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Mexico's labor market: The importance of education-occupation matching on wages and productivity in developing countries

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Abstract

The positive impact of education on earnings, wages, and economic growth is well documented; however, the issue of education-occupation matching in developing countries has been largely ignored. Since workers' levels of schooling and their occupations' required level of education both affect wages, policymakers may find it useful to note if such mismatches exist, if they impact wages, and if they can be avoided. Empirical results from Mexico suggest that in order to obtain the maximum economic benefits from increases in educational attainment levels, a developing country needs to take steps to assure increases in occupational levels also occur. Additional evidence of the positive link between educational attainment and wages is also provided. Due to the multi-period nature of the data; a new method of measuring required education is developed which opens up the education-occupation matching literature to data sets which are not cross sectional in nature.
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1. Introduction

One recent social development has been the increase in the average educational attainment of the global workforce. For instance, over the time period of 1975 to 1995, literacy rates rose from 79% to 90% in Mexico and from 31% to 48% in developing countries overall (World Bank, 2004). This development is significant due to the positive relationship between schooling and wages (Becker, 1964; Mincer, 1974; Card 1999) and the importance of education in economic growth (Lucas, 1988; Barro, 1991; Mankiw, Romer, & Weil, 1992). Implicit in this relationship is the ability of the labor market to effectively utilize the human capital of the workforce. In general, the literature does not address the issue of whether such an implicit assumption is applicable in developing countries.

With over 85% of the world population residing in low and middle income countries (per capita income less than $9,076), it is important to test the viability of the education-occupation matching literature in developing

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countries (World Bank, 2004). Given the differences between developed and developing countries, it is plausible that the findings in the overeducation literature may not hold outside the labor markets of high income countries. This paper examines some of the findings in the overeducation literature for a developing country. Given the importance of personal contacts in securing employment found in developing countries (Banerjee, 1991; Mortensen & Vishwanath, 1994), education-occupation mismatching may potentially be problematic.

In this paper, the level of required schooling is approximated using the average level of educational attainment for each occupational classification (see a complete description later in the paper). Adequately educated individuals have the required level of schooling to perform one's occupation—an education-occupation match. Undereducated individuals have less education than required and overeducated individuals have more education than required in their occupation.

It is important to remember that overeducation and undereducation are measured by an individual's years of education as compared to the years of education necessary for their occupation and are relative terms. Thus, in a country like Mexico we still find overeducated individuals because Mexico has a relative abundance of jobs that require low levels of educational attainment. Researching education-occupation mismatches in Spain, Alba-Ramirez (1993, p. 260) notes that overeducation can exist "since even in an economy without a surplus of college graduates … it is likely that some workers perform jobs for which they are overqualified." This research does *not* imply that an overeducated (undereducated) worker has more (less) than the "optimal" amount of schooling. In fact, we are making no claim as to what the "optimal" amount of education is; only that overeducation, as commonly defined, exists in developing countries.[1]

In addition to impacting wages (as will be shown), several studies depict overeducation as potentially having adverse effects on productivity (Tsang, Rumberger, & Levin, 1991; Duncan & Hoffman, 1981; Rumberger, 1987; Tsang, 1987; Tsang & Levin, 1985), job satisfaction (Tsang & Levin, 1985; Allen & van der Velden, 2001), and worker turnover/mobility (Sicherman, 1991; Alba-Ramirez, 1993; Robst, 1995a). Moreover, overeducation and migration have been shown to be positively linked (Quinn & Rubb, 2005).

This paper is the first known empirical study to examine the impact of education-occupation mismatches on wages in a developing country. If educational mismatches exist, future economic researchers and policy makers may find it useful to see if they can be avoided. Specifically, if educational mismatches exist and have an adverse impact on wages and productivity, efforts to improve educational attainment levels across society without corresponding increases in occupational levels may not be successful at maximizing economic growth. The study also examines the existing theoretical framework for education-occupation mismatches as it applies to the Mexican labor market. In turn, this research helps generalize the literature by confirming earlier studies of Mexico's labor market using the standard wage model described by Mincer (1974). The focal point of the paper is an examination of the returns associated with education-occupation mismatches using the wage model developed by Duncan and Hoffman (1981). The study tests for the robustness of the findings by using a variety of specifications for the amount of required education in each occupation, including a new method of measuring required education. This new method of measuring required education is intended to solve any potential biases that may arise from the literature's standard mean/mode approaches being applied to non-cross sectional data. The results are then compared and contrasted to findings in more developed countries.

