# Endogenous Skill Acquisition and Export Manufacturing in Mexico*

David Atkin†

December 2009

**Abstract**

Studies based on firm-level data find that both exporting firms and multinational corporations pay higher wages, for a given skill level. However, the literature overlooks the fact that export manufacturing firms may also change the educational choices of the workforce. This paper confirms that for Mexico over the period 1986-2000, the export sector pays higher wages than other sectors, but school drop out increases with the arrival of new export jobs. The workers induced to enter export manufacturing eventually earn less than they would have earned had the jobs never appeared and they stayed in school. I causally identify these effects by looking within 2,443 municipalities and examining how the education of different cohorts varies with new factory openings in the municipality at key school-leaving ages. Export manufacturing attracts impatient students by paying very high relative wages accompanied by low returns to a few more years of education, and offering plenty of jobs to low-skill workers straight out of school. The magnitudes I find suggest that for every ten new jobs created, one student drops out of school at grade 9 rather than continuing on through grade 12.

JEL Codes: F16, J24, O12, O14, O19

*Preliminary and incomplete. Special thanks to David Kaplan at ITAM for computing and making available the IMSS Municipality level employment data. Thanks to Angus Deaton, Penny Goldberg and Gene Grossman for guidance and encouragement throughout. Further thanks to David Card, Richard Chiburis, Hank Farber, Marco Gonzalez-Navarro, Leonardo Iacovone, Fabian Lange, Adriana Lleras-Muney, Marc Melitz, Marc-Andreas Muendler, Jesse Rothstein, Sam Schulhofer-Wohl, Eric Verhoogen and seminar participants at Princeton, the 15th BREAD conference, the 1st LACEA TIGN conference and Yale for their useful comments. Financial aid from the Fellowship of Woodrow Wilson Scholars at Princeton University is gratefully acknowledged. Any errors contained in the paper are my own.

†Department of Economics, Yale University, 27 Hillhouse Ave., CT 06511. E-mail: david.atkin@yale.edu

# 1 Introduction

There is a large and growing literature exploring the impact of exporting firms and multinational corporations on developing countries. One of the most robust stylized facts to come out of the study of microlevel firm data has been that exporting firms pay higher wages.[1] This was first shown for Mexico by Bernard (1995) and later by Zhou (2003) and Verhoogen (2008). Similarly, Aitken, Harrison, and Lipsey (1996) demonstrate that foreign firms in Mexico pay higher wages compared to domestic firms.

All these studies focus on salaries paid by firms, and identify exporter or foreign firm wage premia while controlling for education levels. However, individual incomes depend on both the education of the worker and the salary paid at each education level, and export manufacturing may induce a different amount of skill acquisition. This paper finds that this is exactly what happened in Mexico. I use lumpiness in the timing of sectoral employment changes at key school leaving ages within municipalities to show that, unlike other formal sector jobs, expanding export industries pulled workers out of school at younger ages, permanently inhibiting their skill acquisition. The booming high-tech export-manufacturing industries that sprung up in Mexico with trade liberalization did pay higher wages conditional upon education levels, but workers eventually experienced lower incomes due to these new job opportunities. These lower incomes resulted from workers acquiring less education than they would have otherwise, and accordingly receiving lower salaries by the end of the sample period, commensurate with their skill level.

Mexico provides a perfect setting to study the impacts of globalization on the labor force. Over the period spanned by the data (1985-2000), Mexico turned its back on import substitution and liberalized trade. The country joined GATT in 1986 and gradually reduced tariffs, culminating with the signing of NAFTA in 1994 and its subsequent implementation. During these years, Mexico's economy underwent a rapid transition. Many new plants opened, often in the form of Maquiladoras,[2] to manufacture products for export. Total employment in export manufacturing rose from

[1]Bernard and Jensen (1995) first presented this fact for the US, and later other authors confirmed this for many developing countries including Chile, Colombia, Estonia, Korea, Slovenia, Taiwan and Sub-Saharan Africa. Schank, Schnabel, and Wagner (2007) surveys this literature and provides references.

[2]The Maquiladora program allows duty free imports of goods for assembly and re-export. These firms were initially confined to border areas, but by the year 2000 about one quarter of them were in non-border states. This form of company alone accounts for 50 percent of manufacturing exports. While initially employing many more women than men, 49 percent of employees were male by the year 2000.

under 900,000 formal sector jobs at the beginning of 1986 to over 2.7 million jobs in 2000. A substantial proportion of these jobs were in multinational corporations, with nearly two thirds of manufacturing exports originating from foreign affiliates by the year 2000 (UNCTAD 2002).

A simple theoretical framework guides the empirical work. I modify a Becker (1962) human capital model to include stochastic job opportunities and heterogeneous wage profiles across industries. These stochastic job opportunities provide wage premia that depend on the exact year of entry into the labor force and persist over a worker's career. Such premia originate from well-documented firm and cohort-specific non-compensating wage differentials.[3] In this sense, the paper relates to the recent trade literature that looks at the impacts of trade in settings where labor markets do not function in a standard neoclassical manner and such wage differentials are present.[4] When a formal firm opens, some students will drop out of school, expecting to be better off by taking the new job rather than by chancing the job market with more education in the future. On the other hand, if the student expects that jobs will continue to be available in that firm in the future, they may choose to stay in school longer, but only if the firm will reward the additional skill acquisition. Which effect dominates depends on the wage and availability of jobs at different skill levels, the returns to schooling within the industry, and the likelihood that there will still be job vacancies next period.

In this paper, I find that export-manufacturing firms fall into the former category, where new jobs induce school dropout. The Mexican census allows me to explore the various industry features detailed above that produce such heterogeneous effects. The industry pays relatively high starting wages to low skill workers and has many low skill jobs available for school leavers. Additionally, there are low returns to additional education and vacancies in this industry are the least likely to still be available in the next period. The result is that for every ten high-tech export jobs that arrived, one student dropped out at grade 9 rather than continuing on through grade 12. In contrast, non-export manufacturing offers high wage premia for high school graduates and so new jobs induce skill acquisition.

[3]Firm-specific wage premia are shown for Mexico by Frias, Kaplan, and Verhoogen (2009). Baker, Gibbs, and Holmstrom (1994) present evidence for substantial cohort-specific wage premia in the US. In Mexico, where formal sector jobs are rationed (Duval Hernandez 2006) and between one and two thirds of the labor force work in the informal sector, not all jobs are equally remunerative.

[4]For example, Davis and Harrigan (2007), Amiti and Davis (2008) and Helpman, Itskhoki, and Redding (2008), with some empirical evidence on the importance of these non neoclassical features in Frias, Kaplan, and Verhoogen (2009).

A unique data set makes this analysis possible. Since firm employment and location decisions are partly driven by local skill levels, cross-sectional studies cannot identify any causal impact of new job creation on skill acquisition. Drawing on firm-level employment data from the Mexican social security system, I calculate annual changes in formal sector employment by industry for the 2,443 municipalities in Mexico. I merge these data with 10 million individual schooling records from the 2000 Mexican census, matching each cohort to the job growth in their municipality at ages 15 and 16, when they should complete compulsory education and can first enter formal employment. Having cohort-specific schooling and local employment measures at a very granular level allows me to look within municipalities and plausibly identify the causal impacts of job availability on education decisions.

The difference-in-difference approach mitigates bias coming from omitted variables. I use the within estimator to see how (de-trended) education varies over cohorts within municipalities, depending on how many new jobs arrive during a cohort's key school-leaving ages. To avoid a bias coming from reverse causation—local skill levels determining formal firm employment decisions—I require that deviations in the education levels of specific cohorts do not drive firm employment and location decisions. In the case of Mexico, this assumption is reasonable as the large pool of migrants and informal workers make wage setting unresponsive to small changes in the labor supply of a single cohort. However, the skill choices of multiple cohorts may affect location decisions, and accordingly I exploit an instrumentation strategy similar to that of Angrist and Lavy (1999). New factory openings require large fixed costs, and therefore are lumpy in nature. This provides a discontinuity at the time of the factory opening, and therefore I instrument job growth with large factory openings or expansions, and in effect compare cohorts who reached the key school leaving age at the time of the factory opening to slightly younger or older cohorts did not.

The final section of this paper examines the income effects of these schooling choices. I find that already by the year 2000, the cohorts who were exposed to the arrival of new high-tech export-manufacturing jobs at ages 15 and 16 report lower income than other cohorts, commensurate with their lower education levels. The income decline corresponds to an 7.9 percent return to schooling, comparable the existing estimates of the returns to schooling in Mexico of between 7.5 and 16.1 percent a year (Patrinos 1995, Psacharopoulos, Velez, Panagides, and Yang 1996).

My findings are broadly supportive of standard models of trade with endogenous skill acquisition. Findlay and Kierzkowski (1983) incorporates human capital decisions into a Heckscher-Ohlin model and shows that trade exacerbates initial skill differences across countries by raising the return to the abundant skill—the Stolper–Samuelson effect.[5] Several authors, starting with Stokey (1991), have explored the dynamic implications of trade in models of endogenous growth, where the skill acquisition decisions can determine long run growth outcomes due to positive spillovers from education, with Wood and Ridao-Cano (1999) providing some cross-country support for such models.

These results are not at odds with Verhoogen (2008), who finds that the large peso devaluation in the mid-1990's resulted in skill upgrading within non-Maquiladora export-manufacturing industries. An earlier literature found evidence that trade reforms had increased returns to skill within Mexico's manufacturing sector as well as return to post-secondary education for professionals and administrators (Cragg and Epelbaum 1996, Hanson and Harrison 1999, Feenstra and Hanson 1997), although a more recent literature has found this process reversing after 1995, with the returns to skill actually falling (Robertson 2004, Airola and Juhn 2005, Gladys 2006). My results are driven by the fact that trade liberalization brought many new export manufacturing jobs to Mexico, and these jobs predominantly required relatively low skills—generally less than high school—while paying high wages.[6] Therefore, I hypothesize that while these job arrivals increased the returns to education within the manufacturing industry, they also raised the opportunity cost of schooling for students deciding whether to attend high school and potentially reduced the returns to education on the educational margin relevant to many low skill workers. Meanwhile, the economy wide returns to education for workers entering the labor force need not be related to changes in the skill premium within industries. The economy wide returns to education depend on the sectoral choices made by youths at different educational levels, and the availability of jobs in different sectors at different skill levels. Since the majority of students with education beyond high school enter the service sector rather than the manufacturing sector, the returns to high skill in these service sectors are the primary determinant of the returns to education at the top end of the distribution.

The returns to education in the labor market have been extensively studied in the labor eco-

[5] Ambiguous results obtain when credit constraints are introduced to such a model (Cartiglia 1997, Ranjan 2001, Chesnokova and Krishna 2009).

[6] Using my year 2000 census sample that excludes Mexico City, 85 percent of formal sector employees in my export industries (defined in section 3.2) have less than a high school education.

nomics literature. However, comparatively little is known about how local labor market conditions impact educational attainment, and this paper also adds to that literature. Card and Lemieux (2000), Betts and McFarland (1995) and Kahn (2007) for the US and Clark (2009) for the UK use panels of region or state-level unemployment rates to show that students stay in school longer during a recession, since there are fewer jobs available for school dropouts.

There are few studies that look at the developing world. In these countries many children leave school at very young ages, and understanding what pulls them out and what keeps them in school merits particular attention. The literature most relevant to this paper explores the impacts of industrialization on educational attainment. Goldin and Katz (1997) show that in the early 20th century, areas of the United States with large manufacturing sectors providing unskilled jobs saw significantly slower educational growth compared with other areas. Federman and Levine (2005) find that growth in industrial employment at the district level in Indonesia is positively correlated with higher enrollments. Le Brun, Helper, and Levine (2009) perform a similar exercise for Mexico by comparing educational changes between the 1990 and 2000 censuses with the total manufacturing growth over that period across municipalities. The authors find that manufacturing growth is associated with increased education for younger children but that girls aged 16 to 18 in municipalities with more growth in Maquiladora employment over the 1990's have significantly less educational attainment than do girls in low-growth municipalities. Finally, Munshi and Rosenzweig (2006) explore the schooling decisions of low-caste Indian children in Bombay, and find that caste networks mean that only the girls switch into the English schools that provide them with an opportunity to take advantage of the new white-collar occupations that globalization has brought to India.

This paper improves on this literature by drawing on a panel of substantially more groups than the studies above (1808 municipalities) and by using a novel instrumentation strategy that controls for potential reverse causality that comes from endogenous firm location choices. These rich data allow me to break out the educational impacts of local job availability by industry and to seperate the educational impact of periods of job declines from periods of job growth. I confirm the importance of looking at this level of detail by the fact that new employment opportunities in export manufacturing have opposite effects to formal sector job growth in domestic manufacturing and the service sector, and that years of job growth have assymetric effects to years of job declines.

The policy implications of my findings are important for both Mexico and the many other countries pursuing export-oriented industrialization. As Mexico strives to climb up the value chain, their existing export policies discourage the skills necessary to attract and nurture high value-added industries. The endogenous growth literature suggests that education has positive externalities and may be a key determinant of long-run growth rates (Lucas et al. 1988). At a regional level, polarized skill distributions can quickly develop if a growing low-skill workforce attracts further export-manufacturing jobs. Additionally, since the year 2000, many of the jobs in the export sector have left Mexico and moved to lower wage locations, leaving a less educated workforce without the well-paid jobs to compensate.

On an individual level, if the youths are simply impatient, new export manufacturing jobs increase welfare despite lowering annual income by the year 2000. However, if the young are hyperbolic discounters as suggested by Oreopoulos (2007), new export-manufacturing jobs may bring welfare losses. There will be more clear welfare costs if some of the students dropped out of school in anticipation of finding an export-manufacturing job that never materializes, or workers misestimated wage profiles in the rapidly changing high-tech export-manufacturing industry.

The next section lays out the theoretical framework. In section 3, I present the empirical specification, introduce the rich data set and discuss the methodology. In section 4, I present the basic regression results and perform robustness checks in section 5. Section 6 explores why only export-manufacturing jobs induce school dropout. In section 7, I look at income effects. Finally, section 8 discusses policy implications and concludes. In appendix A, I discuss in further detail the assumptions required for the error term to be exogenous in my main specification. In appendix B, I deal with compositional changes due to out-migration and appendix C explores the possibility that students misestimated wage profiles in the rapidly-changing high-tech export-manufacturing industry.

## 2 A Framework for Understanding Educational Choices

I briefly outline the decision-making process a student faces in order to understand clearly the potential effects of new employment opportunities on educational attainment. Students starting school at time zero must make two sequential and irreversible decisions: whether to drop out of school and if they drop out of school which industry $i$ to enter. Students cannot borrow or save and utility is linear in income. While still at school at time $t$, non-work utility is $\overline{y}_t$ which depends on family support, disutility from school attendance and part-time employment. If a student drops out of school in year $t$, having obtained $s$ total years of schooling and enters industry $i$, he or she receives income (and utility) $\varepsilon_{ist} y_{is\tau}$ for each year $\tau$ thereafter. The industry wage profile is $y_{is\tau}$ which depends only on the worker's education level and experience The wage premium, $\varepsilon_{ist}$, will be described shortly, and depends on the year of first entry into the workforce, $t$, and persists over the worker's lifetime.

I can write the expected discounted utility of working in industry $i$ as a function of the expected net present value of wages, $Y_{ist}$, for a student starting to work in year $t$ and discounting at rate $\rho$:

$$E_t \sum_{\tau=t}^{\infty} \frac{\varepsilon_{ist} y_{is\tau}}{(1+\rho)^{\tau-t}} \equiv \varepsilon_{ist} Y_{ist}.$$

A student in year $t$ drops out after $s$ years of school, $D_s = 1$, if the highest expected discounted utility across all industries exceeds the expected discounted utility of staying at school. Otherwise, the student stays on at school for at least another year, $D_s = 0$:

$$D_s = \mathbf{I}\left[\max_{i \in I}(\varepsilon_{ist} Y_{ist}) \geq \overline{y}_t + \frac{E_t[V_{t+1}]}{(1+\rho)}\right], \tag{1}$$

where $V_t$ is the value function at time $t$.

The education decision corresponds to an optimal stopping model. Students decide whether to take the best job on offer to them or to wait one more period. If they wait, they consume the continuation value $\overline{y}_t$ and retain the option to choose again next period with one more year of schooling, when there may also be more vacancies and better jobs on offer.[7]

The maximum obtainable industry wage premium, $\varepsilon_{ist}$, summarizes the job opportunities in a given year available to a particular student. There are two reasons for the existence of this wage premium. Firstly, only certain firms will offer a particular worker a job in any given year. Firm-specific non-compensating wage differentials and job rationing characterize Mexican formal sector employment,[8] and so wage premia will vary by firm. These wage premia may derive from efficiency

[7] A recent literature views education as a sequential choice (Hogan and Walker 2007, Heckman, Lochner, and Todd 2006), although this type of model is more common in the investment under uncertainty literature.

[8] Frias, Kaplan, and Verhoogen (2009) document firm-specific wage differentials in Mexico, while Duval Hernandez

wage models (Shapiro and Stiglitz 1984, Davis and Harrigan 2007), fair wage considerations (Akerlof and Yellen 1990, Egger and Kreickemeier 2008), search models where high productivity firms find vacancies more costly (Burdett and Mortensen 1998), insider bargaining (Abowd and Lemieux 1993) or simply external pressures from foreign consumers to pay high wages in the export sector (Harrison and Scorse forthcoming).

Formally, $\varepsilon_{ist}$ is the best firm-specific wage premium among all the job offers received by a student entering industry $i$ with schooling $s$ in year $t$. $\varepsilon_{ist}$ persists over the individuals working life. If the student receives no job offers in that industry, $\varepsilon_{ist} = 0$. Since different firms hire new employees each year, $\varepsilon_{ist}$ will vary with the year of entry into the labor market. Secondly, even for a given firm, there may be wage premia that depend on the labor supply and demand conditions during the year of entry into that firm.[9] Beaudry and DiNardo (1991) show that within firms, a cohort-specific wage premium emerges endogenously from optimal lifetime contracts for risk-averse credit-constrained workers, who desire protection from productivity shocks.[10]

The industry wage premium $\varepsilon_{ist}$ in year $t$ depends upon the net new jobs $l_{it}$ created in industry $i$ that year, $\varepsilon_{ist} = \varepsilon_{is}(l_{it})$. Net new jobs $l_{it}$ is the proxy for job availability that I will use in the empirical analysis. New job creation in industry $i$ weakly increases the maximum obtainable industry wage premium in three ways: by increasing the number of high-premia firms offering jobs, by increasing the probability of any single student being offered a specific job at a high-premia firm and by bidding up premia for new entrants within each firm ($d\varepsilon_{is}(l_{it})/dl_{it} \geq 0$).

I explore the pathways through which net new job creation $l_{it}$ impacts educational choices by rewriting equation 1 with a binary schooling choice of either dropping out of school at time $t$ ($s = 0$) or completing high school at time $t + 1$ ($s = 1$):

$$s = \mathbf{I}\left[\max_{i \in I}(\varepsilon_{i0}(l_{it})Y_{i0t}) < \overline{y}_t + \frac{E_0[\max_{i \in I}(\varepsilon_{i1}(l_{i,t+1})Y_{i1,t+1})]}{(1+\rho)}\right].$$

In the simplest case, new jobs arriving today in industry $i$, $l_{it}$, reduce schooling by raising the

(2006) finds evidence of formal sector job rationing in Mexico. Maloney (2004) suggests that the least skilled may prefer self-employment to the worst formal sector jobs but this does not seem to be the case higher up the skill distribution (Gong and van Soest 2002).

[9]For the empirical section, I will assume that annual cohort-level deviations in education are too small to affect aggregate formal sector labor supply in the municipality. However, cumulative educational changes over several cohorts, or large migration flows, will lead to changes in aggregate formal sector labor supply over time.

[10]Evidence for such "handshake" models comes from substantial cohort effects found in personnel data as documented by Baker, Gibbs, and Holmstrom (1994).

best wage on offer if the student drops-out today.[11] However, net new jobs today, $l_{it}$, change the expected industry wage premium in the future, $E_t\varepsilon_{i1}(l_{i,t+1})$. For example, a new factory-opening brings many current vacancies, but students may also expect the factory to hire additional workers next year or more firms to arrive, drawn by positive spillovers or cyclical growth in that industry. If the realization of $l_{it}$ affects $E_t\varepsilon_{i1}(l_{i,t+1})$, both the best current job and the best expected future job may change and the net impact on schooling will be ambiguous. Whether new jobs in industry $i$ encourage or discourage school dropout depends on four factors that I will now discuss.

The lower the serial correlation between new jobs today and new jobs tomorrow, $l_{it}$ and $l_{i,t+1}$, the more likely new jobs in industry $i$ at time $t$ are to induce school dropout. The best expected future wage premium in that industry, $E_t\varepsilon_{i1}(l_{i,t+1})$, will improve by only a small amount with low positive serial correlation and will actually deteriorate with a negative serial correlation. One implication of this is that educational impacts will differ between years of job growth and years when job losses dominate. In Mexico over 1986-2000, most years saw substantial formal sector employment growth. Consequently, a rare year of job losses encourages students to stay on at school as good jobs are unavailable today but should be available in the future ($l_{it}$ and $l_{i,t+1}$ are negatively correlated if $l_{it} < 0$).[12] The next three cases focus on years of job growth that will be my empirical focus, with students expecting a positive correlation between jobs today and jobs tomorrow.

The lower the returns to education in industry $i$, the more likely new jobs in industry $i$ at time $t$ are to induce school dropout. The expected industry wage premium for high-school graduates $E_t\varepsilon_{i1}(l_{i,t+1})$ needs to increase substantially with $l_{it}$ to make staying on in school worthwhile if the net present value of wages with a high-school education ($Y_{i1,t+1}$) is not much greater than wages without ($Y_{i0,t+1}$).

