is short, and the largest expansion in college enrollment was in the late 1990s. Ideally, we need to compare the cohorts in the early 2000s with the cohorts in the early 1990s. Nevertheless, we can compare wages for three cohorts when they were 23-25 years old. The cohort 1975-1979 had 23 years old (on average) in 2000, the same occurs for the cohort 1980-1984 in 2006 and the cohort 1985-1989 in 2010. The earnings of the cohorts 1975-1979 and 1980-1984 are approximately the same when

they both enter the labor force. But the cohort 1985-1989 shows substantially lower earnings at the time of entry into the labor market (close to 20 percent). It is difficult to disentangle the effect of lower college quality due to the macroeconomic crisis in 2008.

In order to explore these issues more deeply, we regress the average of the log wage of college-educated workers against age and cohort variables. For cohorts 1950-1954 to 1975-1979 we have yearly data from 2000 to 2015 (96 observations), and for the cohort 1980-1984 (1985-1989) since 2003 (2008) when they start their labor life (21 observations). In total, we obtain 117 observations. The variable cohort is defined such that 0 represent the oldest cohort (1950-1954) and 7 the youngest cohort (1985-1989). Similarly, age is normalized to start at 0. Hence, the constant is interpreted as the average log wage of college-educated workers at cohort 0 (1950-1954) when they are 23 years old. Table 4 shows the results of that regression. Estimating the contribution of age, cohort and its interaction, suggests the opposite: i.e., the wage of new entrants has been increasing with each cohort. The cohort coefficients imply that there is an increasing pattern of earnings up to the 1970-1974 cohort, and then earnings decline for the latter cohorts.<sup>12</sup> So, the decline of wages among college-educated workers coincides with the timing of the increase in supply around 2000, when workers in the cohort 1975-1979 start their labor life. The age coefficients imply a regular inverted U-shape for the age-earning profile. The negative coefficient of the interaction between the cohort and age variables is important. This implies that the earnings of younger cohorts start to decline at a younger age over time. In other words, the peak in earnings is obtained at younger ages for recent cohorts and the peak is lower than previous maximum earnings in previous cohorts. For females, we find relatively similar results but the peak in wages for recent entrants to the labor market is for the cohort 1975-1979 and then newer cohorts obtain lower wages when they start their labor life. Table 4 also includes a regression that controls for the size of the cohort (log of the proportion of individuals in that cohort with respect to all college-educated individuals in a year). The results are similar to those in the first two columns. Supply is relevant to determine wages of males but not of females, which is likely driven by the increase in female labor force participation in the period. The key result holds: younger cohorts are earning less than older cohorts when they were starting their labor life and that wages decline at the end of the labor life.<sup>13</sup>

<sup>12</sup> The difference between average log wage for cohort 1970-1974 (cohort number 4 in the regression, cohort 0 refers to cohort 1950-1954) and 1975-1979 (cohort number 5 in the regression) is a decline of 3.9% (first we multiply each cohort coefficient by cohort number and then take the difference).

<sup>13</sup> In estimations not shown, we estimate the regressions with a dummy variable for the period 2009-2015 (post-crisis) with similar results.

TABLE 4: COHORT REGRESSIONS. LOG HOURLY WAGE. RESTRICTED TO WORKERS WITH COLLEGE.

	Males	Females	Males	Females
	Specification 1: Not including own supply		Specification 2: Including own supply	
Cohort	0.1624 [0.083]	0.3269 [0.063]	-0.1236 [0.011]	-0.0937 [0.007]
Cohort <sup>2</sup>	-0.0224 [0.006]	-0.0331 [0.005]		
Age	0.0625 [0.016]	0.0943 [0.012]	0.0094 [0.005]	0.0129 [0.004]
Age <sup>2</sup>	-0.0014 [0.000]	-0.0018 [0.000]	-0.0006 [0.000]	-0.0005 [0.000]
Cohort*Age	-0.0082 [0.002]	-0.0125 [0.002]	0.0003 [0.001]	0.0001 [0.001]
Log Supply			-0.0438 [0.0262]	0.0018 [0.018]
Constant	3.5632 [0.264]	2.8814 [0.199]	4.3452 [0.081]	4.1957 [0.061]
Observations	117	117	117	117
Adj. R-squared	0.931	0.955	0.923	0.936

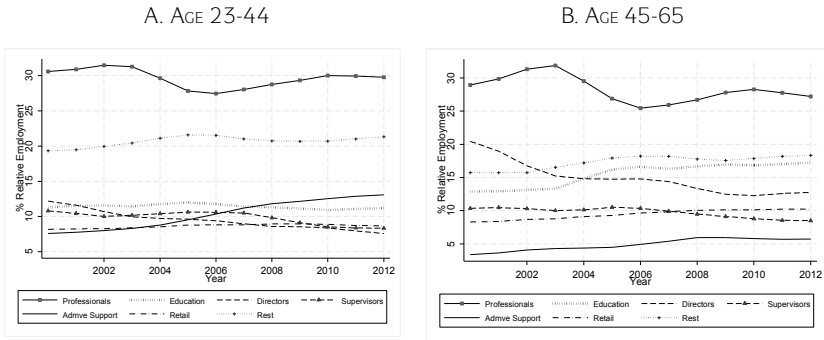
Notes: Authors' calculations using quarterly Labor Force Surveys. Cohort starts in 0 and ends in 7, where 0 is the oldest cohort and 7 is the youngest cohort. Age starts at 0 (Age-23). The constant can be interpreted as the average log hourly wage for the oldest cohort with an average age of 23. Log supply refers to the log of the proportion of individuals in that cohort with respect to total college-educated individuals. Specification 2 does not include the quadratic term given that it is no longer significant.