2. Education-occupation mismatching

In developed countries the incidence and the wage effects of education-occupation mismatches, specifically overeducation, are well documented in the literature. Recent surveys by Rubb (2003a) and Hartog (2000) discuss studies on overeducation for Germany, the Netherlands, Spain, the United Kingdom, Portugal, Hong Kong and the United States. These studies show that overeducated individuals earn less than others with similar levels of schooling who are in occupations that require their level of education. Nonetheless, the returns from the schooling that cause the overeducation remain positive. That is to say, overeducated individuals earn more than individuals with less schooling in their occupation. Likewise, undereducated individuals earn more than other individuals with their level of schooling, but less than their adequately educated work colleagues. For example, an individual with 7 years of education who works in an occupation that requires 8 years of education will earn more than an individual with 7 years of education who is working in an occupation that requires only 7 years of education.

[1] In a somewhat similar vein, the existence of overeducation in Mexico does not provide any per se evidence of an inefficient labor market. After all, overeducation exists in highly developed and efficient labor markets. None-the-less, development economists generally find inefficient labor markets to be common in developing economies (Giugale, Lafourcade & Nguyen, 2001; Perkins, Radelet, Snodgrass, Gillis, & Roemer, 2001; Poirson, 2000a; Poirson, 2000b; Rama, 1998; Shen 1984).

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In total, the fact that the returns from education vary depending on whether an individual is overeducated, adequately educated, or undereducated potentially implies that society's human capital is potentially not being fully utilized. A strict interpretation of human capital theory would suggest that the returns from additional schooling that is required be the same as the returns from schooling if an individual is overeducated or undereducated, at least in the long run if other things are equal. On the other hand, this does not imply that education is completely unproductive. For this to occur, the returns from overeducation and undereducation must be zero. If this is the case, schooling only impacts wages indirectly via changes in required education (Duncan & Hoffman, 1981).

While the primary goal of this research is to test the impact of education-occupation mismatches on wages, several theories have been developed explaining the existence of education-occupation mismatches—three of which are particularly relevant for the case of Mexico. The research presented in this paper is not intended to definitively comment on any of the alternative explanations of the existence of overeducation for developing countries. Moreover, this paper is not intended to add to the discussion as to the causes of overeducation in developed countries found in the literature.[2]

First, overeducation may occur if employers use education as a means of job-screening in labor markets with imperfect information (Spence, 1973). This source of education-occupation mismatches may be particularly acute in countries such as Mexico with less readily available employment information. Overeducation exists, in part, because of problems associated with asymmetric information.

Second, Thurow (1975) develops a job competition model where potential employers use education as an indicator of the cost of investing in an individual's training to perform a specific job in an environment with asymmetric information. As such, employers may hire employees with more education to potentially save on training costs. Highly educated individuals may accept employment for which they are overeducated while competing for a job. Rumberger (1987, p. 26) notes "since this allocation is based on available supplies of both individuals and jobs, workers may possess more education and skills than their jobs requires. In other words, employers may be unable or unwilling to fully utilize the education and skills of their workers."

The third plausible explanation for the existence of education-occupation mismatches can be found in the assignment models of the labor market (Sattinger, 1993). In these models, the returns associated with additional education depend, in part, on the quality of the assignment of heterogeneous workers to heterogeneous jobs. The returns associated with investments in human capital via educational attainment are limited if occupations do not utilize all of the schooling of the workers. That is to say, overeducated individuals earn less than others with their level of educational attainment because of an occupational ceiling on productivity. Indeed, the existence of "unequal wage structures among economic sectors provide indirect evidence of an assignment problem" (Sattinger, 1993, p. 837).

In this light, the marginal product of labor and wages are associated primarily with the job's characteristics, not the employee's characteristics, as human capital theory suggests. In Mexico, employers may not be flexible in their ability to utilize the surplus human capital of overeducated employees. If this occurs, productivity and the returns on wages from higher levels of schooling will be fully realized only if additional educational attainment levels are accompanied by increases in occupational levels.