The higher the proportion of employees that are school dropouts in industry $i$, the more likely new jobs in industry $i$ at time $t$ are to induce school dropout. An increase in net new jobs $l_{it}$ has

[11] Of course if the best wage on offer does not change, new jobs in sector $i$ have no effect. Adding a cost to job searching makes dropout more tempting when new jobs arrive since the search costs will be lower that year. Similarly, relaxing the assumption of irreversible school dropout reduces the option value of staying in school and so increases the probability of dropout when new jobs arrive. Incorporating job separations into the model reduces dropout with the arrival of new jobs since a student may not keep their first job forever and can change job if better opportunities arise.

[12] Additionally, with low job growth in a specific industry in the formal sector, most students will receive no job offers anyway, $\varepsilon_{i0}(l_{it}) = 0$. Consequently there will be asymmetric effects as job losses cannot lower $\varepsilon_{i0}(l_{it})$ further but job gains can raise $\varepsilon_{i0}(l_{it})$.

a larger impact on the current maximum obtainable industry wage premium for school dropouts $\varepsilon_{i0}(l_{it})$ if the majority of the vacant positions do not require high school education.

The higher the wages for school dropouts in industry $i$, the more likely new jobs in industry $i$ at time $t$ are to induce school dropout. An increase in net new jobs $l_{it}$ is much more likely to actually improve the current best attainable job for school dropouts, $\max_{i\in I}(\varepsilon_{i0}(l_{it})Y_{i0t})$, when industry $i$ pays relatively high wages compared to similar jobs in other industries.

The relative importance of these four mechanisms determines whether net new jobs in industry $i$ encourage or discourage educational attainment. After estimating the impact of net new jobs on schooling decisions, I will try to understand the heterogeneous effects seen across different industries by exploring these channels.

The model focuses on a single cohort in a single location, and so to bring the model to the data, all the variables above require cohort $c$, and location $m$ subscripts. Individuals within each cohort differ in their discount rates, $\rho$, at school utility, $\overline{y}_t$, and potentially other characteristics that affect the best attainable job in a particular industry and year. The cohort average schooling level, $S_{mc}$, aggregates the schooling decisions of the entire cohort, with high $\rho$ low $\overline{y}_t$ individuals likely affected by new jobs with quite different characteristics than the new jobs that affect individuals with low $\rho$ and high $\overline{y}_t$.

# 3 Empirical Implementation

## 3.1 Empirical Specification

The school dropout equation 1, suggests that the impact of new job opportunities on educational attainment is ambiguous. Accordingly, I estimate a reduced form equation, and will return to the theoretical model in order to understand why I find heterogenous effects of new job opportunities on education by industry. I regress school attainment on net new jobs by industry as follows:

$$S_{mc} = \sum_i \beta_i l_{mci} + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}. \tag{2}$$

$S_{mc}$ is the average total years of schooling obtained by February 2000 for the cohort born in year $c$ in municipality $m$. The labor demand measure, $l_{mci}$, is the net new formal jobs per worker in industry $i$, municipality $m$ ($\Delta$employment$_{mi}\backslash$working-age population), in the years that the cohort turned age 15 and 16. The municipality is located in state $r$. I choose five industries which will be described in the next section; Non-Export Manufacturing, Low-Tech Export Manufacturing, High-Tech Export Manufacturing, Commerce/Personal Services and Professional Services.

The theoretical analysis suggested that there may be different coefficients on positive and negative labor demand shocks as years of recession and years of boom have very different implications for future job expectations. Therefore, I my main specification interacts the measure of net new jobs, $l_{mci}$, with indicator dummies. $\boldsymbol{I}^+$ takes the value 1 if $l_{mci} > 0$, and $\boldsymbol{I}^-$ takes the value 1 if $l_{mci} < 0$.

$$S_{mc} = \sum_i \beta_{1i} l_{mci} \boldsymbol{I}^+ + \sum_i \beta_{2i} l_{mci} \boldsymbol{I}^- + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}. \tag{3}$$

The $\beta_{1i}$ coefficients for the two export sectors are my main coefficients of interest, and they estimate the change in the school attainment of workers that results from new export-oriented manufacturing jobs arriving during the most common school-leaving years. I include municipality fixed effects and a full set of state-time dummies. The state-time dummies (state-specific cohort dummies) control for the fact that education trended upwards during the period, but at different rates across Mexico.[13] In section 3.3, I discuss potential reverse causation and omitted variable bias in detail, and present a novel instrumentation strategy.

The main specification focuses on new jobs arriving at ages 15 and 16, although I examine other exposure ages for robustness. Compulsory schooling in Mexico ends with Secundaria (grade 9), and most children complete this grade at either 15 or 16 depending on their birth date. The compulsory schooling law only dates from 1992 and enforcement is rare (Behrman, Sengupta, and Todd 2005), however, ages 15 and 16 are still the two most common school leaving ages and when the decision to attend high school is taken. For formal sector employment, the minimum working age is 16,[14] and so at this age formal sector jobs first offer a direct alternative to school. The specification

[13]The state-time dummies also remove trends that arise because younger cohorts have had less time than older cohorts to complete their education, and the degree of measurement error for younger cohorts will vary with the education level of the state.

[14]The actual minimum working age is 14, however children under 16 require parental consent and a document confirming they are medically fit. Additionally they cannot work overtime, in certain hazardous industries, beyond 10pm or more than 6 hours a day (Bureau of Economic and Business Affairs 2001). Accordingly, the minimum working age in the formal sector is usually taken as 16. While there is much child labor in Mexico, most of this is in the informal sector.

accommodates grade slippage, since job arrivals at ages 15 or 16 affects all students even if they are not in grade 9 at that age, as formal sector work is now possible.[15] Therefore, ages 15 and 16 are the most appropriate exposure ages on both the schooling and employment sides.

### 3.2 Data

I use two sources of data in this paper. The educational data come from a 10.6 percent subsample of the 2000 Mexican decennial census collected by the National Institute of Statistics, Geography, and Informatics (INEGI).[16] The subsample filled out a special long form, with more detailed questions covering migration, income, sector of employment and education. The 10.1 million person records cover all 2,443 municipalities in Mexico. I obtain the annual working-age municipality population by linearly interpolating INEGI population data for ages 15-49 from 1990, 1995 and 2000. I cannot, unfortunately, use family background data for the individuals, as many of the older cohorts I study have left their parental homes at the time of the census.

The employment data originate from the Mexican Social Security Institute (IMSS), and cover the complete universe of formal private-sector establishments, including Maquiladoras.[17] IMSS provides health insurance and pension coverage and all employees must enroll. The aggregations from the firm to municipality level were carried out at ITAM, where the data is held securely. I construct the main variable, net new jobs, from annual changes in employment, by industry, by municipality. The data cover 1985-2000, with annual employment recorded on December 31st each year. Kaplan, Gonzalez, and Robertson (2007) contains further details on the IMSS data.

This paper focuses on the impact of export-oriented manufacturing, and so I break the manufacturing sector into export and non-export industries. Unfortunately, the IMSS data only contains the industry of each firm, not whether it exports or not. Therefore, I define a firm as an exporter if it belongs to a 3-digit ISIC classification (Rev. 2) industry where more than 50 percent of output was exported for at least half the years in the sample.[18] The theoretical framework suggests

[15]In the sample of students currently at school who had completed 9 years of school in February 2000, 32 percent were older than 16 as some children start school late, drop out and return later, or are held back a grade.

[16]The census, XIII Censo General de Poblacion y Vivienda 2000, is publicly available from IPUMSI Minnesota Population Center (2007).

[17]In Mexico the informal sector comprises anywhere between one third and two thirds of employment according to the IMF and OECD. Only 1,577 municipalities contain any registered private firms.

[18]The industry categories used by IMSS, the 2000 Census and the 3-digit ISIC classification (Rev. 2) were matched by hand. The export and output data come from the Trade, Production and Protection 1976-2004 database (Nicita and Olarreaga 2007).

that new jobs in a high-skill rather than low-skill industry may produce quite different educational outcomes. Therefore, I split both export manufacturing and services into two categories by the average skill level of employees in the 2000 census. These industry groupings are shown in table 1, along with the number of jobs in each industry in the IMSS dataset.[19]

Table 1: Composition of Industries

| Group | Industry Subgroups | Jobs (2000) |
|---|---|---|
| Non-Export Manufacturing | Metals, Minerals, Glass, Plastics, Chemicals, Paper, Publishing, Food, Beverage, Tobacco | 1,087,457 |
| Low-Tech Export Manufacturing | Textiles, Apparel, Shoes, Leather, Wood, Furniture | 898,592 |
| High-Tech Export Manufacturing | Electrical, Transport and Scientific Equipment; Toys, Clocks, Ceramics. | 1,396,645 |
| Commerce, Personal Services | Transport, Communications, Rental, Food, Lodging, Domestic and Recreational Services | 3,066,358 |
| Professional Services | Professional, Technical, Medical, Educational, Administrative and Financial Services | 1,733,037 |

Figure 1 provides more details about these firm groupings. The first bar shows that all the export manufacturing groups export more than 100 percent of their output and far more than the non-export sectors (as the measure of output in Nicita and Olarreaga 2007 does not include all the imported intermediate components that typify the Mexican export production). The second bar shows that Maquiladoras constitute about 50 percent of total exports in these sectors, and a much smaller fraction in non-export sectors. Only the high-tech export manufacturing sector has substantial foreign involvement, with over 65 percent of its employees in foreign owned firms (the third bar), and it is this sector that makes up the bulk of Mexican exports (the fourth bar).[20] The skill and age distributions of these industry groupings are shown in figures 2 and 3.[21]

I combine the education and employment data using the 1985 municipal boundaries, merging any municipalities classified by INEGI as metropolitan zones or where more than 10 percent of the

[19]Author's calculation from IMSS database, excluding Mexico City metropolitan area.

[20]All these figures are for the whole of Mexico and come from Banco de Mexico, Nicita and Olarreaga (2007) and Ibarraran (2004).

[21]These distributions come from IMSS insured workers in the year 2000 census. The age distribution histogram also lists the total employment by industry for the census sample of IMSS insured non-migrants in municipalities excluding Mexico City.

working population commute to a nearby municipality.[22] The Valle de México metropolitan zone contains 18 million people across three States and 8,000 square km. I exclude this one observation as its large weighting would have too large an influence on the estimates, especially since it is not plausible that students are affected by new job arrivals on the other side of the metropolitan zone.[23] This leaves a panel of 13 cohorts across 1,808 municipalities.[24]

Finally, I restrict the sample to non-migrants defined as those people born in the same state they are currently living in, and who also lived in their current municipality in 1995. Including in-migrants confounds the impact of local job opportunities on education, since the census does not ask where they lived at ages 15 and 16. Therefore, my estimates are only representative of non-migrants. Out-migration may still lower the cohort education levels of non-migrants in my sample if new job arrivals induce the least educated to remain in the municipality. However, in appendix B I demonstrate that these compositional effects are not driving the negative educational impacts I find for export manufacturing as new jobs encourage the more educated to remain in the municipality, and cohort sizes do not seem to be responding to changes in manufacturing employment. Therefore, my results for export manufacturing may be attenuated towards zero through migrant composition effects. The number of incoming migrants does affect the coefficients however, with the educational effects of net new jobs attenuated when there is a larger share of migrant workers in the that industry in that workforce.

Mexico is unique in having a publicly available census with low-level geographic identifiers that can be matched to annual local employment data. A large census subsample is necessary to identify the causal impacts of new job opportunities on schooling, because it allows comparisons between the education of different cohorts within the same municipality (the difference-in-difference estimator). The industry detail of the IMSS data provide an opportunity to explore heterogeneous industry effects, in particular for export manufacturing, that cannot be identified using the state-level unemployment rates as in the existing literature for the US (Card and Lemieux 2000, Kahn

[22]If workers commute to nearby municipalities, the error terms will be spatially correlated, hence the need for this correction. When a municipality sends workers to two different municipalities who do not send workers to each other, two synthetic municipalities are created, with both containing the sending municipality (but with its relative weighting halved). Each municipality represents a single labor market, the correct unit from the theoretical analysis.

[23]Unfortunately a further breakdown is not possible because the IMSS classification within Mexico City is proprietary and cannot be matched to the INEGI codes used in the Census.

[24]To calculate changes in employment, I lose the first year of data, 1985. Since the census was collected in February 2000, only firm data through 1999 is relevant. This leaves 14 years of data, but the two-year exposure window reduces the length of the panel to 13 cohorts.

2007).

### 3.3 Empirical Methodology and Threats to Identification

With a theoretical framework in place and the basic specification introduced, I now address the two main econometric concerns: omitted variables and reverse causality. Omitted variables will bias coefficients if a third factor affects both a municipality's education level and its attractiveness as a location for a firm. For example, the neoclassical growth model predicts that poorer municipalities will converge with richer municipalities, with both education and the number of firms increasing, due to high returns to low human and physical capital. Alternatively, if education is a luxury good, a municipality sitting on a silver seam will enjoy high education levels and many firms drawn to the mines and wealthy clients. A simple cross-section confounds these effects with the causal impact of labor demand on education. The municipality fixed effects sweep out time-invariant features of the municipality, while the flexible state-time dummies control for any omitted variable that changes over time within the 32 states of Mexico. Together, this comprehensive set of controls mitigates the omitted variable bias.

One worry is that there are complementary investments at the time of new factory openings. For example, a company may agree to build a school when it opens. However, such complementary investments will affects all cohorts equally, with younger cohorts seeing larger effects as they are exposed for a longer time. However, I find disproportionate effects on the cohorts of school leaving age. Additionally, Helper, Levine, and Woodruff (2006) look at how school building decisions are made and find that prior to 1992 these decisions were made at the national level, and after 1992 decisions were made at the state level with little municipality say.

Reverse causality, from municipality education levels attracting firms, leads to inconsistent estimates of $\beta_{1i}$. The wages for different skill groups drive firm location and employment decisions, and these wages depend on the local education distribution.[25] For example, a municipality with many high skilled workers attracts high-tech formal sector jobs. Fortunately, the rich data allow plausible estimates of the causal effects of labor demand on educational attainment using the difference-in-difference approach. This methodology compares cohorts over-time within a munici-

[25] Wages only depend on local factors if labor is not perfectly mobile between municipalities. Bernard, Robertson, and Schott (2004) show that factor prices are not equalized across Mexico, resulting in an inverse relationship between relative wages and relative skill levels.

pality, and allows me to relax the restriction that municipality education levels do not affect current firm employment decisions. Instead, reverse causality will not bias the estimates if a single cohort deviation in de-trended education does not affect firm employment decisions in the past, present or future (strict exogeneity). So while a firm may wish to locate in a highly skilled location, or in a location where skills are increasing rapidly over time, the fact that the cohort that is aged 16 has an unusually strong desire for education does not factor into their decision.

The standard exogeneity requirement, that $l_{mci}$ is independent of shocks to education $\varepsilon_{mc}$, is likely to hold for several reasons. Firstly, a single cohort is a very small component of the local skill distribution and so will have only a minor influence on the labor pool the firm can hire from. Secondly, Mexico has an enormous informal sector and large numbers of migrants who provide a close to perfectly elastic supply of labor for small annual changes in labor demand.[26] Finally, entrepreneurs must obtain cohort-varying information about the skill level in a municipality, which is not readily available. The strict exogeneity requirement is slightly less plausible. Future deviations in cohort education will presumably not affect firm decisions since they are unknown at the time of hiring, however past deviations may, since all these workers have entered the job market and their skill levels are observable. So for example, if a particularly bad teacher works at a local school for several years and many students drop out, this may have a non-negligible effect on the local unskilled wage after many cohorts have been exposed. We can think of this essentially as an omitted variable problem, where we have an omitted variable changing within municipalities over time. Any bias from a past deviation will be divided by 13 since it is contained inside the demeaned error term $\overline{\varepsilon_m}$, however this bias may still be non-negligible.[27]

As a method of addressing these potential reverse causation and omitted variable problems, I follow Angrist and Lavy (1999) and pursue an instrumental variable strategy that resembles a fuzzy regression discontinuity design. I instrument changes in employment with large changes in employment by single firms (positive or negative changes of 50 or more employees in a single year at a single firm). A firm would respond to a deviant cohort with a small increase in employment, not a new factory opening or a large expansion that will be costly to reverse. Such large changes come

[26]There is a shortage of formal sector employment opportunities in Mexico, as shown by (Duval Hernandez 2006), who provides evidence of formal sector job rationing and segmentation between the informal and formal sectors.

[27]If new factories do lower education and low schooling levels do attract factories, then the direction of the bias on $\beta_{1i}$ is ambiguous.

from demand shocks external to the municipality, $u_{mc}$ in the notation of appendix A, or changes in the pool of labor that have built up over many years and are exogenous to a single cohort's education decisions. Such changes over multiple years will hopefully be picked up by the state-time trends, or by my specification where I further include a linear municipality time trend in section 5. Therefore, these lumpy changes in the industry job environment are discontinuous, and so by comparing cohorts who were at key schooling leaving ages when these changes occur with those in nearby cohorts who were slightly older or younger, I can determine the educational impacts of new job arrivals, at least for the subset of the population impacted by these large factory openings. Appendix A formalizes the statements above, and derives more precise conditions under which my instrumental variables approach is likely to be valid.

This strategy also solves issues with measurement error. IMSS registration defines formality. However, some firms existed informally prior to registering with IMSS, attenuating the results. Any omitted variables which both encouraged firms to register and affected cohort education choices could bias the results. Focusing only on large changes (which can only occur in larger firms) deals with this problem as major employers cannot avoid registration with IMSS.

As an additional identification strategy that mitigates reverse causation worries, I follow the widely used methodology pioneered by Bartik (1991) to isolate labor demand shocks. I instrument for net new jobs per worker in a particular industry and municipality by the growth rate of that industry in the whole state, interacted with the total number of jobs per worker in the previous year in that municipality. This variable will serve as a valid instrument for net new jobs per worker as long as state industry growth rates are not correlated with labor supply shocks in the municipality once the flexible state trends have been controlled for.[28] As there are an average of 58 municipalities in each state in my sample, this condition is likely to be satisfied as long as none of my broad industries are concentrated in a very small number of municipalities. It is exactly the variation in job creation across municipalities within states that could potentially be the result of shocks to schooling if firms decide to locate in a particular state for statewide factors (geography, state level governance or inducements etc.) and then choose the precise municipality based on educational

[28]Municipalities vary in their initial industry composition and this provides variation in the predicted growth of net new jobs by industry across municipalities. This is equivalent to including national time trends and identifying off the interaction of the state level industry mix and national industry growth rates, as is common in the US literature, for example Bartik (2006).

trends. Instrumenting with the predicted growth in new jobs if all municipalities within the state shared that years job growth equally will be robust to reverse causation arising from labor supply shocks causing changes in firm employment decisions in this manner.

All the regressions use the survey weights from the 2000 Census to make them representative of Mexico, excluding the capital city metropolitan area. Specifically, I weight each cohort in each municipality by the number of individuals that the cell represents (the sum of all the cohort observations multiplied by their survey weights). I cluster all standard errors at the municipality level. As shown by Bertrand, Duflo, and Mullainathan (2004), because I have a large number of groups (1808 municipalities) and the treatment variable has plenty of variation, clustering at the municipality will prevent misleading inference due to serial correlation in the error term across years within a municipality. Similarly, as discussed in Baltagi and Kao (2000), the large number of groups mitigates concerns regarding spurious correlation.

## 4 Basic Results

Figure 5 shows the basic identification strategy for a single municipality, Matamoros. This municipality lies on the US border and saw one of the largest influxes of new jobs per worker over the period. The figure plots the residuals over time after regressing both schooling and net new jobs per worker (large single-firm changes only) in high-tech export manufacturing on the municipality fixed effects, the state-time dummies and the net new jobs per worker in the other formal sector industries. While just one example, it is clear that the cohorts who were exposed to a particularly substantial number of new factory openings in high-tech export manufacturing attained fewer years of schooling than the surrounding cohorts. Figure 6 shows the same figure for the 20 municipalities that received the largest number of net new jobs per worker in export manufacturing over the period, and similar patterns can be seen in many of the municipalities. The panel regression, equation 2, essentially aggregates these effects over all 1808 municipalities.

Table 2 shows the results from the basic specification, regression 2. The arrival of new formal sector jobs in both export-manufacturing sectors increases school dropout, while new jobs in non-export sectors induce students to stay in school longer. Skill acquisition depends on the local availability of jobs, and export-manufacturing firms uniquely reduce educational attainment.

My theoretical framework suggested there may be quite different effects in years of job growth compared to years of job decline. Table 3 shows the results of regression 3 where the $\beta$ coefficients are allowed to vary depending on the sign of net new jobs per worker. The positive net new jobs per worker effects are shown in column 1, and are very similar to the results from table 2. The decision to allow the coefficients to vary is justified by the fact that the coefficients on negative net new jobs per worker, in the second column, are all negative, implying that job losses in all these industries encourage students to stay on longer at school. Accordingly, in all the non-export sectors, the impact of net new job arrivals is significantly different to the impact of net new job losses. The theoretical framework predicted that if periods of job losses are likely to be reversed, students stay on at school to acquire skills as they wait for job opportunities to improve. I verify this hypothesis by looking at the transition matrix for negative, positive and zero values of net new jobs in table 7. About 50 percent of the time a negative net new jobs shock persists, while in contrast positive shocks persist 70 to 80 percent of the time, supporting the fact that the low persistence of negative shocks drive the consistently positive school impacts across industries.

As discussed in section 3.3, my preferred specification involves instrumenting for net new jobs per worker with the net new jobs per worker attributable to large expansion or contractions at particular firms (changes of more than 50 employees in a single firm in a single year). These instrumented regression results, shown in tables 4 and 5, are very similar, except for in commerce and personal services where the coefficient falls considerably. This result is perhaps unsurprising, as the majority of jobs in this sector are in small firms, and we may expect this industry to be most likely to make small adjustments to the number of employees in response to changes in the local supply of youths leaving school.

The second instrumentation strategy, instrumenting for net new jobs with the predicted value of net new jobs if the municipality grew at the state growth rate for that industry, is shown in table 6. The results are similar although larger in magnitude, at least for the two export manufacturing industries and the service sectors, suggesting that reverse causation is not biasing my results downwards and leading to spurious negative coefficients.[29] However. the second instrument is much weaker, and so the estimates are more imprecise. Accordingly, for the remainder of the

[29]For the second instrumentation strategy, I cannot split up years of positive and negative net new job growth. When I use state trends there is too little variation across municipalities in years of positive or negative job growth, and so I do not have a sufficient number of instruments.

paper I focus on the first instrumentation strategy.