In order to disentangle the roles of labor demand across age groups, we analyze the pattern of employment by occupation level. We use the two-digit occupation category in the labor force surveys until 2012.<sup>14</sup> Figures 7 and 8 illustrate that the group that has been hurt the most is the category of *Director*. Their share in total employment declined (especially among older workers)

<sup>14</sup> It is not possible to go up to 2014 because the occupation category changed in 2012. Although the National Statistics and Geography Institute (INEGI) includes a dictionary to match occupation categories between time periods, there are still large discontinuities for some of the occupations in 2012.

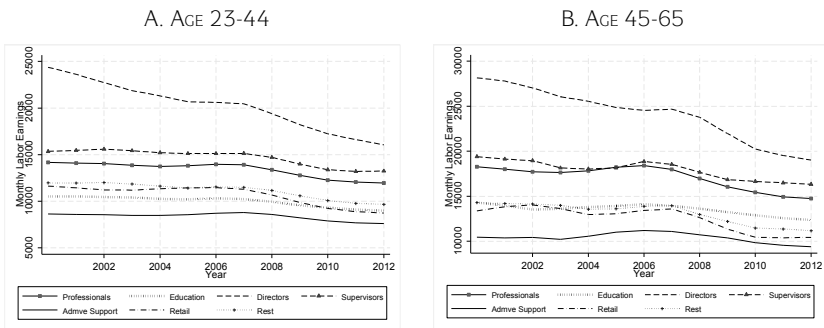
and their real wages fell the most. This result suggests that labor demand for highly-paid occupations has declined substantially, however this has affected both young and older workers.

FIGURE 7: CHANGE IN RELATIVE EMPLOYMENT BY AGE GROUP. RESTRICTED TO WORKERS WITH COLLEGE.



Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2012. Relative employment refers to the share in employment of that occupation out of total employment. Restricted to workers with college education. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.

FIGURE 8: MONTHLY EARNINGS BY AGE GROUP. RESTRICTED TO WORKERS WITH COLLEGE.



Notes: Authors' calculations using quarterly Labor Force Surveys from 2000 to 2012. Earnings are in constant Mexican Pesos 2014:1. Earnings refer to full-time workers (at least 30 weekly hours of work) with a valid wage. It includes workers with college education: salaried, self-employment and owners. Earnings below and above the 1 and 99 percentile (within gender and education group) are dropped. Lines are smoothed by a moving average with a 0.4 weight to the current observation and 0.3 to the previous and post observation.





#### 4. MAIN FINDINGS AND CONCLUSIONS

In sum, there is no evidence supporting the hypothesis that the decline in the wages of college-educated workers has been driven by what happened to younger workers. If the degraded tertiary effect or the demand-supply mismatch exists among younger workers, it has been more than offset by other forces. On the other hand, the evidence suggests that there is a process that negatively affects older workers, those of 50 and more in particular. Older workers, for example, do not feature the typical continuously increasing concave wage function; rather, they experience a sharper decline in their wage. These findings are summarized in Table 5. We also observe that the age at which the slope becomes negative occurs at younger ages with each cohort (Table 3). This could be evidence of an accelerated skills-obsolescence effect. However, the year at which the wage becomes negative for the college-educated of every cohort coincides with the year in which Mexico entered into recession: 2008.

TABLE 5: SUMMARY OF EVIDENCE

Hypothesis	Shown in	Degraded tertiary	Obsolescence / Labor Saving
Datt-Ravallion	Table 2	No evidence	Not applicable
Evolution of wages by age	Figure 4	No evidence	Some evidence that older workers' salaries fell more rapidly
Wage inequality by age	Figure 5	No evidence	Evidence consistent with high-wage older workers' wages falling relatively to other older workers' wages
Evolution of wages by cohort	Table 3	Some evidence with the very young cohorts but it overlaps with year of macro-economic crisis	Evidence that the wages of older workers decline
Cohort regression	Table 4	No evidence. On the contrary, the average entry-point wage has been increasing over time for the younger cohorts	Evidence that the wages of older workers decline in the more recent cohorts and that this accelerates with how recent the cohort is.

This paper examined whether there is evidence of a degraded tertiary education effect, a skills-obsolescence effect or both in explaining the decline in the relative wages of skilled workers in Mexico, which has been observed since the early 2000s. The fall in returns to college education may be the outcome of a process in a particular age group, for example, lower quality of tertiary education in younger workers—the “degraded tertiary education effect”. Another explanation is that older workers in recent cohorts receive lower wages than their counterparts in previous cohorts due to a skill mismatch with the demands of the economy or to a technical change that makes skilled-labor redundant—the “skills-obsolescence effect”.

Using data from Mexican labor surveys for the period between 2000 and 2014, we do not find evidence to support the hypothesis that the decline in the relative wages of skilled workers is explained by a degraded tertiary effect or a demand-supply mismatch among younger workers. If these effects have taken place, they have been more than offset by other forces. There is evidence, however, of a process that is taking a negative toll on workers of 50 years of age and older. Rather than a continuously increasing concave wage function, these workers present a sharper decline in their wage.

In addition, there is some support of an accelerated skills-obsolescence effect, which is suggested by the fact that the age at which the slope becomes negative occurs at younger ages with each cohort. Nevertheless, this finding must be interpreted with caution as the year at which the wage becomes negative for the college-educated of every cohort (2008) is the same year in which the country entered into recession.

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