3. Data and definitional issues

The data is taken from the 1987 to 1999 Mexican Migration Project (MMP) 1987–1997 which is run jointly by the University of Guadalajara and Princeton University. Each year the MMP generally samples at least 200 households from three to five different (non-repeating) Mexican communities. This multi-period cross-sectional data set is analogous to the traditional cross-sectional data sets used in the studies cited in this paper. Excluded from the analysis are individuals who are not in the labor force, old individuals (over age 65), young individuals (under age 15) and those considered to be self-employed. As a check for robustness, separate estimates were made which excluded individuals in occupations with fewer than 10 observations. Estimates were also made placing such individuals into the nearest/similar occupational category. The results for these

[2] Johnson (1978) and Jovanovic (1979) hypothesize that some workers temporarily accept jobs for which they are overqualified because of the cost associated with finding a proper job. Job search cost are likely prevalent in developing economies. Sicherman and Galor (1990) and Robst (1995a) suggest that young workers accept positions for which they are overeducated to gain experience that will help with future career mobility. This second best employment results in some individuals being temporarily overeducated and is plausible for Mexican workers. Human capital theory tells us that overeducated workers may substitute weaknesses in other areas of human capital by having more schooling than required. Such weaknesses include lower quality schooling (Robst, 1995b), less experience due to career interruptions (Mincer & Polachek, 1974), less on the job training (Sicherman, 1991) anda variety of other possibilities. In Mexico, human capital differences are also likely to exist among those with a similar level of educational attainment. These theories view overeducation as part of an efficient labor markets (see note 1).

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additional estimates (not shown for brevity) are also robust.

The sample contains a total of 4945 men and is believed to be large enough to make reliable statistical inferences.[3] The data set is useful because it contains 100 occupational categories. Moreover, the data set provides information on wages, metropolitan area, marital status, and years of schooling. The MMP samples both urban and rural communities. Interested readers can learn more about the data set at http://mmp.opr.princeton.edu.

Several different methods of measuring required education (*ED_REQ*) have been developed in the literature. To check the robustness of the findings, this paper uses two existing definitions of required education and introduces a third definition. The first measure of required education uses each occupation's mean level of schooling (ED_REQ_{MEAN}). For the purpose of measuring the incidence of overeducation only (not the returns associated with the years of overeducation and the years of undereducation), individuals will be overeducated for a particular occupation if their level of education exceeds ED_REQ_{MEAN} by one standard deviation. The approach has been used with US data (Verdugo & Verdugo, 1989; Cohn & Khan, 1995; Rubb, 2003b), US and Hong Kong data (Cohn, Johnson, & Ng, 2000), Hong Kong data (Ng, 2001), and Portugal data (Kiker, Santos & De Oliveira, 1997).

The second method of measuring required education uses the mode level of educational attainment within an occupational category (ED_REQ_{MODE}). This recent introduction into the literature has been applied in studies of Portugal (Kiker et al., 1997), Hong Kong (Ng, 2001), and both the US and Hong Kong (Cohn, Johnson, & Ng, 2000).[4]

Note that only Kiker et al. (1997) and Ng (2001) use both the mean and mode level of measuring required education. Accordingly, these studies of Portugal (Kiker et al.) and Hong Kong (Ng) will be used to contrast and generalize the findings of this study. Both examine data from 1991. It should be noted that in 1991 GNP per person for Mexico, Portugal, and Hong Kong are $4816, $11,284, and $19,750, a sizeable difference (in 2002 US dollars, IMF, 2003). Portugal is particularly relevant as it has the lowest income of the high-income countries analyzed in the existing overeducation literature.

The multi-period nature of the MMP data set is different than the purely cross-sectional data sets used in other studies. It is possible that the nature of the data set biases the results. This bias may arise if the educational levels required to perform specific occupations are dynamic. Required educational levels for an occupation may be dynamic over time with changes in technology and educational quality. To check for this possibility, an alternative measure of required education is developed. This new measure allows required education to vary based on the individuals' year of birth and the survey year. As a first step, the following regression is run:

$$ED\_ACTUAL = \Sigma\beta_{\mathrm{occup}} OCCUP + \beta_{\mathrm{birth}} BIRTH + \beta_{\mathrm{year}} YEAR + \varepsilon, \quad (1)$$

where *ED_ACTUAL* is an individual's actual educational attainment, *OCCUP* is a vector of occupational dummy variables, *BIRTH* is an individual's year of birth, *YEAR* is a time trend variable that captures the year of the survey and ε is an error term. General (not occupation specific) changes in the level of required education are controlled for with the coefficients for *BIRTH* and *YEAR*. The coefficients of this estimate are then used in an alternative measure of *ED_REQ* described next. The coefficients for *BIRTH* and *YEAR* are .106 and .050, respectively, and are statistically significant at the .01 level.