The magnitude of these coefficients implies large effects. As a concrete example, a 90th percentile positive shock to high-tech export manufacturing of 0.01 net new jobs per worker over the two year exposure period, results in the cohort who were 16 at some point that years obtaining 0.08 years less school on average. If the new factory only affects the educational choices of youths who drop out that year to work in the factory, the change in education for youths who drop out to work in the factory is equal to the coefficient on net new jobs multipled by the ratio of new jobs to workers and divided by the ratio of new jobs to workers just for the single cohort of youths aged 16 in the year the new factory opened. A single cohort comprises between 3 and 5 percent of the Mexican population aged 15-49. Therefore, if every new high-tech export job arriving in the municipality goes to a member of this cohort, his or her education is reduced by one third of a year. If this cohort actually obtains only 10 percent of the new jobs on offer, and so only one student's education decision is affected by every ten new jobs, the decline in education corresponds to one student dropping out of school at grade 9 to work in the new factory job, rather than finishing high school at grade 12.[30]

I find that new export-manufacturing opportunities induce students to drop out of school, while new opportunities in other industries do not. For the rest of the paper I will focus on the positive net new job effects, which describe the educational impacts of a successful export-oriented industrialization policy. I proceed in two stages. Firstly, I explore the robustness of the main result. Secondly, I try to understand what makes export manufacturing so different to other industries by investigating impacts across different ages and skill levels, as well as the wage profiles, skill composition and structure of employment shocks in each industry.

# 5 Robustness Checks

Tables 9 and 10 rerun the preferred specification, equation 3 instrumenting for net new jobs per workers with large changes in net new jobs per worker, with several modifications. Column 1

[30]Of course, if some students leave school to work in these new export-manufacturing jobs, but would have dropped out anyway, the cohort can obtain a higher percentage of the new jobs (with only 10 percent of the new jobs causing students to change their education decision). These proportions of jobs going to young workers seem reasonable. In the Census sample, younger ages are overrepresented in the two formal export manufacturing sectors. In high-tech export manufacturing, 9.6 percent of workers are 18 years old or younger, rising to 13.3 percent of the low-tech export manufacturing workforce.

(in both tables) repeats the basic specification. Column 2 in table 9 includes a linear municipality level trend. This controls for education within the municipality that may be trending up or down over the period, attracting or repelling firms relative to other municipalities in that state. With only 13 years of data, including 1808 trend terms risks over-fitting and causing attenuation due to the inclusion of so many controls in this regression. However, the coefficient on high-tech export manufacturing remains significantly negative, although it is smaller. The other two manufacturing coefficients retain their signs and fall slightly but are no longer significant. The two coefficients on services actually reverse sign. The service sector is most likely to suffer reverse causation and fixed costs of expansion are small, and there may also be omitted variables correlated with the service sector and education.

In column 3, I cap education at 12 years and recalculate $S_{mc}$. By capping education at 12 years, most of the sample will have reached their final level of schooling by the year 2000. With university included, the amount of misreporting will vary by municipality depending on the proportions entering higher education and this could bias the results. The magnitude of all the coefficients falls with the decline in the range of total schooling, but the signs remain unchanged. As a further check, in column 4 I further restrict attention to individuals not at school at the time of the census and recalculate $S_{mc}$. Results are once more unchanged. I can be confident that the main results are being driven by students making school dropout decisions before the end of high school.

Columns 5 and 6 split the sample into men and women. Now the right hand side variable is net new (fe)male jobs per (fe)male working age population. I find similar results for both sexes. The only significant change is that for women, service sector jobs have a much larger impact.

Column 7 includes controls for the fact that urban and rural municipalities may have seen differential trends over time which are not picked up by the state-time dummies. To control for this, I include a full set of state dummies interacted with a time trend multiplied by the percentage of the municipality population that is classified as rural. Additionally, I include a dummy variable for whether or not the Progresa program was in operation in the municipality in that year.[31] Since Progresa encouraged children to stay at school in rural areas by offering cash incentives and was made available to rural families in many municipalities at the tail end of my sample period, this

[31] The Progresa dummy takes the value 1 in the 1998 and 1999 if more than 10 percent of the population received Progresa or Procampo payments in the 2000 Census. This measure has some error since Procampo is an agricultural subsidy program, but no specific Progresa indicator is available in the census.

could potentially be a cause of omitted variable bias. Results are essentially unchanged when these additional controls are included.

Column 8 in table 10 shows the results when I exclude Monterrey and Guadalajara. These are the largest cities in the sample, and they may be driving the results as I use population weights. The coefficients change slightly, but the significance and conclusions are unchanged.

In columns 9 through 11, I divide the municipalities into 3 regions and in columns 12 and 13, I split the municipalities by average income in the year 2000. The results are fairly similar across all these specifications. There is a positive effect on education from high-tech export manufacturing in the south, where almost no such jobs were created. Poorer municipalities saw larger negative education effects from low-tech export manufacturing, where lower non-work utility makes dropout more tempting.

The sample includes only non-migrants because the census does not record where migrants were living at ages 15 and 16. Consequently, I can only make inferences about non-migrants. Many export-oriented manufacturing workers do migrate for work from poorer, often rural areas. Therefore, these results may underestimate the total educational impacts of export-oriented manufacturing, since migrants who are so tempted by these jobs that they are willing to move for them should also be very willing to forgo education.

However, migration effects could still be biasing my results, as local labor market conditions affect out-migration from my sample in different ways depending on skill levels. For example, a factory opening in a school dropout's municipality may stop him or her from migrating, but have no impact on the migration decision of a student intending to go to university. This could produce a negative coefficient on net new jobs, but the real cause is low education individuals not leaving my municipality sample. This composition effect, while interesting in its own right, has very different implications. In appendix B, I address this issue by showing that new export-manufacturing jobs do not affect the sample cohort size. Using data on the municipality of residence in 1995, I also show that when new jobs arrive, the more skilled are less likely to migrate, raising schooling through composition effects. Therefore, if anything, I am underestimating the negative impacts of export manufacturing, since composition effects will bias the coefficient upwards. I also show that as expected, the educational impacts of new industry job arrivals in a municipality are attenuated by the presence of a large number of migrants working in the industry in that municipality.

Not every student who drops out of school because a new factory opens will end up working at that factory. Some youths may drop out when a new factory opens, expecting to work in export manufacturing in the future, but consequently fail to find a job there. These students will have lower education without even gaining from the high wages that export-manufacturing jobs offer. This is a case of students misestimating the best available wage premium. New formal sector jobs may also create additional informal jobs, and these may be the jobs that the student drops out of school for–informal piece-work contracts for a formal manufacturing firm for example. The job environment also affects parental income and hence a child's schooling decision through non-work income. Higher non-work income increases school attendance, and so cannot explain the effects found for export industries but may be behind the positive coefficients for the other industries. The regressions estimate the total causal impact of new jobs in each industry on educational attainment, and several of these additional channels may play a role in altering educational choices.

## 6 Investigating Industry Differences

In the theoretical framework, I highlighted four industry features that change the relationship between new jobs and educational attainment: the serial correlation of the labor demand shocks, the relative quantity of jobs available at each skill level, the relative attractiveness of the wage profile at each skill level and the returns to education within a particular industry. At the individual level, students have different discount rates, $\rho$, non-work utilities, $\overline{y}_s$, and innate abilities. These individual characteristics result in sorting of workers, magnifying the impact of the observed differences between industries. I investigate all these avenues, and show that each one contributes to the uniquely negative impacts of export manufacturing on education.

Non-export manufacturing and high-tech export manufacturing employ similarly educated workers to perform comparable tasks. Therefore, understanding why new jobs in one of these industries cause students to stay at school, while new jobs in the other cause students to drop out, merits special attention.

## 6.1 Different People in Different Industries

First, I look at selection effects that lead to the average discount rate $\rho$, non-work utility $\overline{y}$, and perhaps innate abilities varying by industry of employment. Individuals with relatively high $\rho$'s, or low $\overline{y}$'s are more affected by tempting opportunities for immediate work, since they value current income more. If the industry features of export manufacturing particularly attract these students, this can explain the heterogeneous industry impacts of new jobs on education.

I rerun the basic specification on several ages of exposure and broken down by skill group in order to explore whether different industries impact different schooling decision margins. Table 11 shows equation 2 for four different ages of exposure: ages 13-14, when some restricted formal sector employment is first legal and students make the decision to enter middle school; ages 15-16, my main specification; ages 18-19, at the time of high school graduation when students choose whether or not to enter university; and ages 22-23, when students complete university and have no further schooling choices.

For each exposure age I present three regressions: the column marked "All" is the full sample, the column marked "Schl>6" restricts the sample to only individuals with more than primary school in the year 2000 and the column marked "Schl>9" restricts the sample to only individuals with more than middle school (Secundaria) in the year 2000. While selection into these samples is endogenous, it allows me to evaluate, somewhat crudely, the impact of new job arrivals on different skill groups.

Looking across exposure ages, high-tech and non-export manufacturing have the largest coefficients at ages 15 and 16, while for services the magnitudes are greater at younger ages. The effects of new jobs decline at ages 18-19 for all industries, with little impact by ages 22-23.[32] Figure 7 presents this evidence graphically and shows the results of running the preferred (instrumented) specification at every age of exposure between 7-8 and 23-14 and plotting the effect on positive net new jobs per worker for the three manufacturing sectors. This decline in the coefficients is reassuring, since in later years there are fewer people left in school, whose educational choices might still be altered by new job arrivals. The lack of effect at ages 22-23 for manufacturing provides a falsification test, as by this age education decisions should be complete. Any impact there is at

[32]I cannot pick out exact exposure ages. Since net new jobs are correlated over time, some of the impact at ages 13-14 may well be coming from later ages. With such a short panel, and an age cohort spread over two school grades, I cannot meaningfully include multiple exposure ages in the same regression.

ages 22-23 comes from the least educated in services; the two more restrictive samples, "Schl>6" and "Schl>9", show much weaker effects. There is substantial evidence of educational slippage and adult education in the 2000 census,[33] and this may be behind the least skilled continuing to acquire skills in response to new service sector job opportunities even at ages 22 and 23.

For low-tech export manufacturing, the impact of new jobs is all on the least skilled at ages 13-16, since the coefficients become insignificant without the least educated in the sample ("Schl>6"). For high-tech export manufacturing, impacts decline without the least skilled, but remain significant (and similarly for services).[34] For professional services and high-tech export manufacturing, there continue to be effects at ages 18-19 for the most skilled (Schl>9), presumably acting on the university entry margin. Non-export manufacturing shows quite different results, with the coefficients unchanged throughout the skill distribution at ages 13-16, implying that the more skilled are the ones staying on at school. By ages 18-19, new non-export-manufacturing jobs no longer impact educational decisions, suggesting that the 9 to 12 years of school margin is most relevant for non-export manufacturing.

The effects at younger ages may well be driven purely by parents or siblings being exposed to the new factory openinings. These new jobs will potentially increase family income, raising education, or require children to look after younger siblings instead of their now employed family member, reducing education. Youths may also drop out of school when a new factory opens even if they are too young to be immediately employed, as they now expect to be able to obtain such a job in future with their current level of education.

In conclusion, new jobs arriving in different industries affect different groups of people. New low-tech export-manufacturing jobs reduce schooling only for the least skilled, while new high-tech export-manufacturing jobs reduce schooling by greater amounts for the less skilled. These less skilled individuals are likely to have higher discount rates and lower non-work utility on average. This group contrasts with those affected by new non-export-manufacturing jobs, which increase the schooling of the more skilled, attracting low discount rate, high non-work utility types. For the two service sectors, the largest positive schooling impacts are at young ages and for the least skilled. Because services require workers to perform a quite different set of tasks, those students

[33]Between 20 and 30 percent of any grade is more than one year older than the normal age for that grade and over 600,000 people older than 20 report currently attending school, yet have not completed grade 12.

[34]Part of this decline may simply be from reducing the range of the schooling variable.

affected by new service jobs may also have different work preferences and individual comparative advantages compared to those affected by new manufacturing jobs. Now I will examine the nature of the labor demand shocks and wage profiles by industry to discover why export manufacturing seems to attract these younger and less skilled students.

### 6.2 Serial Correlation of Net New Jobs Per Worker

First, I explore differences in the serial correlation of job creation across industries. With strong serial correlation, new jobs today also mean new jobs in future, making it less tempting to drop out this period. With zero or negative serial correlation, new job opportunities are not likely to be maintained, and so students drop out of school to grab these opportunities while they are still available.

The transition matrix for positive, zero and negative net new jobs in table 7 shows that the two export-manufacturing sectors have the lowest probability of a positive shock being followed by another positive shock. Therefore, export-manufacturing job opportunities are less likely to be sustained, encouraging greater school dropout. I present further evidence in table 8, by estimating the coefficient on lagged net new jobs by industry, using an Arellano-Bond linear dynamic panel estimator. The omitted industry dummy is high-tech export manufacturing. For high-tech export manufacturing, the coefficient on the autoregressive process is negative, but positive for all other industries (significantly different only in the case of professional services).[35] Low-tech export manufacturing has the second lowest coefficient of 0.014. This is further confirmation that the levels of serial correlation in net new jobs per worker are lower in these industries, making dropout more tempting.

### 6.3 Quantity of Jobs Available at Different Skill Levels

The five industries demand quite different education levels, and so new job arrivals will have different effects on the economy-wide returns to education. A new job shock in an industry where most jobs require high skills will not induce dropout at low levels of education, since the best job

[35] The Arellano-Bond estimates should not be taken too seriously since the Hausman and Sargan tests of overidentifying restrictions are roundly rejected, suggesting that lagged levels of the differences in net new employment are not exogenous. This is not simply coming from weak instrumentation because of the process being close to a random walk. Using lagged differences to instrument for levels, as suggested by Blundell and Bond, does not improve matters.

available with a low level of education does not change. However, the shock may encourage skill acquisition by improving the best job available in the future with more education. If an industry only employs older workers, school dropout will be less tempting since immediate employment is not possible anyway.

Figure 2 shows histograms of years of schooling by industry for my sample of formal employees in the private sector, as well as for the residual sector of all other employees.[36] Low-tech export manufacturing is the least skilled formal sector, with 40 percent the workforce having less than 9 years of schooling and only 17.5 percent with more than 9 years. Non-export manufacturing and high-tech export manufacturing have almost identical skill distributions. The service sectors are more skilled and professional services the most skilled, with 34 percent of workers having more than 12 years of education. The informal sector is unsurprisingly the least skilled.[37]

Figure 3 shows histograms of age as well as total employment, broken down by industry. Unsurprisingly, the mean age shifts to the right when the industry is more skilled. Both export-manufacturing sectors have significantly younger workforces. Compared to non-export manufacturing, which has a similar skill distribution, high-tech export-manufacturing firms have a much larger proportion of employees under 25. Jobs in export manufacturing are clearly available to the young first entering the workforce, while employees tend to be older in other industries.

The relative abundance of formal sector jobs upon entering the labor force can be seen most clearly in figure 4, in which I show frequency histograms of education for new workers, who recently entered formal sector employment.[38] The height of the bars corresponds to the total number of employees at each skill level, and the height can be compared across industries. The two export industries provide a disproportionate number of jobs to recent entrants with less than a high school education (12 years of school). The shape of the education distribution for non-export manufacturing is the same as in figure 2, implying workers enter this industry later in their careers.[39]

For workers with six years of schooling and below, low-tech export manufacturing provides

[36] I define private formal sector workers in the census as full-time workers with IMSS health insurance and non-zero income. Wives, children and unemployed husbands of IMSS workers are also eligible for IMSS insurance, and may impart some error. To match the main regression, the sample comprises non-migrants aged 16 to 28.

[37] There are some excluded formal sector workers: public sector employees insured by ISSSTE, employees of PEMEX and a relatively small number of agriculture, construction, mining and utilities workers insured by IMSS.

[38] I define the new workers sample as non-migrant full-time workers who have five years or less experience past age 16, the age most formal sector job hiring can begin.

[39] This is not just a result of more vigorous hiring in export sectors in the late 1990's. The 1990 census shows a similarly younger workforce in export manufacturing.

the main source of formal sector jobs at young ages, while almost no professional service jobs are available. The service sector employs almost all the formal workers with a university education, and most high school graduates. Therefore, the arrival of new jobs in the service sector increases the chance of finding a high-skilled job in the future and raises the effective returns to schooling. Meanwhile, the arrival of new jobs in export manufacturing lowers the effective returns to schooling by increasing the number of jobs available for less skilled workers coming straight out of school.

### 6.4 Wage Premia by Industry and Skill Level

Now I turn to exploring differences in wage profiles between industries. New jobs arrivals at any skill level are more likely to enter into the schooling decision when the wage offered in that industry is high compared to the other available jobs at that skill level. The relatively more attractive the job is for low skill level workers, the more likely new jobs will induce school dropout.

A typical wage profile has two dimensions; education and experience. In this section, I focus on the wages for new workers in their first years of employment.[40] These wages are the most relevant feature of the wage profile, as impatient students weigh initial wages most heavily in their dropout decision, especially with uncertain future wage paths and the possibility of losing or changing jobs in future.

Wages, and even legal minimum wages, vary substantially across Mexico. My regression estimates come from the within municipality dimension, and so to understand what is driving them I need to look at the relative wages within the sample municipalities. Therefore, for each industry and skill level, I calculate the average wage premium over the local municipality informal wage for workers with the same skill level. The data come from the 2000 census. To estimate these wage premia, I run a Mincer-like wage regression of log income[41] for individual $j$ on a set of industry-school level dummies, $d_i d_s$. I also include a full set of municipality-school level fixed effects, $\gamma_{ms}$:

$$\ln Y_{jmis} = \sum_{i \neq \text{informal}} \sum_s \psi_{is} d_i d_s + \sum_m \sum_s \gamma_{ms} d_m d_s + X_j + \varepsilon_{jmis}.$$

By omitting the schooling dummies for the informal sector, the coefficients $\psi_{is}$ on the other industry

[40] Again, I define this as wages for workers with five or less years of experience post age 16.

[41] I use earned income for individuals who work 20 or more hours a week and are not currently at school. The earned incomes are then winsorized at the 1 percent level.

dummies measure the premium that each industry $i$ pays over the informal sector wage at that skill level $s$. As the informal sector is by far far the most common sector for low skilled Mexicans, this seems the most likely alternative sector. I also include a set of controls, $X_j$, for sex, experience (with the coefficient allowed to vary by industry) and a rural dummy. The industry that pays the highest premium available to a particular worker at each skill level, $\max_{i \in I}(\varepsilon_{ist} Y_{ist})$, determines the effective returns to schooling and the dropout decision.

Figure 8 shows smoothed plots of the wage premia over the informal sector by skill level for the three manufacturing industries, as well as commerce that provides an alternative sector of formal employment for low skilled workers.[42] I focus on 6 to 12 years of schooling, the relevant education margin for the overwhelming proportion of workers in Mexico. The solid lines show the three manufacturing industries, with non-export the lightest and high-tech export the darkest line. The dashed line represents the commerce sector. For non-export and high-tech export manufacturing, I also display markers for the weighted means at each schooling stage, where the size of the marker is proportional to the number of employees with that level of schooling.

For workers with only primary education (6 years of school), low-tech export manufacturing offers exceptional wage premia of over 20 percent. For intermediate years of schooling, around 9 years, high-tech export manufacturing offers the best premia of about 20 percent. However, with 12 years of schooling, non-export manufacturing offers the best wage premia of about 20 percent over the informal wage for that level of schooling.[43]

The wage premia provide strong support for the uniquely negative schooling impacts of new export-manufacturing jobs, and why in section 6.1 the low skilled were found to be most affected. Low-tech export manufacturing drags the least skilled out of school, since the arrival of new jobs alters the best current available job for those with only a primary school education, but does not change the best available job for those with higher levels of education. High-tech export manufacturing, with consistently high wage premia across schooling levels, induces school dropout at all ages. This contrasts with non-export manufacturing, which encourages students to stay on to

[42] There is substantial geographical variation in firm location by industry. To obtain estimates of wage premia that correspond to my regression results and are representative of the non-migrant population of Mexico excluding Mexico City, I weight wages in each municipality by the regression municipality weights.

[43] The difference in the wage premia for 9 years of schooling between high-tech export manufacturing and non-export manufacturing is significantly different to the wage premia differential between the two industries with 12 years of schooling (F-stat of 7.24).

complete high school as the industry pays larger wage premia to workers with 12 years of schooling, and so is the best available job with that level of schooling. The commerce sector offer lower, but still positive, wage premia, while there are very few jobs available for workers with low levels of education in professional services. However, as shown in the previous section, these industries are where most of the formal sector jobs for the more skilled are located, and so new job arrivals should still raise the returns to schooling.

These census wage premia strongly support the ample evidence for Mexico that exporters and foreign firms pay higher wages for a given skill level (Bernard 1995, Aitken, Harrison, and Lipsey 1996, Zhou 2003, Verhoogen 2008). For the relatively low skills they require (75 percent of employees have 9 years or less of education), export-manufacturing jobs are more remunerative than jobs in any other sector. In terms of absolute and not municipality relative wages, high-tech export-manufacturing firms pay even better wages, since much of the industry is located in the north of Mexico, where average municipality wages are very high compared to other regions of Mexico.[44]

## 6.5 Returns to Education Within Industries

Finally I look at returns to education within industries. The higher the returns to education in an industry, the more likely new jobs are to encourage skill acquisition. This closely relates to relative attractiveness detailed above, since if an industry has larger wage premia at higher skill levels, it generally implies high returns to education within the industry. These are not the returns to education for an individual, since they will choose the highest net present value industry at any level of education.

In figure 9, I show similar plots to the wage premia above but for the returns to education by industry for recent employees.[45] The returns to schooling are smallest for the two export sectors, and the returns to schooling in non-export manufacturing rise substantially beyond 9 years of schooling. For 6 to 9 years of schooling, the returns to schooling are essentially zero in manufacturing. For the lowest skill groups, if export-manufacturing jobs are available to them now,

[44] The large number of domestic migrants who head to northern Mexico to work in these factories provides the clearest evidence of high export manufacturing wages.