Since the equation does not include a constant and each individual belongs to only one occupation ($\Sigma OCCUP = 1$), the estimates of the occupation coefficients can be used to calculate the level of education required to perform a specific occupation given the individual's year of birth and the year of the survey (ED_REQ_{OLS}). That is to say, we estimate a level of required education unique to each individual. For the purposes of measuring the incidence of overeducation and undereducation (not the wage estimates), individuals are categorized as overeducated (undereducated) if their level of schooling exceeds (is less than) ED_REQ_{OLS} by one standard error of the estimate for β_{occup}. It should be noted that among those considered to be overeducated using ED_REQ_{MEAN}, only 65% are overeducated using ED_REQ_{OLS}, with the rest considered to be adequately educated. As noted in note 4, other studies show that the measure of required education generally has a substantial impact on the incidence of overeducation, but little impact on the returns from schooling via wages.

[3] The sample also contains 493 female observations with sufficient data for purposes of this study. Fewer female observations are observed due to the fact that the MMP collects occupation data from household heads. Female head of households may be an atypical group in Mexico. Results for women are available from the authors upon request.

[4] Other methods of measuring the level of required education include an independent job analysis and directly asking the employee how much education his job requires. The measure of required education generally has a substantial impact on the incidence of overeducation, but little impact on the returns from schooling via wages (see Hartog (2000), Rubb (2003a), Rumberger (1987), or the results presented in Table 1 and 6).

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4. Incidences of education-occupation mismatches

Table 1 gives the incidence of overeducation and undereducation for Mexico, Portugal, and Hong Kong. As is found elsewhere in the literature, the measure of required education used has a tremendous impact on the incidence of overeducation and undereducation (see note 4). Since both the quality of education and needs within occupations vary between countries at any point in time, any measure of required education using an average will have its setbacks. The problem is even more compounded by the multi-period nature of the data set which is necessary to capture educational mismatches with the Mexican data set (hence, the motivation for creating the OLS approach for required education). As such, caution is advised in interpreting incidence results. Despite this caution, a presentation of the incidence of overeducation and undereducation is standard in the literature and is provided here. Additionally, comparisons of Mexico to other more developed countries are presented to give interested readers a sense of how Mexico's educational mismatch problem is or is not unique.

The overall incidence of overeducation in Mexico is 17.2% using the mean definition of required education for men. Using the mode and OLS definition of required education, the incidence of overeducation is 39.9 and 13.5%, respectively. Mexican men have a higher incidence of overeducation than men in Portugal and Hong Kong (Kiker et al., 1997; Ng, 2001).[5] The incidence of undereducation in Mexico is 19.4% using the mean definition of required education for men. Using the mode and OLS definition of required education, the incidence of undereducation is 30.9% and 13.8%, respectively. The incidence of undereducation is higher in Mexico than in Portugal and Hong Kong.

It is plausible that over the time period of the study the incidence of overeducation and undereducation changed. Table 2 shows the incidence of overeducation and undereducation for four separate time periods using the estimates of required education developed for the 13 year period. Caution is advised in interpreting the results because the incidence of over- and under- education is sensitive to the definition of required education and because the demographic characteristics of the sample change each year. Tentatively, a lower incidence of overeducation existed in the late 1980s.

Education-occupation mismatches may occur to offset strengths and weaknesses in other areas of human capital, most notably potential experience (*EXP*) estimated as an individual's age minus years of education minus five. We hypothesize that overeducated workers will have lower amounts of experience and undereducated workers will have greater experience. To test this hypothesis, three multinomial logit models are run of the form:[6]

$$\mathrm{LOG}[Pr(O)/Pr(A)] = \beta_{\mathrm{ed}} ED\_ACTUAL + \beta_{\mathrm{ex}} EXP + \beta_{\mathrm{ex2}} EXP^2 + \beta_{\mathrm{US}} EXP{\sim}US + \beta_{\chi}\chi + \varepsilon \quad (2)$$

and

Table 1
Incidence of overeducation and undereducation for men

	Men		
	Mean	Mode	OLS
Mexico 1987–1999			
Overeducated	17.2	39.9	13.5
Undereducated	19.4	30.9	13.8
Portugal 1991[a]			
Overeducated	10.9	25.5	n.a.
Undereducated	5.3	16.0	n.a.
Hong Kong 1991[b]			
Overeducated	14.2	37.3	n.a.
Undereducated	11.7	28.1	n.a.

[a]Kiker et al. (1997).
[b]]Ng (2001).

Table 2
Incidence of overeducation and undereducation for men in Mexico

	Men		
	Mean	Mode	OLS
1987–1989 ($n = 1442$)			
Overeducated	11.3	30.1	10.5
Undereducated	26.1	35.9	13.8
1990–1991 ($n = 1092$)			
Overeducated	17.7	42.7	15.5
Undereducated	16.9	34.0	12.4
1992–1994 ($n = 1288$)			
Overeducated	20.1	42.0	16.1
Undereducated	15.9	27.9	13.9
1995–1999 ($n = 1,123$)			
Overeducated	20.9	47.5	12.4
Undereducated	17.2	24.9	15.1

Four time periods.

[5]It should be noted that these studies likely use different occupational classification systems.

[6]See Kiker et al. (1997) and Alba-Ramirez (1993).

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$$\mathrm{LOG}[Pr(U)/Pr(A)] = \beta_{\mathrm{ed}} ED\_ACTUAL + \beta_{\mathrm{ex}} EXP + \beta_{\mathrm{ex2}} EXP^2 + \beta_{\mathrm{US}} EXP{\sim}US + \beta_{\chi}\chi + \varepsilon. \quad (3)$$

The models capture the probability that an individual is overeducated and undereducated (compared to being adequately educated). $Pr(\mathrm{O})$, $Pr(\mathrm{U})$ and $Pr(\mathrm{A})$ represent the probability and individual is overeducated, undereducated, and adequately educated, respectively. χ is a vector of other control variables listed in Table 3. US experience impacts the model in three ways, EXP, EXP^2, and $EXP{\sim}US$. As such, the coefficient for months of US experience is relative to overall experience. Yearly and regional fixed effects are controlled for with dummy variables. All regressions also contain an individual's actual educational level, ED_ACTUAL.

Table 4 presents the multinomial-logit results for Eq. (2) and (3). Potential experience decreases the likelihood that an individual is overeducated (relative to being adequately educated) for most relevant values of experience. In general, experience increases the likelihood of men being undereducated (relative to being adequately educated). Experience is shown to have a similar impact on the likelihood of overeducation and undereducation in Spain (Alba-Ramirez, 1993) and in Portugal (Kiker et al., 1997).

Months of US experience has a positive impact on the likelihood of being overeducated (relative to being adequately educated). The negative relationship between overall experience and the likelihood of overeducation is smaller in magnitude when one's experience is obtained in the United States. This suggests Mexican workers with US experience are less likely to have found Mexican employment for which they are adequately educated. These results are consistent with the hypothesis that contacts are playing a role in employment decisions. Individuals with (without) US work experience are less (more) likely to have developed contacts in Mexico and more (less) likely to be in jobs for which they are overeducated, Ceteris paribus. While this is a plausible explanation for the US experience result, there is no theoretical prediction for this variable.

Residences of a large metropolitan area are robustly less likely to be overeducated for their occupations and generally more likely to be undereducated. Marital status does not have a robust statistically significant impact on the likelihood of overeducation and undereducation for men. Actual education has a statistically significant positive relationship with overeducation and a negative relationship with undereducation, as is found in studies of Spain (Alba-Ramirez, 1993) and Portugal (Kiker et al., 1997).

5. Wage estimates—empirical strategy

The paper uses two approaches to modeling wages. The first approach follows the Mincerian specification (Mincer, 1974)

Table 3
Descriptive statistics of select independent variables

	Mean	Std. Dev	Description
ED_ACTUAL	6.08	4.68	Individual's actual level of educational attainment
ED_OVER	1.32	2.16	Years overeducated (*mean*)
	1.66	2.62	Years overeducated (*mode*)
	1.18	1.98	Years overeducated (*OLS*)
ED_REQ	1.32	1.86	Years of required education by occupational category (*mean*)
	1.20	2.10	Years of required education by occupational category (*mode*)
	1.18	1.68	Years of required education by occupational category (*OLS*)
ED_UNDER	6.08	3.21	Years undereducated (*mean*)
	5.62	4.21	Years undereducated (*mode*)
	6.08	3.53	Years undereducated (*OLS*)
EXCH RATE	4.23	2.38	Mexican peso—US dollar exchange rate in survey year
EXP	28.86	13.99	Potential experience (age—ED_ACT-5)
EXP~US	16.19	44.33	Months of experience in US labor market
MARRIED	0.94	0.23	Marital Status (1 if Married)
METRO_1	0.25	0.43	Resident of metropolitan area with population >100,000
METRO 2	0.30	0.46	Resident of medium city with population 15,000–100,000
METRO_3	0.29	0.45	Resident of town with population 2500–15,000
METRO_4 (base)	0.16	0.37	Resident of village with population less than 2500

Sample consists of 4945 Mexican men.