[45] As with the wage premia plots in section 6.4, in order to look at returns to schooling within municipalities, I run Mincer-like regressions, but now including municipality-industry fixed effects instead of municipality-school level ones. I omit all the industry-school level dummies for workers with 9 years of education: $\ln Y_{jmis} = \sum_i \sum_{s \neq 9} \beta_{is} d_i d_s + \sum_m \sum_i \gamma_{ms} d_m d_i + X_j + \varepsilon_{jmis}$. Therefore, the curves are representative of the returns relative to 9 years of schooling in that industry for non-migrants in Mexico excluding Mexico City.

there is little to gain from staying in school until grade 9. The effects highlighted hold throughout the wage profile. Figure 10 shows the full age-earnings profile holding education constant.[46] The uppermost line shows university education, the lowermost shows 6 years of schooling. The low returns to schooling in the export industry for those with 6 to 9 years of schooling persist past the first few years of employment.

I now verify whether the heterogeneous impacts of new jobs on education can be rationalized by these estimated wage profiles. My regression results implied that for a similar quantity of new jobs arriving at ages 15-16, high-tech export manufacturing (HTEM) reduces and non-export manufacturing (NEM) increases education. If relative wage premia and returns to education are responsible, high-tech export manufacturing should have a higher net present value of wages with 9 years of education and a lower net present value of wages with 12 years of education:[47]

$$\sum_{\tau=t}^{\infty} \frac{E_t[y_{HTEM,9,\tau}]}{(1+\rho)^{\tau-t}}] > \sum_{\tau=t}^{\infty} \frac{E_t[y_{NEM,9,\tau}]}{(1+\rho)^{\tau-t}}],$$

$$\sum_{\tau=t+3}^{\infty} \frac{E_{t+3}[y_{HTEM,12,\tau}]}{(1+\rho)^{\tau-t}} < \sum_{\tau=t+3}^{\infty} \frac{E_{t+3}[y_{NEM,12,\tau}]}{(1+\rho)^{\tau-t}}.$$

Figure 11 shows the overlaid wage profiles for 9 and 12 years of schooling in the two industries. The inequality conditions will be satisfied for any $\rho$, with the wage profile for high-tech export manufacturing everywhere higher than non-export manufacturing for 9 years of schooling, and almost everywhere lower for 12 years of schooling. The same rational student who intended to stay at school for 10 or 11 years can be induced to drop out of school at grade 9 when high-tech export-manufacturing jobs arrive, but stay on until grade 12 if non-export-manufacturing jobs arrive instead.

### 6.6 Summarizing Different Industry Impacts

By following the theoretical framework and investigating specific features of the different industries, I can explain my key finding that only new jobs in export manufacturing reduce school

[46]These are locally weighted regressions of the wage relative to the local informal sector with 9 years of school to allow comparability across education levels and industries. I restrict the sample to men since many women in Mexico drop out of the labor market and return in later life, breaking the link between age and experience.

[47]Under three simplifying assumptions this inequality must hold. A student makes a binary decision (9 or 12 years of schooling). The arrival of new jobs guarantees a job in that sector now or in future, otherwise there are no obtainable jobs in that sector. High-tech export manufacturing is not the best available job with 12 years of schooling and non-export manufacturing is not the best available job with 9 years of schooling.

attainment. Low-tech export manufacturing offers very high wage premia and an abundance of jobs for young workers with only primary school education, alongside flat returns to additional schooling. The arrival of new jobs induces high discount rate, low non-work utility individuals to drop out of school and enter employment. High-tech export manufacturing pays high wage premia for all levels of education, particularly between 7 and 11 years of schooling, where high premia remain even between schooling stages. These high-tech export firms hire many young workers with moderate levels of education, and the returns to additional education are relatively flat, especially up to 9 years of schooling. The low serial correlation of new job creation in the industry means that these jobs may no longer be available in future should students stay on in school. All of these factors tempt the students with moderate impatience and non-work utility to drop out when new high-tech export-manufacturing jobs arrive.

Non-export manufacturing has a similar skill distribution to high-tech export manufacturing, yet has an older workforce and fewer jobs for young workers. The wage premia on offer, while initially lower than in high-tech export manufacturing, rise dramatically at 12 years of schooling, with high returns to finishing high school. This is sufficient to rationalize new jobs in the industry inducing educational acquisition, especially among low discount rate, high non-work utility types. The arrival of service sector jobs raises the individual return to schooling by providing the bulk of formal sector employment opportunities that reward skill acquisition beyond high school.

# 7 Income Effects

I now turn to analyzing the income effects that come from the arrival of new jobs. The 2000 census records the earned monthly income for everyone employed in the last month. I run the same reduced form as for schooling, except I replace schooling with the cohort mean of log earned income, $\ln Y_{mc}$:[48]

$$\ln Y_{mc} = \sum_i \beta_{1i} l_{mci} \boldsymbol{I}^{+} + \sum_i \beta_{2i} l_{mci} \boldsymbol{I}^{-} + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}.$$

[48]This measure excludes everyone who reports no earned income, and so I am evaluating the wage margin not the labor market participation margin. I use log income as is standard in the labor literature, both to reduce problems related to outliers and because income is typically log normal. I drop all workers who report working for less than 20 hours per week, and winsorize the log wage at the 1 percent tails. Results are essentially unchanged without this cleaning procedure.

The identification strategy is very similar to the schooling regression. The municipality fixed effects and state-time dummies deal with omitted variables. Reverse causality is less of a problem than in the schooling case. To avoid simultaneity, I require that cohort income deviations in the year 2000 do not impact labor demand in previous years. This is likely to be satisfied without having to rely on the further arguments that were needed in the schooling case, since my employment growth data run up to 1999 and are therefore predetermined. Again I instrument with large expansions and contractions at a single firm.

The impacts of positive net new jobs are shown in table 12 for the three age groups where I found negative schooling effects from export manufacturing. The income effects generally match the educational effects. Those industries where new jobs encourage more schooling see positive income gains. Here new jobs have an unambiguously positive effect. However, for high-tech export manufacturing, where new jobs discourage education acquisition, I find these job arrivals result in income losses. Despite the high wage premia on offer in the industry, by the year 2000 the average log income of cohorts exposed to the arrival of high-tech export-manufacturing jobs actually declines.

The magnitude of the income loss from high-tech export manufacturing lines up with other estimates of the returns to schooling in Mexico. For ages 15-16, I find the largest negative coefficient of -0.580 on log income. This corresponds to a return to schooling of 7.9 percent per year (simply the exponential of the income coefficient divided by the coefficient on schooling). This is in the range suggested by Patrinos (1995) and Psacharopoulos, Velez, Panagides, and Yang (1996), who put the return to an additional year of schooling in Mexico at 7.5 percent in 1989, 16.1 percent in 1991 and 7.6 percent in 1992.[49] An estimate of the returns to schooling in the lower range of estimates is not surprising as these are synthetic returns to schooling. I am comparing an individual who experiences new export manufacturing plants opening at their key school leaving ages, and these jobs pay high wages conditional upon the skill level, to the income of an otherwise identical individual who stays on at school in the alternative scenario that no factory opened.

The arrival of low-tech export-manufacturing jobs brings no such income losses. This might be expected from the analysis of the previous section. Low-tech export manufacturing causes the

[49] I can also calculate a back of the envelope discount rate using my theoretical model, assuming a constant wage throughout the workers lifetime. With linear utility, and at school income, $y_t$, at half of work income, the value of the discount rate, $\rho$, is about 17.5 percent. With log income this falls to 12 percent. If at school income is only a quarter of work income, the two numbers are lower (10 percent and 6 percent respectively).

least skilled to drop out, for whom the returns to education were very small (in the 6-9 year range). However, these jobs paid very high wages premia over the informal sector, fully compensating for any wage decline coming from a lower level of education.

### 7.1 Individual Welfare Implications

Incomes losses do not necessarily imply welfare losses. Impatient or credit-constrained students may quite rationally forgo schooling for immediate income gains, knowing that in a few years their salaries will be lower than if they had stayed at school. If students are simply impatient, policymakers may still have paternalistic concerns for their citizens. There is some evidence that people are more myopic when they are young and this may be justification for intervening to increase schooling (Oreopoulos 2007). The recent literature on time inconsistent preferences (Laibson 1997) opens up the possibility that individuals in the year 2000 might want to have acquired more education when they were younger, but did not want to when the school dropout decision was being made.

Credit constraints pose a different policy problem, since a market failure lies behind them. Credit constraints work through low non-work utility $\overline{y}$, with the education decisions of very poor families affected. These families are unable to borrow enough money to maintain an adequate $\overline{y}$ if their child is not working. For new jobs to actually reduce the schooling of credit-constrained individuals, there would have to be no other (including informal) employment opportunities available, so that they would have stayed at school had the jobs not arrived. Credit constraints will also bind when non-export jobs arrive, so an unconstrained subpopulation would have to drive the results for these industries. As an empirical check, I rerun the income regression for the richer and poorer municipalities separately. If credit constraints were responsible for the negative income effects of high-tech exports, these negative coefficients should be larger for poorer municipalities where $\overline{y}$ is lower.

Table 13 shows this regression and the exact opposite is true. High-tech export manufacturing increase incomes in poorer municipalities. As was the case for low-tech export manufacturing in table 12, in poor areas students still drop out of school early (as shown in table 10), yet they find their incomes increased. In these areas, the high wages in high-tech export manufacturing presumably compensate for the lower education, given the paucity of well-paying alternative options in the municipality. Therefore, the credit constraints story is not a plausible explanation for the negative income effects I find from new jobs in high-tech export manufacturing. In poorer areas, the income effects from low-tech export manufacturing become negative, which is not surprising given that the education reduction was almost three times larger here (table 10).

There are several situations where the income losses I find would imply welfare losses. If students drop out early in anticipation of obtaining a high-tech export-manufacturing job in future, but the vacancies have been filled when they apply or the firm rejects their application, there is an obvious welfare loss. In this situation, the student has misestimated the labor demand shock, $\varepsilon_{ist}$, which is particularly likely in the export-manufacturing industries. In section 6.2, I showed that export manufacturing had the lowest serial correlation in new job creation. Similarly, Bergin, Feenstra, and Hanson (2007) provide evidence that the Maquiladora sector is exceptionally volatile, as shocks to US demand are amplified in the employment decisions of firms that outsource to Mexico.

Alternatively, students may actually be misestimating the industry wage profile $y_{ist}$, and did not expect to have quite as low an income by the year 2000. The rapid expansion in export manufacturing brought in foreign assembly line technologies and management techniques that were previously unfamiliar to Mexico. These assembly jobs have higher job turnover and lower returns to experience than the traditional manufacturing sector and this may not have been evident initially. In appendix C, I provide empirical evidence that students in the early years of trade liberalization may not have fully anticipated changes in the returns to experience in high-tech export manufacturing, and that this may have been partly responsible for the negative schooling and income effects I observe.

In both these two situations, students incorrectly forecast their future incomes when export-manufacturing jobs arrive, and individual welfare losses accompany negative income effects. Misestimation suggests a specific policy remedy. For emerging low-cost export-manufacturing locations such as Vietnam, efforts needs to be taken to inform the local population of the volatile nature of these jobs and their likely wage profiles, so that the optimal educational choices can be made. Jensen (2006) carries out a wage profile information intervention in the Dominican Republic, giving students estimates of the returns to education, and finds it to be somewhat successful.

A final implication is that a steady flow of new firm arrivals may be better for the local education levels than surges of new firm entry followed by pauses as students seem to be dropping out in response to lumpy firm openings. Such an implication follows from my theoretical framework where a low serial correlation of new job arrivals increased school dropout as students want to grab formal sector jobs while they were available. This hypothesis can be tested in a simple manner. I regress the average education of all the cohorts in the municipality on the mean new jobs created in each industry over the period 1986-1999, the coefficient of variation of net new jobs in each year, state dummies and controls for average income per capita in 2000 and the percentage of the municipality population classified as rural. Table 14 shows the results of this regression, and the hypothesis is supported for the two export manufacturing industries. Municipalities which experienced more variable job growth had lower average educational attainment, conditional upon the mean job growth in the municipality. Policymakers may wish to take this into account when making industrial policy and try to engineer a steady flow of new factory openings.

# 8 Conclusions

This paper finds that for Mexico 1986 to 2000, the changing industry composition altered the skill distribution. In particular, new export-manufacturing jobs induced students to drop out of school at younger ages. The magnitudes I find suggest that for every ten new jobs created in high-tech export manufacturing, one student dropped out at grade 9 rather than continuing on through grade 12, with about half as large an effect for low-tech export manufacturing. Despite high-tech export manufacturing paying high wages for any given skill level, new jobs in this industry at key schooling ages eventually reduced incomes by the year 2000, since workers acquired less education than they would have otherwise.

The specific features of export manufacturing can explain the effects I find. Low-tech export manufacturing attracts the least skilled by offering the highest wage premia for young workers with only primary education. New high-tech export-manufacturing jobs induce school dropout as they pay high wage premia at all levels of schooling, but especially for workers with 7 to 11 years of schooling, and a large number of these jobs are available to recent school leavers with low levels of education. Additionally, there are low returns to additional education and vacancies in this industry are the least likely to still be available in the next period.

In the previous section, I discussed the consequences for individual welfare of these results. However, individual educational decisions have positive externalities, which justify governments all over the world subsidizing school attendance. The most prominent of these spillovers comes from educated workers making those around them more productive. Lucas (1988) suggests that such human capital externalities may be large enough to explain income differences across the world, and Moretti (2004) provides recent evidence using plant-level data. By pulling students out of school, the export-manufacturing sector lowers productivity wherever these students end up working.

My findings are therefore most relevant to industrial development policymakers. Many developing countries, including Mexico, have prioritized raising the skill level of the workforce. These policies are based on the assumption that a more educated workforce will generate and attract firms that produce high value-added exports, rather than just simple Maquiladora-type assembly operations. It is crucial for the success of such policies to know that export-manufacturing jobs pull students out of school, while other formal sector employment opportunities encourage skill acquisition. Feedback loops can magnify these impacts, since firms choose locations based upon the local skill level, and the choices of firms then partly determine the future local skill level. Export manufacturing will lower skill levels in a municipality, and the resulting low-skill population will put downward pressure on unskilled wages and attract even more export-assembly operations. These forces can quickly polarize a country's education distribution, with skilled and unskilled regions forming. When footloose export-assembly jobs move to lower wage countries, as has already started happening to Mexico, the prospects will be bleak for the areas that encouraged export manufacturing, left without jobs or skills.

Fortunately, there is an obvious policy remedy. A system of payments conditional upon school attendance would neutralize the negative educational impact of export-manufacturing jobs. The much-studied Progresa program in Mexico successfully does just that, providing cash transfers to parents who keep their children in school up to grade 9 (Schultz 2004). The roll out was too late to have much impact on my sample, but in further work I will evaluate whether responses to new employment opportunities differed in the Progresa evaluation treatment and control villages. Such a program can be specifically targeted at areas where export-manufacturing jobs cluster, and at the ages where the school dropout effects from export manufacturing are most severe. Another alternative would be , the age of earliest employment in export manufacturing can be raised above 16 to ensure that most Mexican workers will have already chosen their final education levels before they are legally allowed to work in an export manufacturing plant. Finally, reducing the psychic cost of returning to school in later life would allow adults to obtain the education they forewent by entering the labor force when new export manufacturing jobs arrived should these jobs dry up, should they discover that they misestimated the returns in the industry or should they become more patient as they get older.

There is enormous concern over the impact of globalization on the poorer segments of society. One of the most robust stylized facts to come from analyzing firm-level data in developing countries is that exporting and multinational firms pay higher wages than similar firms. I confirm that this is indeed true for Mexico, a poster child of export-oriented industrialization. However, comparing such firm-level wages for a given skill level presents a misleading picture when it is labor income that really matters, and skill acquisition is endogenous. Since export-manufacturing jobs induce students to drop out of school at younger ages, individuals may end up earning lower wages than had these new factories never opened. This finding is crucial for fully understanding how the globalization of production affects the developing world.

# Appendices

## A Conditions For Exogeneity of Main Specification

I can show the conditions for exogeneity more clearly by returning to the model with a binary choice to drop out with schooling equal 0 or stay on to complete high school with schooling equal 1. For clarity, I focus on job growth per worker in a single industry that hires only unskilled workers, and remove the state-time trend from each variable. The proportion of cohort $c$ staying in school in municipality $m$, $S_{mc}$, equals the historical average level of schooling, $\delta_m$, plus the new job opportunities effect that I am interested in, $\beta_1 l_{mc}$, plus a mean-zero error term $\epsilon_{mc}$:

$$S_{mc} = \beta_1 l_{mc} + \delta_m + \epsilon_{mc}.$$

The number of new formal jobs created in the industry per worker, $l_{mc}$, depends partially on the tightness of the unskilled labor market in the municipality.[50] The higher the proportion of the unskilled workforce without formal sector employment, $Z_{mc}$, the larger the downward pressure on the local unskilled formal sector wage in the industry. Firms are partially attracted to a location by the unskilled wage and so new formal job creation is an increasing function the unskilled formal-sector unemployment rate $Z_{mc}$ ($\gamma > 0$).

$$l_{mc} = \alpha_m + \gamma Z_{mc} + u_{mc}.$$

The municipality contains a constant working population of $pop_m$, with a single cohort of $pop_m^c$ youths replacing retirees each year. The unskilled workforce without formal sector employment, $Z_{mc}$, comprises new dropouts from cohort $c$, $(1 - S_{mc})pop_m^c$, a fraction $\phi_m$ of the unskilled workers of previous cohorts, $(1 - \delta_m)(pop_m - pop_m^c)$, who are unemployed or in the informal sector and a number of migrant workers, $M_{mc}$, who would be willing to migrate to the municipality for a formal sector job that period:

$$Z_{mc} = \frac{(1 - S_{mc})pop_m^c + \phi_m(1 - \delta_m)(pop_m - pop_m^c) + M_{mc}}{(1 - S_{mc})pop_m^c + (1 - \delta_m)(pop_m - pop_m^c) + M_{mc}}.$$

[50] Implicitly, I am assuming that skilled and unskilled labor are not substitutable in this simple example.

Therefore, as cohort schooling decisions are a component of $Z_{mc}$, the new jobs created per worker, $l_{mc}$, depends on both the historical municipality average level of schooling, $\delta_m$, and the error term $\epsilon_{mc}$. Regressing $S_{mc}$ on $l_{mc}$ and a constant over a cross-section of municipalities produces biased coefficients as the supply of unskilled labor partially determines firm location decisions. As a single cohort is only a small part of the workforce and in Mexico there is formal sector job rationing and a large informal and migrant workforce, $\frac{dZ_{mc}}{d\epsilon_{mc}}$ is likely to be very small small. The municipality average level of schooling term, $\delta_m$, is multiplied by the whole population of informal labor, and so $\frac{dZ_{mc}}{d\delta_m}$ may be sizable. Therefore, while $\epsilon_{mc}$ is plausibly uncorrelated with $l_{mc}$,[51] $\delta_m$ is likely to be correlated with $l_{mc}$. If I have $c = 1$ to $n$ cohorts of data, the municipality fixed-effects will sweep out the $\delta_m$ term, providing estimates of $\beta_1$ that are not biased by the historical municipality average level of schooling.

However, in order for the condition of strict exogeneity to be satisfied in a fixed-effects estimator, I require that $l_{mc}$ is uncorrelated with all leads and lags of $\epsilon_{mc}$. Over many years, shocks to schooling can substantially alter the proportion of the existing workforce that is unskilled, in effect changing $\delta_m$, and this will have a significant impact on $Z_{mc}$ as $\frac{dZ_{mc}}{d\delta_m}$ may be sizable. While each lagged value of $\epsilon_{mc}$ is divided by the number of cohorts (13 in this case), reverse causality may still be of concern.

Accordingly, I use a fuzzy regression discontinuity design similar to that of Angrist and Lavy (1999). I instrument for $l_{mc}$ with large firm openings, closings, expansions or contractions of 50 employees in a single year. As there are substantial fixed costs and indivisible investments associated with large firm expansions or contractions, these changes will be lumpy. If they are driven by local labor supply at all (rather than demand conditions), they will only occur once $Z_{mc}$ has moved above or below thresholds, $\underline{Z}_m$ and $\overline{Z}_m$, that depend on recent shocks. I superscript these large firm variables with "50":

$$l_{mc}^{50} = \alpha_m^{50} + \gamma^{50} \mathbf{I} \left[ \underline{Z}_m(\epsilon_{mc-1}, \epsilon_{mc-2}, .) < Z_{mc} < \overline{Z}_m(\epsilon_{mc-1}, \epsilon_{mc-2}, .) \right] Z_{mc} + u_{mc}^{50}.$$

Therefore, there will be a discontinuous jump in $l_{mc}^{50}$ when a new factory opens. There is a discontinuity in the expected value of treatment (exposure to new job openings) conditional on

[51] Any bias that does exits from the correlation between $\epsilon_{mc}$ and $l_{mc}$ will reduce the estimated coefficient $\hat{\beta}_1$ if $\beta_1 > 0$, and produce an ambiguously signed bias if $\beta_1 < 0$.

year of birth. As long as schooling, $S_{mc}$, is more smooth than $l_{mc}^{50}$, a contemporaneous jump in schooling and factory openings can be attributed to a new factory changing education as long as a suitable time trend picks up the evolution of schooling in the absence of new factory shock. Therefore, $l_{mc}^{50}$ and adequate time trends will serve as an instrument for treatment status, $l_{mc}$, and produce unbiased estimates of the local average treatment effects about the discontinuity under very weak conditions. Since these discontinuities are functions of year of birth, if we believe that different cohorts have heterogenous treatment effects, we are taking an average that is weighted by the ex-ante likelihood that a cohort is near one of these discontinuities.

## B Migration Composition Effects

The negative educational effects of new export-manufacturing jobs that I find may be spurious if new jobs prevent the low skilled from migrating, and so lower the average education of my sample without changing anyone's schooling choice. I carry out two empirical tests to explore such out-migration composition effects.