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Table 4
Multinomial logit estimate of the likelihood of educational mismatches: Men in Mexico's workforce, 1987–1999

	Mean		Mode		OLS	
	Overed. Log[$Pr(O)/Pr(A)$]	Undered. Log[$Pr(U)/Pr(A)$]	Overed. Log[$Pr(O)/Pr(A)$]	Undered. Log[$Pr(U)/Pr(A)$]	Overed. Log[$Pr(O)/Pr(A)$]	Undered. Log[$Pr(U)/Pr(A)$]
ED_ACTUAL	0.023 (16.7)*	−0.007 (25.9)*	0.043 (9.6)*	−0.043 (12.0)*	0.028 (24.5)*	−0.022 (24.2)*
EXCH_RATE	−0.045 (2.3)**	0.0002 (0.1)	−0.066 (0.2)	0.132 (5.1)*	−0.040 (3.3)*	0.030 (5.1)*
EXP	−0.008 (5.0)*	−0.0001 (0.8)	−0.020 (5.3)*	0.016 (3.2)*	0.005 (4.2)*	−0.003 (5.1)*
*EXP*2/1,000	0.093 (3.2)*	0.002 (1.2)	0.283 (4.7)*	−0.216 (3.0)*	−0.020 (1.1)	0.006 (0.7)
EXP∼*US*/100	0.046 (4.4)*	−0.0005 (0.2)	0.091 (4.2)*	−0.041 (0.1)	0.020 (2.8)*	−0.005 (1.1)
MARRIED	0.005 (0.2)	−0.002 (1.0)	0.064 (1.9)**	−0.007 (0.7)	−0.049 (2.6)*	0.003 (0.4)
METRO_1	−0.051 (2.8)*	0.012 (5.4)*	−0.260 (6.7)*	0.174 (2.1)	−0.040 (2.8)*	0.101 (9.2)*
METRO_2	−0.036 (2.2)**	0.004 (2.9)*	−0.195 (7.0)*	0.056 (1.2)	−0.039 (3.3)*	0.035 (5.4)*
METRO_3	−0.032 (1.8)***	0.003 (1.9)***	−0.157 (5.8)*	0.015 (2.2)**	−0.037 (3.2)*	0.014 (2.2)**
Observations	4945		4945		4945	
Log Likelihood	−2661.9		−4634.8		−2582.3	

A constant, 12 state and 12 year of survey dummy variables are included in each estimate. $Pr(O)$, $Pr(U)$, and $Pr(A)$ represent the probability an individual is overeducated, undereducated, and adequately educated, respectively. Estimates are the marginal effects observed at the mean of the independent variables. Z-statistic in parenthesis; * significant at 1% level; ** significant at 5% level; *** significant at 10% level.

$$\ln W = \beta_{ed} ED\_ACTUAL + \beta_{ex} EXP + \beta_{ex2} EXP^2 + \beta_{US} EXP{\sim}US + \beta_\chi \chi + \varepsilon. \quad (4)$$

The natural log of real monthly wages (1987 pesos) is a function of an individual's actual years of schooling (*ED_ACTUAL*, which is a continuous variable) and other control variables (see Table 3).

The second approach follows the work of Duncan and Hoffman (1981) in modeling wages as a function of years of overeducation (*ED_OVER*), years of undereducation (*ED_UNDER*), and required education (*ED_REQ*). Overeducation is the amount of actual schooling an individual has in excess of required education. Undereducation implies the opposite. That is

$$ED\_OVER = ED\_ACTUAL - ED\_REQ \quad \text{if } ED\_ACTUAL > ED\_REQ$$

$$ED\_OVER = 0 \text{ otherwise}$$

and

$$ED\_UNDER = ED\_REQ - ED\_ACTUAL \quad \text{if } ED\_ACTUAL < ED\_REQ$$

$$ED\_UNDER = 0 \text{ otherwise.}$$

It should be noted that *ED_OVER* and *ED_UNDER* are continuous variables measured in years. Wages are a function of overeducation, required education, and undereducation, not actual schooling. That is

$$\ln W = \beta_0 ED\_OVER + \beta_r ED\_REQ + \beta_u ED\_UNDER + \beta_{ex} EXP + \beta_{ex2} EXP^2 + \beta_{US} EXP{\sim}US + \beta_\chi \chi + \varepsilon. \quad (5)$$

All variables are as previously defined. In this context the marginal returns from additional education given employment in a particular occupation are β_0 if overeducated and $-\beta_U$ if undereducated. If Mexican employers are unable to utilize (offset) the surplus (deficit) education of the workers, $\beta_0(\beta_U)$ will not be statistically different from zero. As mentioned previously, in developed countries the returns from overeducation are positive ($\beta_0 > 0$), but lower than the returns from required education ($\beta_r > \beta_0$).

6. Wage estimates—empirical results

The "standard" columns in Table 5 present the results of the Mincerian wage equation (Eq. (4)). The results are as expected with each additional year of schooling increasing expected monthly wages by 6.5%. Using data from the 'Encuesta Nacional de ingresos y gastos de los hogares' Psacharopoulos, Velez, Panagides, and Yang (1996) find the returns from an additional year of schooling to be 13.4% and 14.7% for the years 1989 and 1992, respectively.[7] The positive relationship most likely occurs because educational attainment develops cogni-

[7] Psacharopoulos, Velez, Panagides, and Yang (1996) note that the overall rate of return from schooling in Mexico in 1963 was 15% according research by Carnoy (1967). An explanation of the differences in the rates of return go beyond the scope of this paper; however, it should be noted that Psacharopoulos, Velez, Panagides, and Yang only control for experience, schooling, and hours worked per week (a variable not available in the MMP data set).

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Table 5
Monthly wage estimates for men in Mexico, 1987–1999; Standard and overeducation, required education, undereducation models

	Men			
	Standard	Mean	Mode	OLS
ED_ACTUAL	0.063 (14.4)*	—	—	—
ED_OVER	—	0.043 (5.2)*	0.048 (6.9)*	0.049 (5.8)*
ED_REQ	—	0.085 (16.1)*	0.076 (16.2)*	0.090 (15.0)*
ED_UND	—	−0.030 (3.1)*	−0.036 ((4.3)*	−0.039 (4.0)*
EXCH_RATE	1.058 (19.4)*	1.039 (19.2)*	1.026 (18.9)*	1.018 (18.7)*
EXP	0.011 (2.2)**	0.009 (1.8)***	0.009 (1.7)***	0.015 (3.1)*
$EXP^2/1000$	−0.153 (2.0)**	−0.155 (2.0)**	−0.130 (1.7)***	−0.168 (2.2)**
EXP∼US	0.005 (15.1)*	0.005 (15.7)*	0.005 (15.6)*	0.005 (15.6)*
MARRIED	0.140 (2.0)**	0.143 (2.0)**	0.148 (2.1)**	0.128 (1.8)***
METRO_1	0.254 (4.2)*	0.218 (3.6)*	0.190 (3.1)*	0.191 (3.1)*
METRO_2	0.996 (19.1)*	0.982 (18.9)*	0.970 (18.6)*	0.956 (18.3)*
METRO_3	0.669 (12.1)*	0.657 (11.9)*	0.649 (11.8)*	0.645 (11.7)*
Observations	4945	4945	4945	4945
F-statistic	1605.0	1531.3	1530.7	1527.6
R squared (adj.)	0.91	0.92	0.92	0.92

A constant, 12 state and 12 year of survey dummy variables are included in each estimate.
Natural log of wages in 1987 pesos. *t*-values in parenthesis;
*significant at 1% level; ** significant at 5% level; *** significant at 10% level.

tive skills, thus improves wages via increases in human capital.[8]

Other variables are as predicted. The peso-dollar exchange rate has a positive impact on wages which are measured in pesos. The peso depreciating leads to an increase in Mexican exports to the United States and has a positive effect on Mexican wages. Marriage has a positive impact on expected wages. The wage-experience profile reveals the traditional concave shape. US experience is rewarded at a higher rate than Mexican experience (note that the other experience variables (*EXP* and EXP^2) contain both US and Mexican experience) with each month of US experience increasing expected wages by roughly one half of one percent. This suggests that although US experience has a negative effect on education-occupation matching; once a position is secured, US experience has a positive impact on wages.

Table 5 also presents the returns associated with schooling when educational mismatches occur (Eq. (5)). Each additional year of required education increases expected wages, with coefficient estimates between .076 and .090. For overeducated men, the return on wages from additional schooling is slightly more than half the return from an increase in required education.[9] It should be noted that education beyond the required level is not completely unproductive; however, overeducated workers potentially face a soft occupational ceiling on their productivity. Overeducated workers receive higher wages by working in occupations that require their level of schooling. Moreover, the coefficient estimates for the overeducation variable are consistent with results for developed countries (see Table 6). As previously stressed, this research *does not* imply that an overeducated worker has more than what society would consider being the "optimal" amount of schooling as such an implication is likely false, but the research *does* imply that society can increase its wages by increasing the employment opportunities of overeducated workers. The coefficient estimates for the undereducation variable range from −.039 to −.030.

The coefficient estimates for the undereducation and overeducation variables are smaller in magnitude than the coefficient estimates for required schooling. That is to say the returns from additional schooling vary based on whether an individual is overeducated, undereducated, or adequately educated. To the extent possible, economic researchers, educators and policy makers should be interested in discovering ways to foster proper labor market assignments and offset problems associated with asymmetric information. Moreover, the

[8]Alternative explanations for the relationship between educational attainment and income are not ruled out by this research.