The first test looks at the size of different cohorts. If these composition effects are important, and if the less skilled are deciding not to migrate, the size of the sample cohort should rise with new jobs in export manufacturing. To test this I replace cohort years of schooling with log cohort size $\ln N_{mc}$ in equation 2, the main specification:[52]

$$\ln N_{mc} = \sum_i \beta_{1i} l_{mci} \boldsymbol{I}^{+} + \sum_i \beta_{2i} l_{mci} \boldsymbol{I}^{-} + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}.$$

Table 15 shows the results from this regression. The cohort size responds positively to new service jobs but there seems to be no impact from the three manufacturing sectors.

The second test examines whether skill differences between migrants and non-migrants can explain the sign of the coefficients I find. If out-migration composition effects are important in explaining the negative coefficients on new export-manufacturing jobs, I should see the education of out-migrants rise relative to the education of non-migrants in a municipality. As the census only records where people lived in 1995, I can no longer use the within municipality variation to identify out-migration composition effects. Instead, I take the average education of people who lived in the municipality in 1995 but not in 2000, $S_{leave,mt}$, divided by the education of people who lived in the municipality in both 1995 and 2000, $S_{stay,mt}$, as my dependent variable. This ratio needs to be positively correlated with changes in employment between 1995 and 2000 for negative coefficients to be the result of the less educated staying in the municipality when new jobs arrive. I restrict my sample to cohorts who turned 15 or 16 between 1995 and 1999. The ratio is then regressed on the sum of the changes in employment over these years by industry. Again, I separate growing municipalities from shrinking ones with indicator dummies, and include state dummies to control

[52] I use log cohort size as municipality populations vary greatly, so by using logs I am looking at proportional changes. Net new jobs are already scaled as they are divided by the number of workers in the municipality.

for potential omitted variables at the region level:

$$\frac{1}{5}\sum_{t=95}^{99}\frac{S_{leave,mt}}{S_{stay,mt}} = \alpha + \sum_i \beta_{1i}[\sum_{t=95}^{99} l_{mit}]\boldsymbol{I}^{+} + \sum_i \beta_{2i}[\sum_{t=95}^{99} l_{mit}]\boldsymbol{I}^{-} + \sum_r \mu_r d_r + \varepsilon_m.$$

The results are reported in table 16. For all sectors the $\beta_{1i}$'s are negative. New formal jobs keep the more educated young in the municipality. For job losses, the effects are also negative or highly insignificant, implying that the more educated leave the municipality when there are no formal sector jobs. This is strong evidence, at least for the later years in the sample, that out-migration effects would tend to increase cohort education averages through composition effects. Therefore, the result that new export-manufacturing jobs reduce schooling would be stronger without out-migration. The fact that new jobs in other sectors increased education, however, may purely or partly be coming from composition effects, particularly for professional services which hires the most-skilled workers and has the largest composition effect.

I have data only for those people living in Mexico in the year 2000, thereby missing all the migrants who emigrated to the United States. Given how large this migration flow is, and the strong possibility these migrants have different skills than domestic migrants, this is a serious concern. However Chiquiar and Hanson (2005) provide evidence that migrants to the US have more education than the average Mexican who stays in Mexico. If potential international migrants decide to stay when new jobs arrive in the municipality, and they have above average education, I would also expect a decline in the relative education of leavers compared to stayers when new jobs arrive. Again, this would imply that my results for export manufacturing underestimate the true negative impact of new export-manufacturing jobs on education.

Migration into the municipality would be expected to attenuate any educational impacts I find. If a particular industry only employs migrants, then new jobs in that industry should have no impact on local youth's education decisions. Accordingly, using the 2000 Census, I calculate $\vartheta_{mi}$, the proportion of migrants in each industry in each municipality. I then interact $\vartheta_{mi}$ with net new jobs per worker:

$$S_{mc} = \sum_i \beta_{1i} l_{mci} \boldsymbol{I}^+ + \sum_i \beta_{2i} l_{mci} \boldsymbol{I}^- + \sum_i \beta_{3i} l_{mci} \vartheta_{mi} \boldsymbol{I}^+ + \sum_i \beta_{4i} l_{mci} \vartheta_{mi} \boldsymbol{I}^- + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}.$$

If the presence of migrants reduces the impact of new jobs on the local population I expect $\beta_{3i}$ to be significant and of the opposite sign to $\beta_{1i}$. These results are detailed in table 17. For both high-tech export manufacturing and commerce, I find the expected pattern. The magnitudes of $\beta_{3i}$ and $\beta_{1i}$ are similar, implying that there is essentially no effect on non-migrant education with new job arrivals if the entire industry employs only migrants. There is a similar pattern for non-export manufacturing, although the interaction term is insignificant. In the other two cases, the main term becomes insignificant with the addition of the interaction.

# C Misestimating Export-Manufacturing Wage Profiles

The model outlined in the theory section has individuals making choices based on their estimates of the future rate of return to education in each sector. Correctly predicting these future returns is a monumental task. The rational expectations approach so common in macroeconomics allows individuals to make errors, but not consistently so. However, in the case of schooling choices, people only make this decision once in their life and so cannot learn from their errors. While they can seek advice from older individuals who have seen the earnings outcomes of their decisions, in an industry undergoing rapid technological and structural change, recent retirees experiences will not help predict returns to education in the future. The role of rapid technological change in making skill acquisition decisions difficult goes back at least to Marshall (1890), who stated in his Principles of Economics:

> Not much less than a generation elapses between the choice by parents of a skilled trade for one of their children, and his reaping the full results of their choice. And meanwhile the character of the trade may have been almost revolutionized by changes, of which some probably threw long shadows before them, but others were such as could not have been foreseen even by the shrewdest persons and those best acquainted with the circumstances of the trade.

The most dynamic sector in the Mexican economy over the period 1985-2000 was export manufacturing. With Mexico's trade liberalization came an enormous number of jobs, often in Maquiladoras, manufacturing and assembling goods for export to the US. Much of this growth came in the electronics and car industries, where many global firms moved operations to Northern Mexico to take advantage of low labor costs and the close proximity to the US market. Growth was especially pronounced after the signing of NAFTA and the large peso devaluation that occurred in the middle of the 1990's.

The jobs in high-tech export manufacturing were novel to Mexico in several ways. These new industries arrived rapidly so there was initially very little local knowledge of the likely timepaths of wages in assembly manufacturing. Bergin, Feenstra, and Hanson (2007) show that this sector is characterized by very high volatility, as demand is driven by foreign markets and firms compete with other export-manufacturing locations. Finally, the sector underwent enormous technological and managerial change as firms moved to more efficient assembly-line technologies with higher job turnover and lower returns to experience.

My hypothesis is that trade liberalization, and the technological changes that accompanied the move from sheltered import substitution to assembly line export manufacturing, reduced the returns to experience for low skill workers in the high-tech export manufacturing sector. Some students, using retrospective wage profile information, may have optimally dropped out to enter high-tech export manufacturing, but they would not have had they known the true wage profile that they would face.

I can summarize this hypothesis with a simple example. I look at the decision to drop out at the end of Secundaria ($S = 9$) with the arrival of new high-tech export-manufacturing jobs, or to stay on and complete high school ($S = 12$). If the student stays on they can obtain a job in professional services, the most skilled sector. Figure 12 shows male wage profiles associated with this example from both the 1990 and 2000 censuses.[53] The rotation of the wage profile for high-tech export manufacturing is clear, with the returns to experience declining between 1990 (the black solid line) and 2000 (the gray solid line). Looking from age 25 onwards, in 1990 a student would not expect to be earning substantially less by dropping out of school, but by 2000 a large wage gap had opened up. This gap is of a similar magnitude to the returns to education backed out of the income and education regressions (a 4 percent return to education at age 25 rising to 7 percent by 28).

I proceed to test this hypothesis in two stages. First, I examine the wage profiles to see if the hypothesis is plausible. In the second stage, I run simple Mincer wage equations by state, and interact estimates of the decline in the returns to experience with net new jobs in my main specification. I show that the negative effects on high-tech export manufacturing are being driven by the states with larger declines in the returns to experience, but only for the older cohorts who may not have anticipated these declines.

The first check is to verify if there really are lower returns to experience in high-tech export manufacturing. For this I use the Encuesta Nacional de Empleo Urbano (ENEU) from 1987-2002, the urban employment survey for Mexico. This is a panel for the large cities in Mexico with individuals followed for 5 quarters. Figure 18 shows the transition matrix for people starting in

[53] Income is converted into year 2000 pesos using national quarterly CPI figures from the OECD. Since in 1990 they did not ask about IMSS insurance, I use the full sample of employees. The IMSS and non-IMSS curves in 2000 are close together.

one of the five formal sectors in period 1. A transition is when a worker leaves their 4 digit ENEU industry for another industry (possibly in the same sector) or unemployment. High-tech export manufacturing has the largest churn, with only 42.31 percent of workers still in the same 4 digit industry over the next four quarters.[54] If I divide the sample into pre-1995 and post-1995,[55] the churn increases in the later period as the pace of technological change in the industry picked up, spurred by the peso devaluation as suggested by Verhoogen (2008).

I now explore how returns to experience varied between the 1990 and 2000 censuses. Figure 13 shows changes in the wage profile of high-tech export manufacturing for different levels of schooling. While the returns to experience declined for 6 and 9 years of schooling, no such decline is evident at higher skill levels. With the Peso crisis, wages fell in general in Mexico, but fell less in export industries buoyed by strong exports. Accordingly, the decline in returns to experience for lower skill levels corresponds to rising returns to skill in this sector, supporting the evidence found by Verhoogen (2008) and Frias, Kaplan, and Verhoogen (2009). There was no similar rotation of the earnings profile in other sectors. I confirm this hypothesis by running a Mincer wage regression for the whole economy and both 1990 and 2000 samples, interacting experience with a dummy for the year 2000. I find that the largest rotation of the experience profile (the coefficient on the interaction term) is in high-tech export manufacturing.

Now I test the hypothesis that changes in returns to experience in high-tech export manufacturing that occurred with the move to export-oriented industrialization led to mistakes in estimating wage profiles and misguided dropout. A wage profile that is flattening makes jobs less attractive in that industry, and so attenuates any negative impacts on education of new jobs for those who are aware of the flattening. However, if a cohort did not predict this rotation, there would be larger negative schooling impacts in regions where the returns to experience later declined the most. I run Mincer wage regressions by industry $i$ and state $r$ for men with between 6 and 11 years of schooling.[56] $E$ is the number of years of post-16 experience (age $-$ years of schooling if more than

[54] This is not just coming from finer division of industry categories in this sector. While there are many 4 digit industries in high-tech export manufacturing, there are even more in non-export manufacturing yet this sector has lower churn.

[55] The ENEU city sample expanded over the period from 16 to 47 cities. For comparability over time, I restrict attention to the original 16 cities minus Mexico City.

[56] Again, I use only men as I cannot reliably measure years of experience for women who leave the workforce and return later in life. I choose only these levels of schooling as this is the skill level that saw their returns to experience decline. However, the results are robust to using the full sample of men.

9 years of schooling), while $d_{2000}$ is a dummy that equals 1 if the data point is from the 2000 Census as opposed to the 1990 Census:

$$\ln Y_{ir} = \psi_{ir} + \psi_{2ir} d_{2000} + \phi_{1ir} E_{ir} + \phi_{2ir}(E_{ir} \times d_{2000}) + \gamma_{1ir} S_{ir} + \gamma_{2ir}(S_{ir} \times d_{2000}) + \epsilon_{ir}.$$

I then use these coefficients to rerun my schooling and income regressions, but interacting $\phi_{2ir}$, the rotation of the experience profile for industry $i$, state $r$, with my net new jobs measures:

$$S_{mc} = \sum_i \beta_{1i} l_{mci} \boldsymbol{I}^{+} + \sum_i \beta_{2i} l_{mci} \boldsymbol{I}^{-} + \sum_i \beta_{3i} l_{mci} \phi_{2ir} \boldsymbol{I}^{+} + \sum_i \beta_{4i} l_{mci} \phi_{2ir} \boldsymbol{I}^{-} + \sum_m \delta_m d_m + \sum_c \sum_r \mu_{rc} d_r d_c + \varepsilon_{mc}.$$

My hypothesis is $\beta_{3HTEM} > 0$; the negative effects on schooling from new high-tech export-manufacturing jobs are larger in states which saw a bigger decline in the experience gradient. However these effects should just be observed for cohorts that were not able to observe this rotation, and hence misestimated wage profiles in high-tech export manufacturing. Accordingly, I run two specifications, first with the full sample, and second just with cohorts reaching ages 15 and 16 before the Peso crisis in 1995, at the midpoint of the census wage data. I present these results in table 19. The hypothesis is supported, with the negative rotation of the earnings profile able to explain the dropout from new jobs in high-tech export manufacturing but only for older cohorts. There are similar effects on income (replacing $S_{mc}$ with $\ln Y_{mc}$). This evidence supports the hypothesis that for older cohorts, some of the negative impact from new jobs came from misestimation of wage profiles in industries undergoing rapid technological change.

## References


Abowd, J., and T. Lemieux (1993): "The Effects of Product Market Competition on Collective Bargaining Agreements: The Case of Foreign Competition in Canada," *The Quarterly Journal of Economics*, 108(4), 983–1014.

Airola, C., and J. Juhn (2005): "Wage Inequality in Post-Reform Mexico," Working Papers 2005-01, Department of Economics, University of Houston.

Aitken, B., A. Harrison, and R. Lipsey (1996): "Wages and Foreign Ownership A Comparative Study of Mexico, Venezuela, and the United States," *Journal of International Economics*, 40(3-4), 345–371.

Akerlof, G., and J. Yellen (1990): "The Fair Wage-Effort Hypothesis and Unemployment," *The Quarterly Journal of Economics*, 105(2), 255–283.

Amiti, M., and D. Davis (2008): "Trade, firms, and wages: theory and evidence," Nber working papers, National Bureau of Economic Research.

Angrist, J., and V. Lavy (1999): "Using Maimonides' Rule to Estimate The Effect of Class Size on Scholastic Achievement*," *Quarterly journal of economics*, 114(2), 533–575.

Baker, G., M. Gibbs, and B. Holmstrom (1994): "The Internal Economics of the Firm: Evidence from Personnel Data," *Quarterly Journal of Economics*, 109(4), 881–919.

Baltagi, B., and C. Kao (2000): "Nonstationary panels, cointegration in panels and dynamic panels: A survey," *Advances in Econometrics*, 15, 7–52.

Bartik, T. (1991): *Who benefits from state and local economic development policies?* WE Upjohn Institute for Employment Research Kalamazoo, MI.

Bartik, T. J. (2006): "How Do the Effects of Local Growth on Employment Rates Vary With Initial Labor Market Conditions," Staff Working Papers 09-148, W.E. Upjohn Institute for Employment Research.

Beaudry, P., and J. DiNardo (1991): “The Effect of Implicit Contracts on the Movement of Wages Over the Business Cycle: Evidence from Micro Data,” *The Journal of Political Economy*, 99(4), 665–688.

Becker, G. (1962): “Investment in Human Capital: A Theoretical Analysis,” *The Journal of Political Economy*, 70(S5), 9.

Behrman, J. R., P. Sengupta, and P. Todd (2005): “Progressing through PROGRESA: An Impact Assessment of a School Subsidy Experiment in Rural Mexico,” *Economic Development and Cultural Change*, 54(1), 237–275.

Bergin, P. R., R. C. Feenstra, and G. H. Hanson (2007): “Outsourcing and Volatility,” NBER Working Papers 13144, National Bureau of Economic Research.

Bernard, A. (1995): “Exporters and Trade Liberalization in Mexico: Production Structure and Performance,” Discussion paper, MIT.

Bernard, A., and J. Jensen (1995): “Exporters, Jobs, and Wages in US Manufacturing: 1976-1987,” *Brookings Papers on Economic Activity: Microeconomics*, 1995, 67–112.

Bernard, A. B., R. Robertson, and P. K. Schott (2004): “Is Mexico A Lumpy Country?,” NBER Working Papers 10898, National Bureau of Economic Research.

Bertrand, M., E. Duflo, and S. Mullainathan (2004): “How Much Should We Trust Differences-in-Differences Estimates?,” *Quarterly Journal of Economics*, 119(1), 249–275.

Betts, J., and L. McFarland (1995): “Safe port in a storm: The impact of labor market conditions on community college enrollments,” *The Journal of Human Resources*, 30(4), 741–765.

Burdett, K., and D. Mortensen (1998): “Wage Differentials, Employer Size, and Unemployment,” *International Economic Review*, 39(2), 257–273.

Bureau of Economic and Business Affairs (2001): “Economic Policy and Trade Practices,” Mexico country report, U.S. Department of State.

Card, D., and T. Lemieux (2000): "Dropout and Enrollment Trends in the Post-War Period: What Went Wrong in the 1970s?," NBER Working Papers 7658, National Bureau of Economic Research.

Cartiglia, F. (1997): "Credit constraints and human capital accumulation in the open economy," *Journal of International Economics*, 43(1-2), 221 – 236.

Chesnokova, T., and K. Krishna (2009): "Skill acquisition, credit constraints, and trade," *International Review of Economics and Finance*, 18(2), 227–238.

Chiquiar, D., and G. Hanson (2005): "International Migration, Self-Selection, and the Distribution of Wages: Evidence from Mexico and the United States," *Journal of Political Economy*, 113(2), 239–281.

Clark, D. (2009): "Do Recessions Keep Students in School? The Impact of Youth Unemployment on Enrolment in Postcompulsory Education in England," *Economica*, 9999(9999).

Cragg, M., and M. Epelbaum (1996): "Why has wage dispersion grown in Mexico? Is it the incidence of reforms or the growing demand for skills?," *Journal of Development Economics*, 51, 99–116.

Davis, D., and J. Harrigan (2007): "Good Jobs, bad jobs, and trade liberalization," Nber working papers, National Bureau of Economic Research.

Duval Hernandez, R. (2006): "Informality, Segmentation and Earnings in Urban Mexico," Discussion paper, Center for U.S.-Mexican Studies.

Egger, H., and U. Kreickemeier (2008): "Firm Heterogeneity And The Labor Market Effects Of Trade Liberalization," *International Economic Review*, 50(1), 187–216.

Federman, M., and D. Levine (2005): "The Effects of Industrialization on Education and Youth Labor in Indonesia," *The BE Journal of Macroeconomics*, 5(1), 1.

Feenstra, R., and G. Hanson (1997): "Foreign direct investment and relative wages: Evidence from Mexico's maquiladoras," *Journal of International Economics*, 42(3-4), 371–393.

Findlay, R., and H. Kierzkowski (1983): “International trade and human capital: A simple general equilibrium model,” *The Journal of Political Economy*, 91(6), 957–978.

Frias, J. A., D. Kaplan, and E. Verhoogen (2009): “Exports and Wage Premia: Evidence from Mexican Employer-Employee Data,” Discussion paper, Columbia University.

Gladys, L.-A. (2006): “Mexico: two decades of the evolution of education and inequality,” Policy Research Working Paper Series 3919, The World Bank.

Goldin, C., and L. Katz (1997): “Why the United States led in education: Lessons from secondary school expansion, 1910 to 1940,” Discussion paper.

Gong, X., and A. van Soest (2002): “Wage Differentials and Mobility in the Urban Labour Market: a Panel Data Analysis for Mexico,” *Labour Economics*, 9(4), 513–529.

Hanson, G., and A. Harrison (1999): “Trade liberalization and wage inequality in Mexico,” *Industrial and Labor Relations Review*, pp. 271–288.

Harrison, A., and J. Scorse (forthcoming): “Multinationals and Anti Sweatshop Activism,” *American Economic Review*.

Heckman, J. J., L. J. Lochner, and P. E. Todd (2006): “Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond,” in *Handbook of the Economics of Education*, ed. by E. A. Hanushek, and F. Welch, vol. 1. Elsevier.

Helper, S., D. Levine, and C. Woodruff (2006): “How Does Economic Liberalization affect Investment in Education?: Evidence from Mexico,” Discussion paper, UCSD.

Helpman, E., O. Itskhoki, and S. Redding (2008): “Inequality and unemployment in a global economy,” .

Hogan, V., and I. Walker (2007): “Education Choice Under Uncertainty: Implications for Public Policy,” *Labour Economics*, 14(6), 894–912.

Ibarraran, P. (2004): “Essays on Labor Markets and Economic Integration in Mexico,” Ph.D. thesis, University of California, Berkeley.

Jensen, R. (2006): "Do the Perceived Returns to Education Affect Schooling Decisions? Evidence from a Randomized Experiment," Discussion paper, John F. Kennedy School of Government, Harvard University.

Kahn, L. (2007): "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy," Discussion paper, Harvard University.

Kaplan, D. S., G. M. Gonzalez, and R. Robertson (2007): "Mexican Employment Dynamics: Evidence from Matched Firm-Worker Data," Discussion paper, ITAM.

Laibson, D. (1997): "Golden Eggs and Hyperbolic Discounting," *The Quarterly Journal of Economics*, 112(2), 443–477.

Le Brun, A., S. Helper, and D. Levine (2009): "The Effect of Industrialization on Children's Education–The Experience of Mexico," *UC Berkeley: Institute for Research on Labor and Employment. Retrieved from: http://www. escholarship. org/uc/item/13n1b2zh.*

Lucas, R. (1988): "On the Mechanics of Economic Development," *Journal of Monetary Economics*, 22(1), 3–42.

Lucas, R., et al. (1988): "On the mechanics of economic development* 1," *Journal of monetary economics*, 22(1), 3–42.

Maloney, W. (2004): "Informality Revisited," *World Development*, 32(7), 1159–1178.

Marshall, A. (1890): *Principles of Economics*. Macmillan and Co.

Minnesota Population Center (2007): "Integrated Public Use Microdata Series-International: Version 3.0," Available online at http://international. ipums. org/international.

Moretti, E. (2004): "Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions," *American Economic Review*, 94(3), 656–690.

Munshi, K., and M. Rosenzweig (2006): "Traditional institutions meet the modern world: Caste, gender, and schooling choice in a globalizing economy," *American Economic Review*, 96(4), 1225–1252.

Nicita, A., and M. Olarreaga (2007): “Trade, Production, and Protection Database, 1976-2004,” *The World Bank Economic Review*, 21(1), 165.

Oreopoulos, P. (2007): “Do Dropouts Drop Out Too Soon? Wealth, Health and Happiness from Compulsory Schooling,” *Journal of Public Economics*, 91(11-12), 2213–2229.

Patrinos, H. (1995): “Education and Earnings Differentials,” Discussion paper, World Bank.

Psacharopoulos, G., E. Velez, A. Panagides, and H. Yang (1996): “Returns to Education During Economic Boom and Recession: Mexico 1984, 1989 and 1992,” *Education Economics*, 4(3), 219–230.

Ranjan, P. (2001): “Dynamic evolution of income distribution and credit-constrained human capital investment in open economies,” *Journal of International Economics*, 55(2), 329 – 358.

Robertson, R. (2004): “Relative prices and wage inequality: evidence from Mexico,” *Journal of International Economics*, 64(2), 387–409.

Schank, T., C. Schnabel, and J. Wagner (2007): “Do Exporters Really Pay Higher Wages? First Evidence from German Linked Employer–Employee Data,” *Journal of International Economics*, 72(1), 52–74.

Schultz, T. P. (2004): “School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program,” *Journal of Development Economics*, 74(1), 199–250.

Shapiro, C., and J. Stiglitz (1984): “Equilibrium Unemployment as a Worker Discipline Device,” *The American Economic Review*, 74(3), 433–444.

Stokey, N. L. (1991): “Human Capital, Product Quality, and Growth,” *The Quarterly Journal of Economics*, 106(2), 587–616.

UNCTAD (2002): *World Investment Report 2002: Transnational Corporations and Export Competitiveness*. United Nations Conference on Trade and Development, Geneva.

Verhoogen, E. (2008): “Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector,” *Quarterly Journal of Economics*, 123(2).

Wood, A., and C. Ridao-Cano (1999): “Skill, trade, and international inequality,” *Oxford Economic Papers*, 51(1), 89.

Zhou, L. (2003): “Why do Exporting Firms Pay Higher Wages?,” Discussion paper, Emory University, Atlanta.

Figure 1: Manufacturing Industry Features

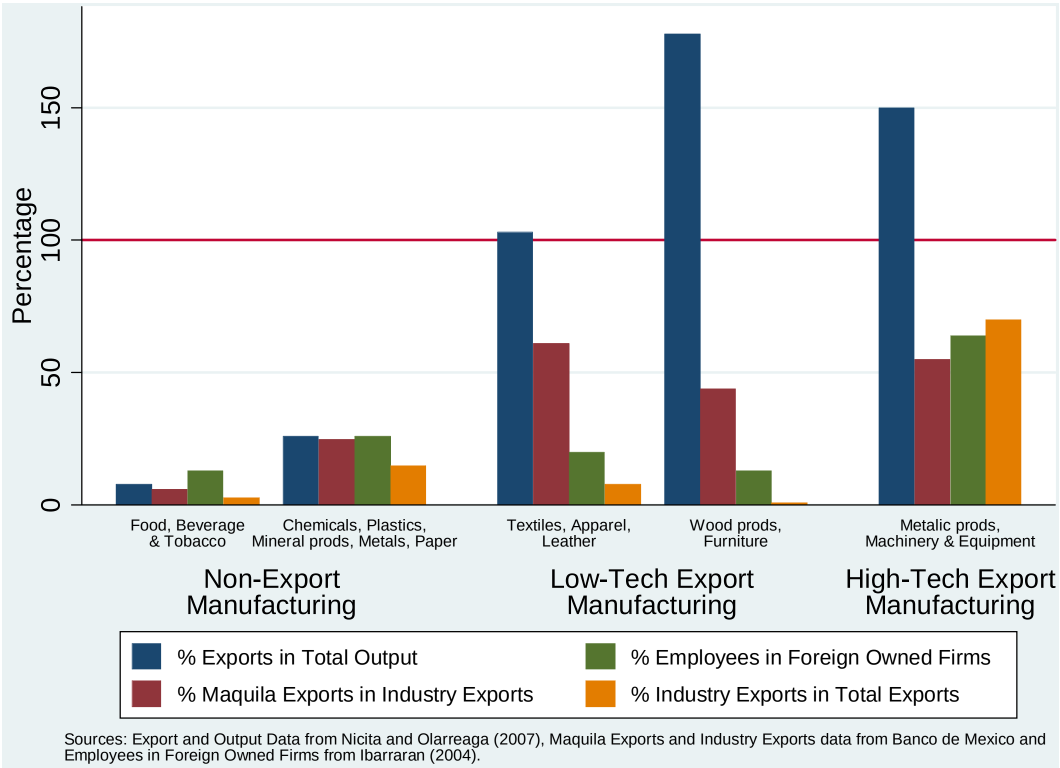


Figure 2: Histogram of Education by Industry (2000, Insured by IMSS)

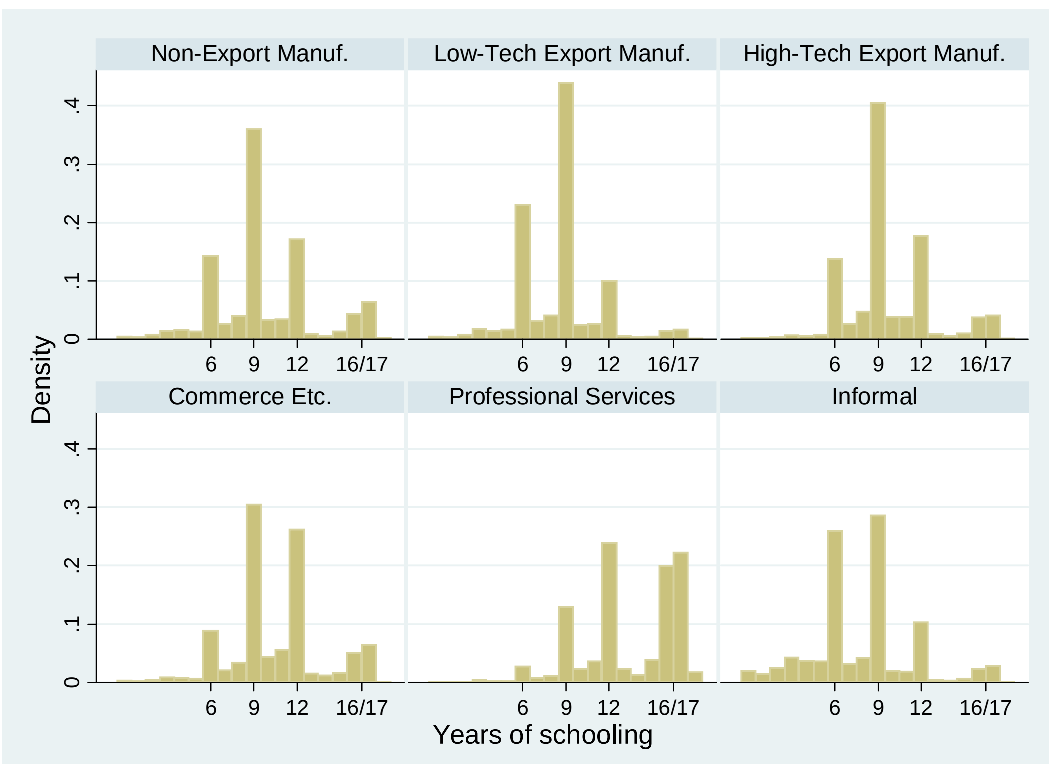

Figure 3: Histogram of Ages by Industry (2000, Insured by IMSS)

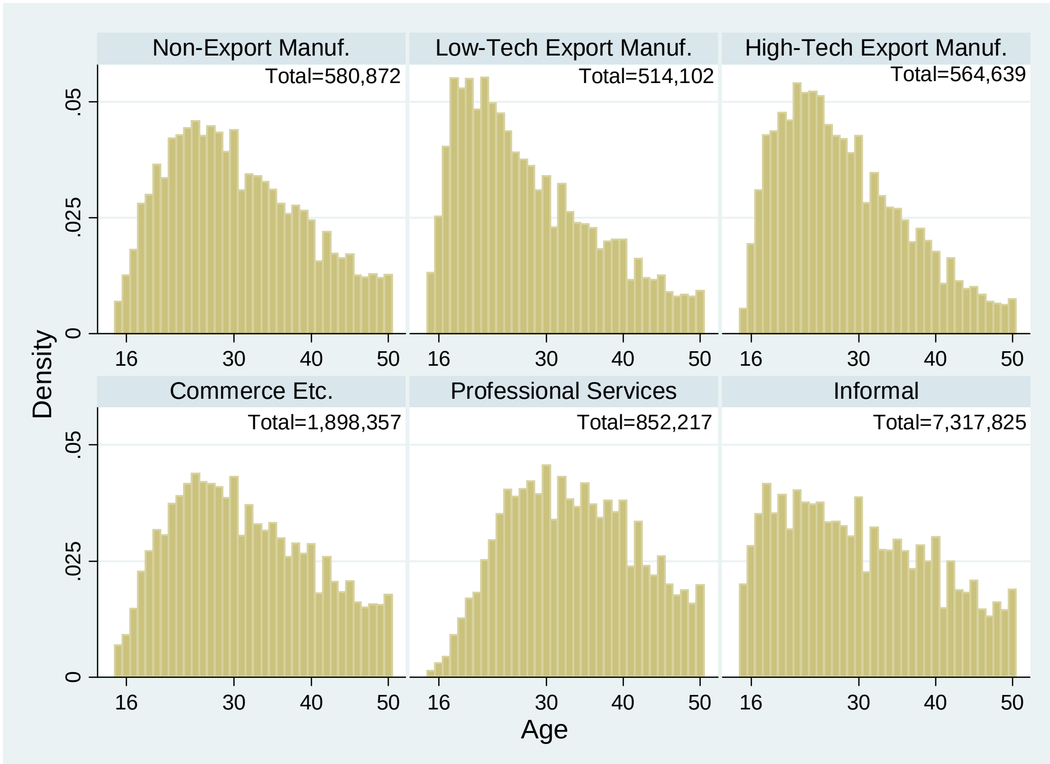


Figure 4: Frequency of Education Levels for New Workers (2000, Insured by IMSS)

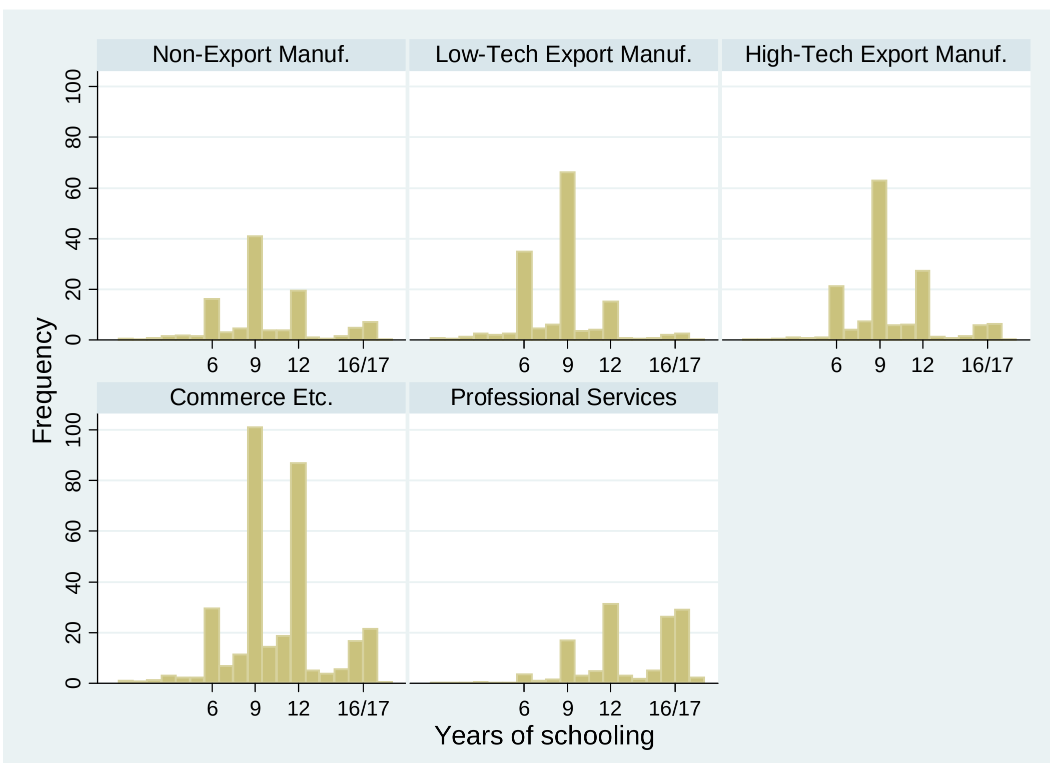

Figure 5: Visual Identification for Matamoros

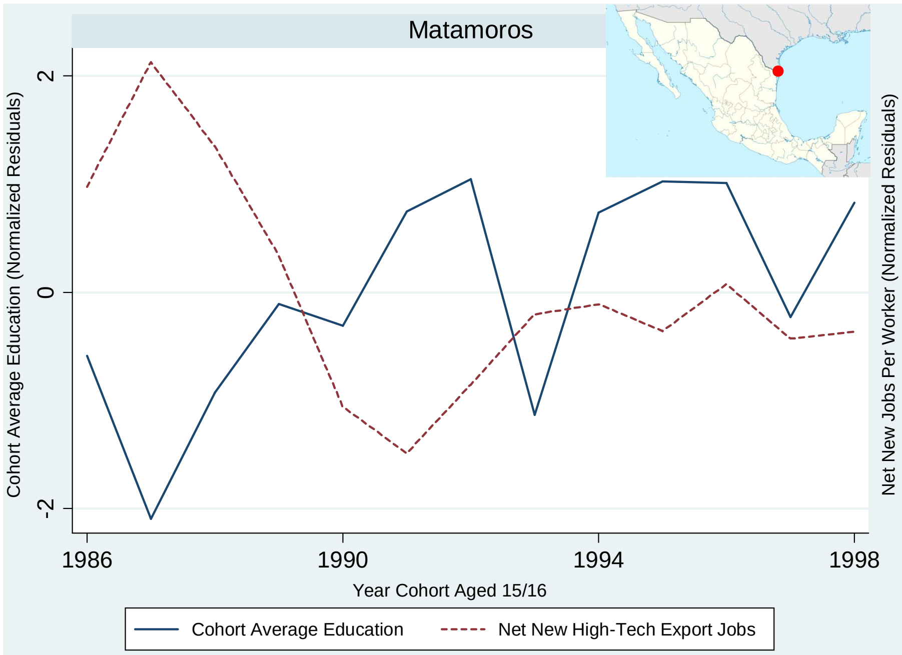


Figure 6: Visual Identification for 20 Municipalities with Biggest Inflows of Net New Jobs Per Worker in HTEM

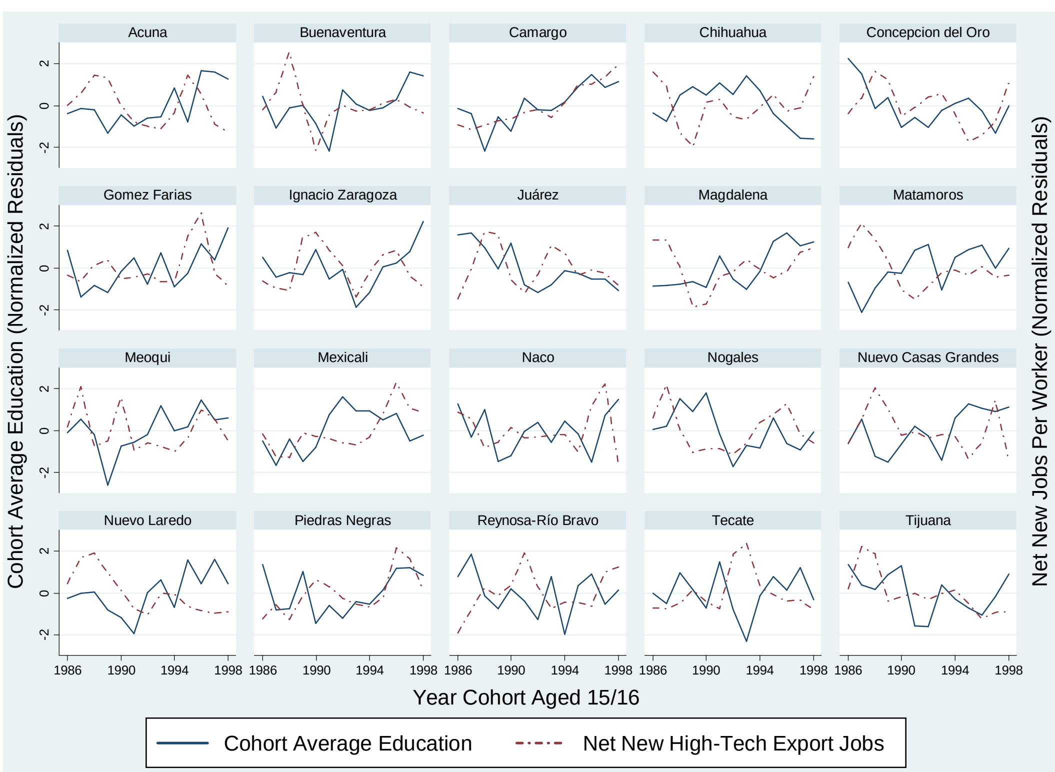

Figure 7: Effect of Positive Net New Jobs per Worker at Different Exposure Ages (Instrumented)

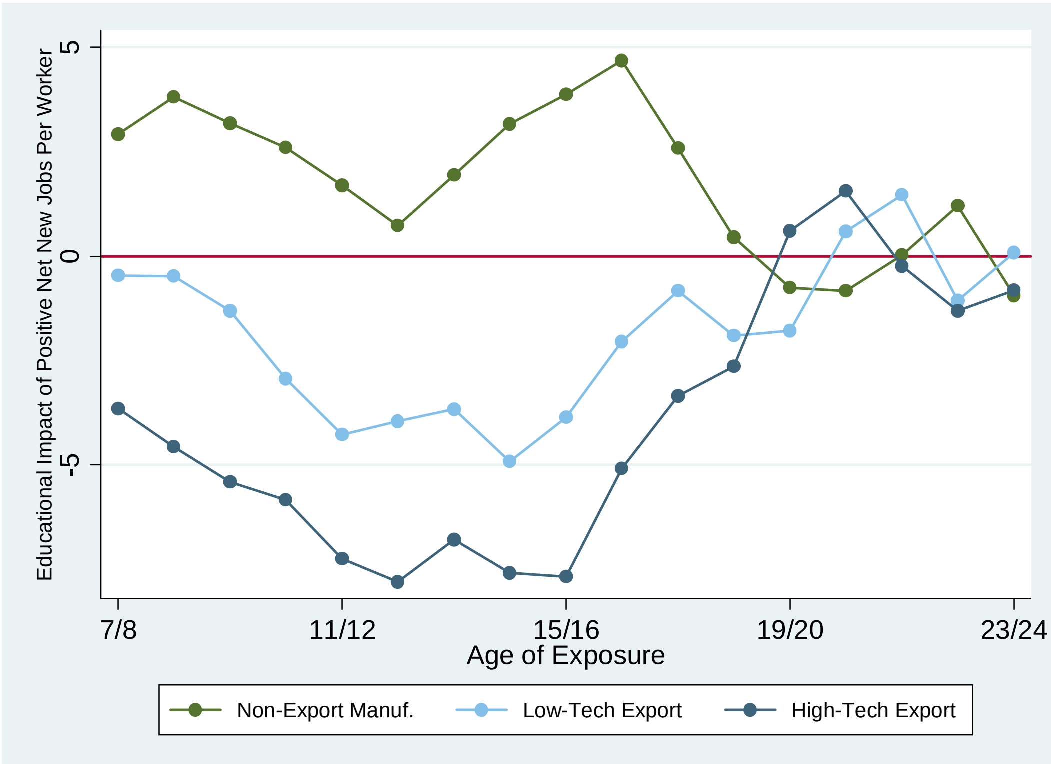


Figure 8: Formal Sector Wage Premia for New Workers (2000, Insured by IMSS)

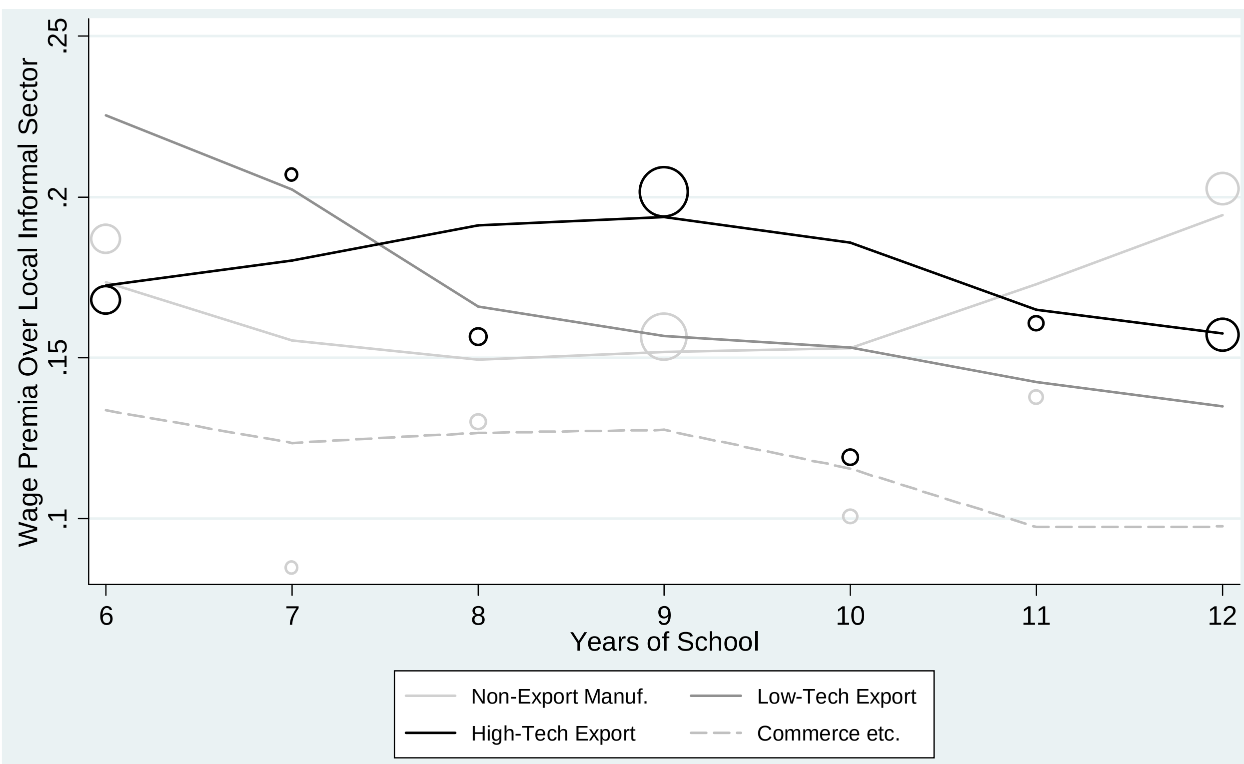

Figure 9: Returns to Schooling for New Workers (2000, Insured by IMSS)