[9]The finding is not the result of diminishing returns from educational attainment. In an alternative version of Eq. (4) (not shown for brevity), containing *ED_ACTUAL* and its squared value, both coefficients are positive, suggesting increasing returns.

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Table 6
Summary of returns from overeducation, required education for and undereducation; Men in Mexico, Portugal, and Hong Kong

	Men		
	Mean	Mode	OLS
Mexico 1987–1999			
Overeducation	0.043	0.048	0.049
Required education	0.085	0.076	0.090
Undereducation	−0.030	−0.036	−0.039
Required less overeducation	0.042	0.028	0.041
Under-plus required education	0.055	0.040	0.051
Portugal 1991[a]			
Overeducation	n.a.	0.063	n.a.
Required education	n.a.	0.086	n.a.
Undereducation	n.a.	−0.054	n.a.
Required less overeducation	n.a.	0.023	n.a.
Under- plus required education	n.a.	0.032	n.a.
Hong Kong 1991[b]			
Overeducation	0.060	0.050	n.a.
Required education	0.140	0.130	n.a.
Undereducation	−0.010	−0.040	n.a.
Required less overeducation	0.080	0.080	n.a.
Under-plus required education	0.130	0.090	n.a.

[a]Kiker et al. (1997).
[b]]Ng (2001).

importance of occupational levels is made evident. Efforts by policymakers to increase educational attainment should be done in conjunction with increasing occupational levels.[10]

7. Conclusion

This study attempts to fill a void in the literature by examining education-occupation mismatches in a less developed country—specifically Mexico. As is found in developed countries, the coefficient estimates for overeducation and undereducation are significantly less than the coefficient estimates for required education, tentatively suggesting that wages are also linked to an occupation's required level of educational attainment. For overeducated workers in Mexico, the return on wages from additional schooling is slightly more than half the return from an equal increase in required education. While it is likely that the average Mexican worker has less education than what would be considered "optimal" for the economy, this research suggests that average wages would increase more if increases in educational attainment levels are accompanied by increases in occupation levels.

This paper represents the first education-occupation matching study to utilize data over several time periods. In seeking to expand this literature beyond strictly cross-sectional data sets, the paper presents a new approach to measuring required education. This new measure allows for required education to vary over time. This will hopefully lead future researchers to expand education-occupation research into panel data sets which would allow for the study of the dynamic effects of this phenomenon.

In addition, this paper serves to generalize the Mexican labor market literature by confirming the work of Psacharopoulos, Velez, Panagides, and Yang (1996) and Carnoy (1967), who also find a positive relationship between education attainment and wages. This paper finds wages to increase by 6.5% if male with each additional year of schooling. The results suggest that the Mexican educational system is effective (though not necessarily efficient) at increasing productivity and wages.

While the data set used in this analysis provides a large number of observations that allows for reliable statistical inferences, it also limits the study in several ways. First, the level of required education is measured in a way that can best be interpreted as a market result. Other methods of measuring required education such as a job analysis of each occupation might lead to other results (see note 4). Second, it would be beneficial to know how education-occupation mismatches directly impact economic development, not just wages. Third, it would be useful to know how education-occupation mismatches impact wages in other less developed countries. The data set used in this research does not allow for an analysis of these issues.

While education-occupation mismatching does *not* demonstrate labor market inefficiencies per se, labor market inefficiencies are commonly believed to exist in developing economies (see note 1). To the extent that overeducation is the result of an inefficient labor market, results in this paper reflect the obvious—improved efficiency will lead to greater economic output. What we provide is a plausible channel in which to improve economic efficiency. For policymakers and researchers, this reflects the importance of promoting better screening mechanisms for employment. The traditional usage of personal contacts as a method of selecting employees may result in labor market inefficiencies and a loss in

[10]If overeducation and undereducation are viewed as part of an efficient labor market as discussed in note 2, the results and policy implications remain essentially unchanged. Individuals with the required level of schooling will increase their wages more if increases in their human capital are accompanied by increases in occupational levels regardless of the reason for the overeducation. Efforts to also focus on increases in occupational levels may be particularly important in developing countries because there is not an abundance of such occupations.

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social welfare. Whether or not policy makers should devote resources towards improving labor market matching depends on the answer to the following question: in developing countries, is overeducation the result of labor market inefficiencies? Future research which answers this question may prove to be of tremendous value.

8. Uncited reference

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