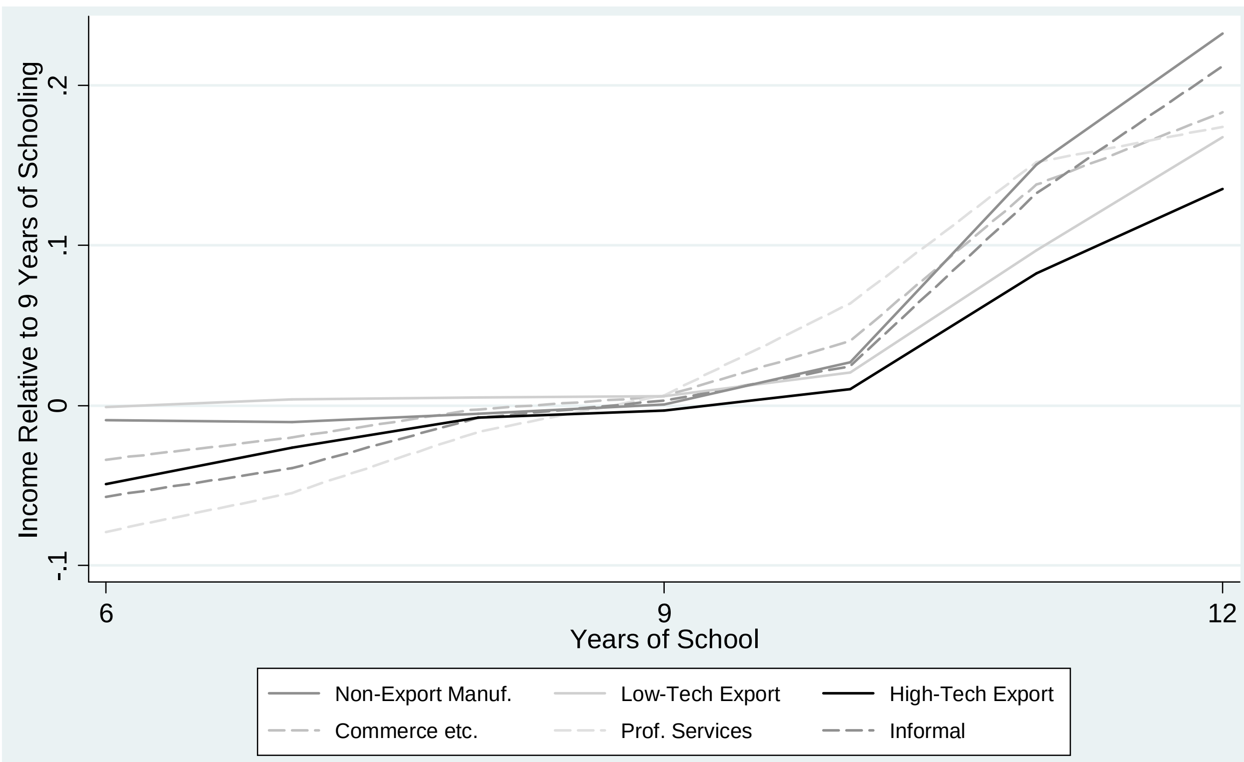

Figure 10: Wage Profiles for Different Levels of Schooling (2000, Insured by IMSS)

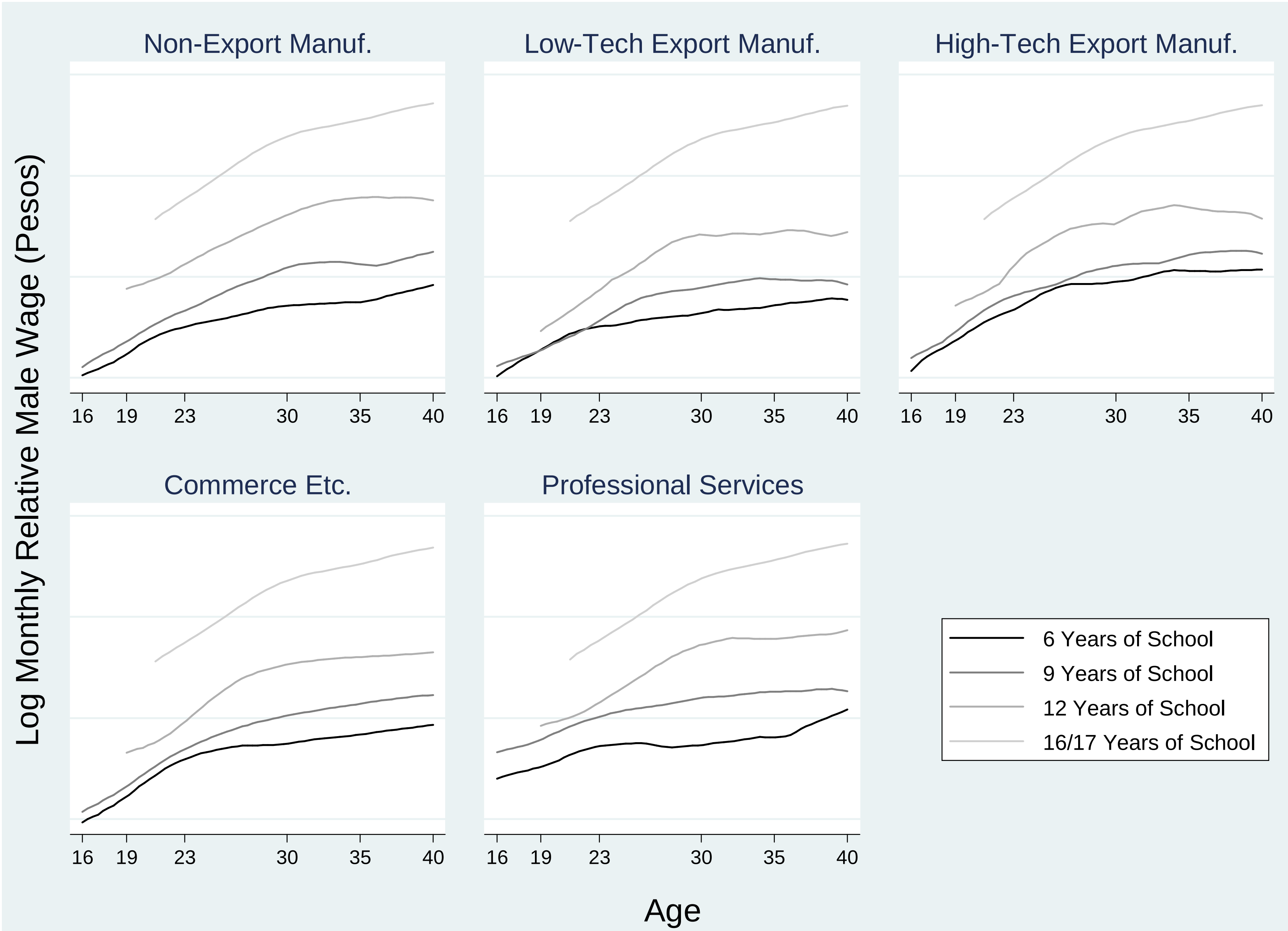

Figure 11: Comparing Wage Profiles in Manufacturing (2000, Insured by IMSS)

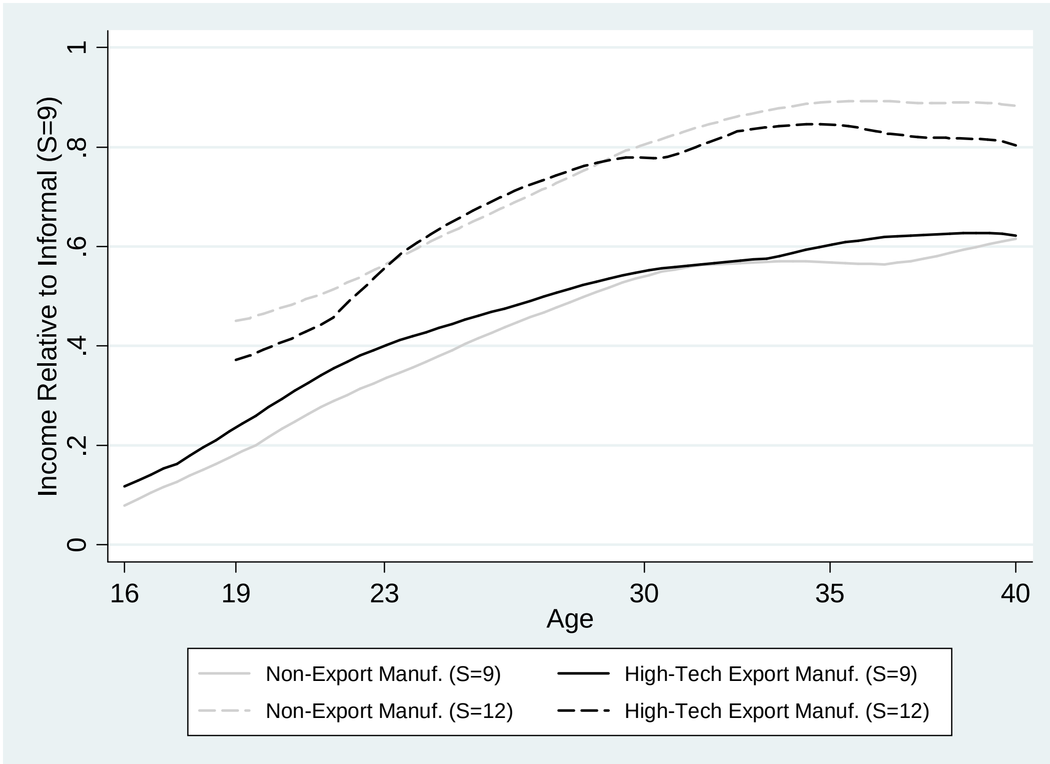


Figure 12: Male Wage Profiles in 1990 and 2000 for a Hypothetical Dropout Decision

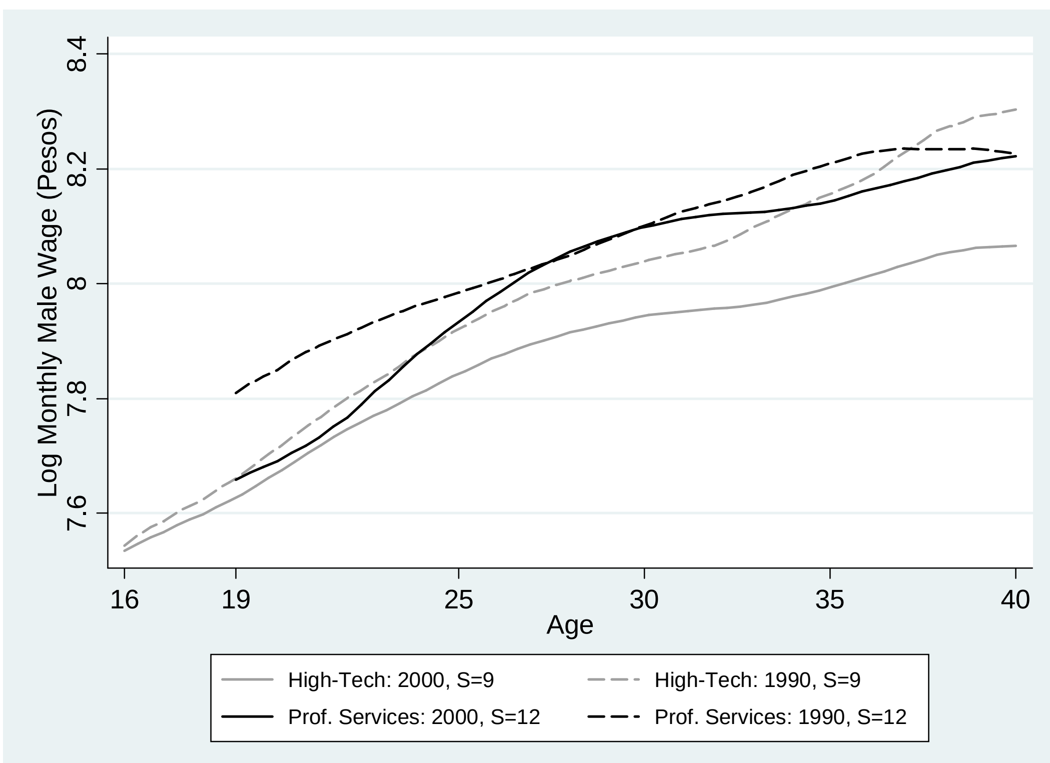

Figure 13: Wage Profiles for High-Tech Export Manufacturing 1990 and 2000

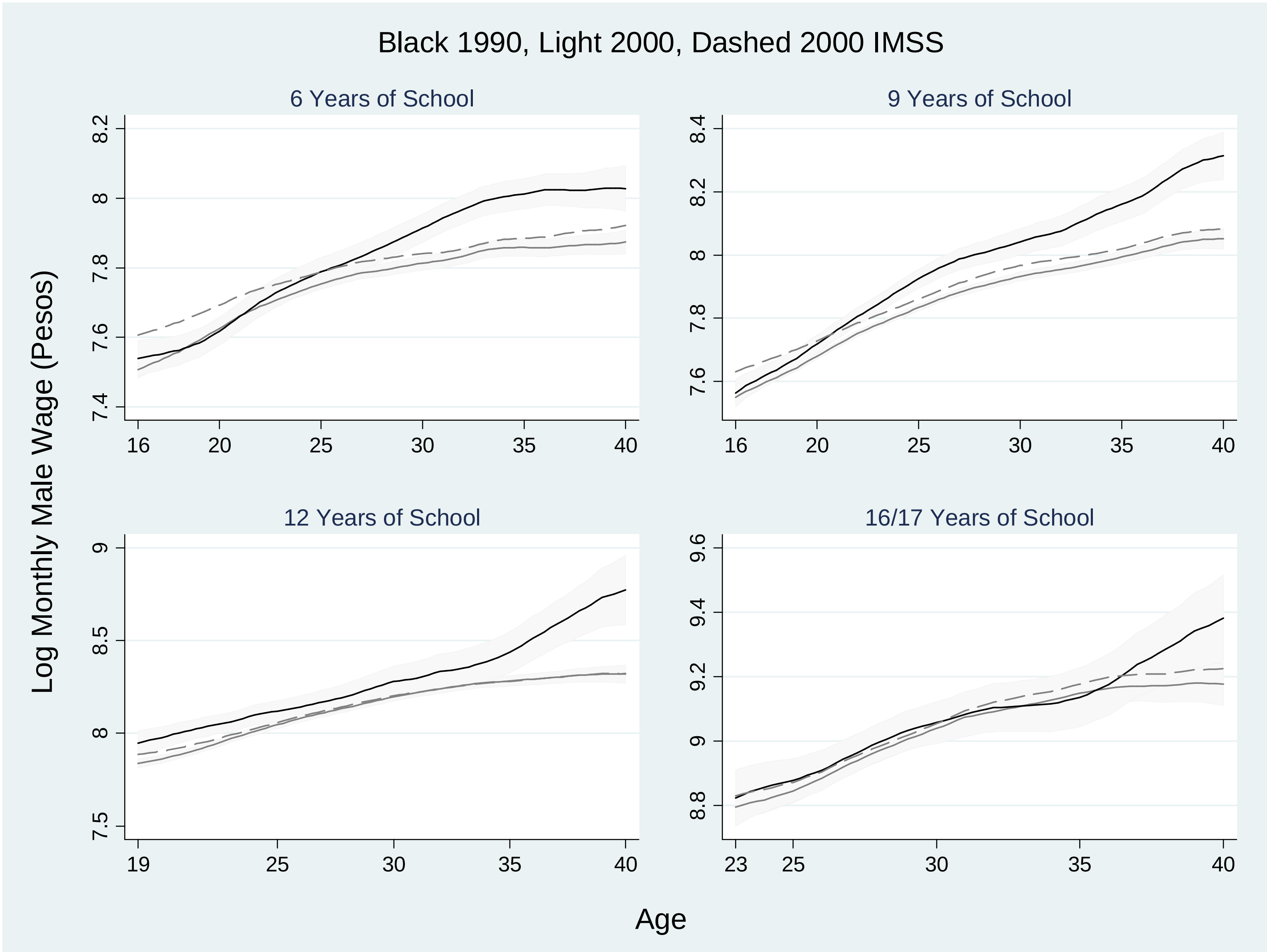

Table 2: The Effect of Net New Jobs on Educational Attainment

| LHS: Cohort Average Completed Years of Schooling | Net New Jobs/Worker at Age 15-16 |
|---|---|
| Non-Export Manufacturing | 2.976** |
| | (1.22) |
| Low-Tech Export Manufacturing | -2.218 |
| | (1.71) |
| High-Tech Export Manufacturing | -6.503*** |
| | (2.13) |
| Commerce, Personal Services | 4.884*** |
| | (1.35) |
| Professional Services | 5.238*** |
| | (1.95) |
| Observations | 23484 |
| $R^2$ | 0.90 |
| Municipalities | 1808 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 3: The Effect of Net New Jobs on Educational Attainment, Positive and Negative Interaction Dummies

| LHS: Cohort Average Completed Years of Schooling | **Positive** Net New Jobs/Worker at Age 15-16 | **Negative** Net New Jobs/Worker at Age 15-16 |
|---|---|---|
| Non-Export Manufacturing | 5.119*** | **-2.394** |
| | (1.61) | (1.66) |
| Low-Tech Export Manufacturing | -3.601** | -4.398* |
| | (1.53) | (2.64) |
| High-Tech Export Manufacturing | -8.056*** | -5.808* |
| | (1.96) | (3.29) |
| Commerce, Personal Services | 8.405*** | **-4.004**** |
| | (1.92) | (1.81) |
| Professional Services | 9.150*** | **-13.11***** |
| | (3.33) | (2.94) |
| Observations | | 23484 |
| $R^2$ | | 0.91 |
| Municipalities | | 1808 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16 interacted with a dummy variable that takes the value 1 if net new jobs per worker is positive, and another dummy variable that takes the value 1 if net new jobs per worker is negative. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent. Bold coefficients have significantly different positive and negative net job effects.

Table 4: The Effect of Net New Jobs on Educational Attainment, Instrumenting with Large Changes in Net New Jobs

| LHS: Cohort Average Completed Years of Schooling | Net New Jobs/Worker at Age 15-16 |
|---|---|
| Non-Export Manufacturing | 1.783* |
| | (1.771) |
| Low-Tech Export Manufacturing | -3.540*** |
| | (-2.761) |
| High-Tech Export Manufacturing | -6.672*** |
| | (-4.605) |
| Commerce, Personal Services | 4.165*** |
| | (3.199) |
| Professional Services | 5.182*** |
| | (3.407) |
| Observations | 23484 |
| $R^2$ | 0.258 |
| Kleibergen-Paap rk Wald F statistic ($1^{st}$ Stage) | 558.03 |
| Municipalities | 1808 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 5: The Effect of Net New Jobs on Educational Attainment, Positive and Negative Interaction Dummies, Instrumenting with Large Changes in Net New Jobs

| LHS: Cohort Average Completed Years of Schooling | **Positive** Net New Jobs/Worker at Age 15-16 | **Negative** Net New Jobs/Worker at Age 15-16 |
|---|---|---|
| Non-Export Manufacturing | 3.870*** | **-2.510** |
| | (1.388) | (1.696) |
| Low-Tech Export Manufacturing | -3.862** | -4.917 |
| | (1.699) | (3.010) |
| High-Tech Export Manufacturing | -7.674*** | -4.169 |
| | (1.752) | (3.146) |
| Commerce, Personal Services | 2.708 | -2.521 |
| | (1.975) | (2.555) |
| Professional Services | 8.123*** | **-9.315*** ** |
| | (2.897) | (2.468) |
| Observations | | 23484 |
| $R^2$ | | 0.26 |
| Municipalities | | 1808 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16 interacted with a dummy variable that takes the value 1 if net new jobs per worker is positive, and another dummy variable that takes the value 1 if net new jobs per worker is negative. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year, also interacted by positive and negative value dummies. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.Bold coefficients have significantly different positive and negative net job effects.

Table 6: The Effect of Net New Jobs on Educational Attainment, Instrumenting with State Growth Trends Interacted with Local Employment

| LHS: Cohort Average Completed Years of Schooling | Previous Years Level | Initial Level (1986) |
|---|---|---|
| | of Employment$_{mi}$ × State Growth$_{mi}$ | |
| | Net New Jobs/Worker at Age 15-16 | |
| Non-Export Manufacturing | -6.883 | -6.375 |
| | (4.34) | (4.25) |
| Low-Tech Export Manufacturing | -9.475*** | -30.30** |
| | (2.97) | (13.9) |
| High-Tech Export Manufacturing | -10.15** | -17.28*** |
| | (4.32) | (5.53) |
| Commerce, Personal Services | 11.33*** | 5.297 |
| | (3.57) | (3.30) |
| Professional Services | 20.65*** | 23.65*** |
| | (6.56) | (6.36) |
| Observations | 21662 | 21651 |
| $R^2$ | 0.21 | 0.13 |
| Kleibergen-Paap rk Wald F statistic ($1^{st}$ Stage) | 10.08 | 3.34 |
| Municipalities | 1808 | 1807 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker predicted if the existing level of local employment expanded by the state growth rate in that industry. The first column uses the previous years employment multiplied by that years state growth rate, the second column uses the initial years employment multiplied by the state growth rate over the years between the initial and current period. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 7: Transition Matrix for Net New Jobs Per Worker

| | Next Periods Value | | |
|---|---|---|---|
| Initial Value | Negative | Zero | Positive |
| Non-Export Manufacturing | | | |
| Negative | 53.03 | 3.10 | 43.87 |
| Zero | 4.94 | 91.84 | 3.23 |
| Positive | 18.51 | 6.12 | 75.37 |
| Low-Tech Export Manufacturing | | | |
| Negative | 53.76 | 2.87 | 43.38 |
| Zero | 3.94 | 94.7 | 1.36 |
| Positive | 18.04 | 8.44 | 73.52 |
| High-Tech Export Manufacturing | | | |
| Negative | 51.08 | 4.13 | 44.79 |
| Zero | 3.79 | 94.4 | 1.81 |
| Positive | 18.83 | 10.29 | 70.88 |
| Commerce, Personal Services | | | |
| Negative | 51.65 | 1.79 | 46.55 |
| Zero | 5.22 | 90.72 | 4.06 |
| Positive | 15.23 | 3.30 | 81.47 |
| Professional Services | | | |
| Negative | 48.85 | 2.67 | 48.47 |
| Zero | 2.51 | 93.98 | 3.51 |
| Positive | 11.09 | 6.78 | 82.13 |

Table 8: Serial Correlation of Net New Jobs per Worker

| (High-Tech Export is omitted category) | LHS: Net New Jobs/Worker |
|---|---|
| L.Net New Jobs/Worker | -0.0517 |
| | (0.047) |
| I.Non-Export Manufacturing | 0.0809 |
| ×L.Net New Jobs/Worker | (0.066) |
| I.Low-Tech Export Manufacturing | 0.0661 |
| ×L.Net New Jobs/Worker | (0.081) |
| I.Commerce, Personal Services | 0.0889 |
| ×L.Net New Jobs/Worker | (0.13) |
| I.Professional Services | 0.124** |
| ×L.Net New Jobs/Worker | (0.055) |
| Observations | 61620 |
| Municipalities | 1027 |

*Notes:* Arellano-Bond linear dynamic panel estimates. Year dummies not shown. Robust standard errors in parentheses. * 10 percent level, ** 5 percent and *** 1 percent.

Table 9: Robustness Checks 1: Other Specifications

| LHS: Cohort Average Years of School | (1) Basic Spec. | (2) Muni. Trend | (3) Capped at 12 | (4) Not at School | (5) Men Only | (6) Women Only | (7) Rural Trends |
|---|---|---|---|---|---|---|---|
| Positive Net New Jobs Per Worker at Ages 15-16 | | | | | | | |
| Non-Export | 3.870*** | 1.409 | 1.913** | 1.778 | 2.578** | 5.793** | 2.806** |
| Manufacturing | (1.388) | (1.254) | (0.950) | (1.201) | (1.10) | (2.53) | (1.319) |
| Low-Tech Export | -3.862** | -1.039 | -3.408*** | -3.934** | -3.944** | -3.431** | -2.451* |
| Manufacturing | (1.699) | (0.960) | (1.204) | (1.596) | (1.79) | (1.75) | (1.410) |
| High-Tech Export | -7.674*** | -3.417*** | -4.904*** | -5.426*** | -5.889*** | -6.229*** | -5.708*** |
| Manufacturing | (1.752) | (1.149) | (1.162) | (1.320) | (1.91) | (2.10) | (1.343) |
| Commerce, | 2.708 | -2.388** | 1.568 | 2.257 | 0.562 | 6.442 | 2.096 |
| Personal Services | (1.975) | (1.178) | (1.425) | (1.606) | (1.31) | (4.07) | (1.499) |
| Professional | 8.123*** | -3.874*** | 4.453** | 4.694** | 6.366*** | 8.470** | 4.012*** |
| Services | (2.897) | (1.105) | (1.779) | (1.907) | (2.14) | (3.42) | (1.405) |
| Negative Net New Jobs Per Worker at Ages 15-16 | | | | | | | |
| | -2.510 | -1.525 | -1.655 | -2.125* | -0.776 | -10.10*** | -1.572 |
| Manufacturing | (1.696) | (1.469) | (1.162) | (1.191) | (1.35) | (3.77) | (1.707) |
| Low-Tech Export | -4.917 | -0.0679 | -1.413 | -3.651 | -3.165 | 0.885 | -2.601 |
| Manufacturing | (3.010) | (2.647) | (2.347) | (2.802) | (3.34) | (3.95) | (2.680) |
| High-Tech Export | -4.169 | -2.475 | -3.348 | -1.494 | -5.960*** | 0.791 | -3.069 |
| Manufacturing | (3.146) | (2.298) | (2.376) | (2.319) | (1.87) | (2.08) | (3.085) |
| Commerce, | -2.521 | -0.501 | -1.469 | -0.533 | -0.287 | -10.89 | -3.075 |
| Personal Services | (2.555) | (1.864) | (1.712) | (2.105) | (1.47) | (17.2) | (2.222) |
| Professional | -9.315*** | -3.624** | -6.195*** | -5.381*** | -6.582** | -7.497*** | -9.659*** |
| Services | (2.468) | (1.694) | (1.727) | (1.857) | (2.79) | (2.39) | (1.991) |
| Observations | 23484 | 23484 | 23484 | 23477 | 23328 | 23375 | 23484 |
| $R^2$ | 0.266 | 0.560 | 0.290 | 0.416 | 0.20 | 0.21 | 0.413 |
| Municipalities | 1808 | 1808 | 1808 | 1808 | 1808 | 1808 | 1808 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. Specifications described in section 5. State-time and municipality dummies not shown. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** 5 percent and *** 1 percent.

Table 10: Robustness Checks 2: Regional Effects

| LHS: Cohort Average Years of School | (1) Basic Spec. | (8) No Big Cities | (9) Northern | (10) Central | (11) Southern | (12) Richer | (13) Poorer |
|---|---|---|---|---|---|---|---|
| Positive Net New Jobs Per Worker at Ages 15-16 | | | | | | | |
| Non-Export | 3.870*** | 3.334** | 7.286*** | 1.118 | 5.068** | 3.398* | 3.321** |
| Manufacturing | (1.388) | (1.321) | (2.395) | (2.612) | (2.088) | (1.825) | (1.656) |
| Low-Tech Export | -3.862** | -5.033*** | -3.368 | -3.973* | -9.004 | -3.770** | -10.46*** |
| Manufacturing | (1.699) | (1.717) | (2.434) | (2.395) | (8.483) | (1.687) | (3.035) |
| High-Tech Export | -7.674*** | -4.961*** | -5.477*** | -27.06*** | 9.632 | -6.037*** | -8.220*** |
| Manufacturing | (1.752) | (1.574) | (1.604) | (7.978) | (24.78) | (1.597) | (2.647) |
| Commerce, | 2.708 | 3.449* | 5.788*** | -5.220 | 7.853** | -1.317 | 4.823** |
| Personal Services | (1.975) | (1.823) | (2.213) | (3.741) | (3.605) | (2.017) | (2.406) |
| Professional | 8.123*** | 6.274** | 15.97*** | 8.262*** | -1.953 | 6.372*** | 6.507 |
| Services | (2.897) | (2.502) | (3.719) | (2.824) | (16.20) | (2.391) | (4.180) |
| Negative Net New Jobs Per Worker at Ages 15-16 | | | | | | | |
| | -2.510 | -1.715 | -4.725 | -6.170** | 2.496 | -2.650 | -2.697 |
| Manufacturing | (1.696) | (1.625) | (3.749) | (2.705) | (2.007) | (1.950) | (3.742) |
| Low-Tech Export | -4.917 | -3.735 | -7.249 | -1.940 | -22.81 | -4.855 | 2.048 |
| Manufacturing | (3.010) | (3.001) | (5.822) | (3.179) | (15.05) | (4.504) | (4.213) |
| High-Tech Export | -4.169 | -5.504* | -1.549 | 4.253 | -23.65 | -4.175 | 4.297 |
| Manufacturing | (3.146) | (3.213) | (4.570) | (5.574) | (14.98) | (3.543) | (4.669) |
| Commerce, | -2.521 | -3.399 | -7.829** | 6.296 | 0.0768 | -0.756 | 2.793 |
| Personal Services | (2.555) | (2.371) | (3.414) | (5.349) | (6.185) | (4.231) | (2.532) |
| Professional | -9.315*** | -6.255*** | -13.01*** | -11.81** | 2.132 | -8.620*** | -9.325 |
| Services | (2.468) | (2.135) | (2.799) | (4.828) | (25.70) | (2.456) | (8.155) |
| Observations | 23484 | 23458 | 4302 | 9789 | 9393 | 11748 | 11736 |
| $R^2$ | 0.266 | 0.229 | 0.486 | 0.194 | 0.175 | 0.357 | 0.324 |
| Municipalities | 1808 | 1806 | 331 | 753 | 724 | 904 | 904 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. Specifications described in section 5. State-time and municipality dummies not shown. Cell population weights, excludes Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** 5 percent and *** 1 percent.

Table 11: Effects at Different Ages and Schooling Decisions

| LHS: Cohort Avg. Schooling | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RHS: Positive Net | Exposure Ages 13-14 | | | Exposure Ages 15-16 | | | Exposure Ages 18-19 | | | Exposure Ages 22-23 | | |
| New Jobs/Worker | All | Schl >6 | Schl >9 | All | Schl >6 | Schl >9 | All | Schl >6 | Schl >9 | All | Schl >6 | Schl >9 |
| Non-Export | 1.95 | 1.95 | 3.29** | 3.87*** | 3.88*** | 4.88*** | 0.45 | 0.46 | 1.61 | 1.216 | -1.67 | -1.61 |
| Manufacturing | (1.64) | (1.30) | (1.67) | (1.39) | (0.98) | (1.48) | (1.37) | (1.41) | (1.30) | (1.49) | (1.36) | (1.35) |
| Low-Tech Export | -3.67* | -0.60 | 0.11 | -3.86** | 0.12 | 0.787 | -1.89 | -1.678 | -0.269 | -1.06 | -1.33 | -0.60 |
| Manufacturing | (2.05) | (1.37) | (1.44) | (1.70) | (1.32) | (1.246) | (1.32) | (1.23) | (1.35) | (1.31) | (1.04) | (1.27) |
| High-Tech Export | -6.79*** | -3.43*** | -3.17*** | -7.67*** | -4.57*** | -3.05*** | -2.63** | -2.81*** | -2.78*** | -1.31 | -0.60 | -0.71 |
| Manufacturing | (1.95) | (1.20) | (0.96) | (1.75) | (1.25) | (1.08) | (1.23) | (0.96) | (1.04) | (1.11) | (0.90) | (1.09) |
| Commerce, | 5.05** | 0.89 | 3.04** | 2.708 | 0.81 | 0.129 | 2.22 | 1.17 | 0.957 | 2.98* | 1.90 | 0.20 |
| Personal Services | (2.24) | (1.44) | (1.37) | (1.98) | (1.27) | (1.19) | (1.58) | (1.26) | (1.39) | (1.66) | (2.04) | (1.86) |
| Professional | 13.36*** | 7.96*** | 4.98*** | 8.12*** | 5.37*** | 4.67*** | 3.53*** | 2.76*** | 2.13*** | 3.05*** | -1.43** | -0.28 |
| Services | (3.86) | (1.96) | (1.48) | (2.90) | (1.70) | (1.14) | (1.01) | (0.68) | (0.61) | (0.69) | (0.71) | (0.53) |
| Observations | 23486 | 22906 | 17970 | 23484 | 22669 | 19352 | 23475 | 22232 | 18468 | 23466 | 21643 | 17489 |
| $R^2$ | 0.63 | 0.92 | 0.93 | 0.27 | 0.79 | 0.91 | 0.23 | 0.27 | 0.65 | 0.35 | 0.16 | 0.12 |
| Municipalities | 1808 | 1808 | 1740 | 1808 | 1807 | 1748 | 1808 | 1804 | 1731 | 1808 | 1801 | 1672 |

*Notes:* Dependent variable is the cohort average years of schooling in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at the listed exposure ages. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. Schl>$x$ restricts sample to those with more than $x$ years of schooling in 2000. Negative net new jobs per worker not shown. State-time and municipality dummies omitted. Regression weighted by cell population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** 5 percent, *** 1 percent.

Table 12: The Effect of Net New Jobs on Log Earned Monthly Income

| **Positive** Net New Jobs/Worker | Monthly Log Income in 2000 (Pesos) | | |
|---|---|---|---|
| Age of Exposure: | Ages 13 to 14 | Ages 15 to 16 | Ages 18 to 19 |
| Non-Export Manufacturing | 0.409 | 0.908*** | 0.377 |
| | (1.128) | (0.337) | (1.373) |
| Low-Tech Export Manufacturing | 0.316 | 0.0768 | 0.551** |
| | (1.212) | (0.290) | (2.024) |
| High-Tech Export Manufacturing | -0.335 | -0.580** | -0.329* |
| | (-1.227) | (0.272) | (-1.653) |
| Commerce, Personal Services | 0.535** | 0.484 | 0.611** |
| | (2.091) | (0.296) | (2.194) |
| Professional Services | 1.227*** | 0.917*** | 0.565** |
| | (5.492) | (0.242) | (2.323) |
| Observations | 21758 | 22069 | 22022 |
| $R^2$ | 0.767 | 0.747 | 0.647 |
| Municipalities | 1800 | 1802 | 1802 |

*Notes:* Dependent variable is the cohort average monthly log earned income in the year 2000. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. Negative net new jobs per worker not shown. State-time and municipality dummies omitted. Cell population weights, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 13: Municipality Wealth Differences and the Impact on Log Earned Monthly Income

| **Positive** Net New Jobs/Worker Ages 15-16: | Monthly Log Income in 2000 (Pesos) | |
|---|---|---|
| | Richer Municipalities | Poorer Municipalities |
| Non-Export Manufacturing | 0.822* | 0.750 |
| | (0.48) | (0.49) |
| Low-Tech Export Manufacturing | 0.408 | -1.277*** |
| | (0.35) | (0.47) |
| High-Tech Export Manufacturing | -0.473 | 0.151 |
| | (0.30) | (0.53) |
| Commerce, Personal Services | -0.0341 | 0.568 |
| | (0.34) | (0.59) |
| Professional Services | 0.667*** | 0.0172 |
| | (0.21) | (0.87) |
| Observations | 11132 | 10937 |
| $R^2$ | 0.81 | 0.62 |
| Municipalities | 903 | 899 |

*Notes:* Municipalities divided by year 2000 average log income. Independent variables are net new jobs per worker arriving in cohort's municipality at ages 15 and 16. These variables are instrumented by the net new jobs per worker attributable to firms that expand or contract their employment by more than 50 employees in a single year. Negative net new jobs per worker not shown. State-time and municipality dummies omitted. Cell population weights, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 14: The Effect of Net New Job Volatility on Municipality Average Education

| LHS: Municipality Average Completed Years of Schooling | Coefficient of Variation Annual $\Delta$Jobs/Worker 86-99 | Mean Annual $\Delta$Jobs/Worker 86-99 |
|---|---|---|
| Non-Export Manufacturing | -0.000415 | 28.71** |
| | (0.00064) | (12.1) |
| Low-Tech Export Manufacturing | -0.0000207*** | -8.372* |
| | (0.0000034) | (4.74) |
| High-Tech Export Manufacturing | -0.000808** | -19.01*** |
| | (0.00037) | (5.07) |
| Commerce, Personal Services | 0.000318 | 25.58*** |
| | (0.00070) | (8.57) |
| Professional Services | 0.000304 | 70.77*** |
| | (0.00024) | (14.4) |
| $R^2$ | | 0.76 |
| Municipalities | | 1808 |

*Notes:* State dummies, percentage rural and household per capita income not shown. Regression weighted by total municipality population, exclude Mexico City and migrants. Robust standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 15: The Effect of Net New Jobs on Cohort Size

| LHS: Log Cohort Size | **Positive** Net New Jobs/Worker Age 15-16 | **Negative** Net New Jobs/Worker Age 15-16 |
|---|---|---|
| Non-Export Manufacturing | 0.353 | 0.470 |
| | (0.51) | (0.48) |
| Low-Tech Export Manufacturing | -0.512 | -1.071 |
| | (0.40) | (0.82) |
| High-Tech Export Manufacturing | -0.283 | -0.462 |
| | (0.43) | (0.57) |
| Commerce, Personal Services | 1.299*** | -0.754 |
| | (0.39) | (0.69) |
| Professional Services | 1.784*** | -2.594*** |
| | (0.62) | (0.74) |
| Observations | | 23484 |
| $R^2$ | | 1.00 |
| Municipalities | | 1808 |

*Notes:* State-time and municipality dummies not shown. Regression weighted by total municipality population, exclude Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 16: Schooling of Migrants/Non-Migrants and Net New Jobs 1995-1999

| LHS: Ratio of Leavers Schooling to Stayers (Aged 15-16 in 1995-99) | **Positive** Net New Jobs/Worker 1995-99 | **Negative** Net New Jobs/Worker 1995-99 |
|---|---|---|
| Non-Export Manufacturing | -0.434 | 0.840 |
| | (0.59) | (2.45) |
| Low-Tech Export Manufacturing | -0.787* | -0.284** |
| | (0.47) | (0.12) |
| High-Tech Export Manufacturing | -1.061*** | 0.0986 |
| | (0.39) | (1.16) |
| Commerce, Personal Services | -0.485 | -1.349 |
| | (0.55) | (1.07) |
| Professional Services | -2.684*** | -1.983 |
| | (0.77) | (1.52) |
| Observations | | 1663 |
| $R^2$ | | 0.07 |

*Notes:* State dummies not shown. Regression weighted by total cohort populations, exclude Mexico City. Robust standard errors in parentheses. * significant at 10 percent level, ** 5 percent, *** 1 percent.

Table 17: The Interaction of Industry Migrant Proportions and Net New Jobs

| LHS: Cohort Schooling Ages 15-16 | **Positive** Net New Jobs/Worker | **Positive** Net New Jobs/Worker×$\vartheta_{im}$ |
|---|---|---|
| Non-Export Manufacturing | 6.275*** | -8.125 |
| | (2.33) | (9.98) |
| Low-Tech Export Manufacturing | -0.0497 | -16.83 |
| | (3.18) | (11.0) |
| High-Tech Export Manufacturing | -16.06*** | 21.84*** |
| | (4.07) | (7.71) |
| Commerce, Personal Services | 13.53*** | -15.74** |
| | (2.64) | (6.40) |
| Professional Services | 0.126 | 45.75** |
| | (5.46) | (18.9) |
| Observations | | 22127 |
| $R^2$ | | 1703 |

*Notes:* $\vartheta_{im}$ is the proportion of formal workers in the 2000 census in industry $i$ and municipality $m$ that are neither born in that state nor lived in that municipality 5 years ago. Negative net new jobs per worker not shown. State-time and municipality dummies omitted. Cell population weights, excludes Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.

Table 18: Industry Churn: Transition Matrix for 4 Digit Industries in ENEU

| No. of Industries | N-E M | L-T E M | H-T E M | Comm. | Prof.Serv. |
|---|---|---|---|---|---|
| 0 Moves | 48.78 | 46.57 | 42.31 | 49.29 | 48.22 |
| 1 Move | 28.92 | 30.41 | 30.26 | 32.83 | 33.47 |
| >1 Move | 22.30 | 23.02 | 27.43 | 17.88 | 18.31 |
| Pre 1995 - Consistent Sample | | | | | |
| 0 Moves | 49.91 | 56.20 | 45.91 | 50.35 | 47.98 |
| 1 Move | 28.64 | 26.91 | 29.20 | 31.87 | 33.63 |
| >1 Move | 21.44 | 16.89 | 24.89 | 17.78 | 18.39 |
| Post 1995 - Consistent Sample | | | | | |
| 0 Moves | 45.93 | 48.76 | 41.34 | 47.56 | 49.85 |
| 1 Move | 29.73 | 29.39 | 30.59 | 33.61 | 31.89 |
| >1 Move | 24.34 | 21.85 | 28.07 | 18.83 | 18.26 |

Table 19: The Interaction of Changes in Returns to Experience and Net New Jobs

| | All Cohorts | | Pre 1995 Cohorts | |
|---|---|---|---|---|
| LHS: Cohort Schooling Ages 15-16 | **Positive** Net Jobs | **Positive** Net Jobs×$\phi_{2ir}$ | **Positive** Net Jobs | **Positive** Net Jobs×$\phi_{2ir}$ |
| Non-Export | 6.848*** | 301.9 | 9.456*** | 246.4 |
| | (2.39) | (235) | (2.89) | (324) |
| Low-Tech Export | -3.817* | -11.17 | 3.064* | -19.98 |
| | (2.02) | (164) | (1.73) | (221) |
| High-Tech Export | -9.241** | -128.7 | 0.780 | 413.1*** |
| | (4.41) | (321) | (1.86) | (152) |
| Commerce, Pers. Services | 5.596*** | -468.9* | 3.195 | -245.8 |
| | (2.13) | (272) | (1.95) | (257) |
| Professional Services | 8.842*** | -1185*** | 2.067*** | -411.2** |
| | (2.04) | (324) | (0.71) | (175) |
| Observations | | 23484 | | 14450 |
| $R^2$ | | 0.91 | | 0.95 |
| Municipalities | | 1808 | | 1808 |

*Notes:* $\phi_{2ir}$ is the estimated rotation of the experience profile between 1990 and 2000 in region $r$, industry $i$, from Mincer regressions. Negative net new jobs per worker not shown. State-time and municipality dummies omitted. Cell population weights, excludes Mexico City and migrants. Municipality clustered standard errors in parentheses. * significant at 10 percent level, ** at 5 percent and *** at 1 percent.