The Good News About Disappearing Jobs: U.S. High School Dropout Rates and Import Exposure*

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Abstract

We exploit regional variation in exposure to Chinese import competition to identify the effect of trade-induced changes in labor market conditions on U.S. high school dropout rates. Employing the methodology of Autor et al. (2013), who examine the effect of increased Chinese import competition on U.S. employment and wages, we argue that increasing import competition increases the relative returns to education and leads to a reduction in dropout rates. For the region with the median dropout rate in 2000, a movement from the 25^{th} to the 75^{th} percentile of change in import exposure per worker corresponds to a reduction in the 2007 dropout rate by 0.456 percentage points, which corresponds to a reduction in the number of dropouts by over 68,000 annually. Using available estimates of the present value of the lifetime net public benefit of each additional high school graduate and extrapolating such an annual reduction in dropouts to the entire country implies a net public benefit between $4.4 billion and $10.2 billion. Results are robust to controls for changes in school quality, demographic composition, and initial labor market conditions.

KEYWORDS: Dropouts, Trade, Endogenous Human Capital, Import Competition

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1. Introduction

The labor market effects of international trade have long been a favorite subject of trade economists, with canonical models emphasizing the reallocation of labor across sectors as countries shift production towards comparative advantage industries. Over the past two decades, the subject has received increased interest as authors have sought to explain the growing wage gap between skilled and unskilled U.S. workers and the decline of the U.S. manufacturing sector.[1]

This paper focuses on a related but distinct issue. We analyze human capital adjustments in response to trade-driven changes in labor market conditions. In particular, we examine whether import competition affects the incentives of students to complete high school. We employ the methodology developed by Autor et al. (2013), who use regional variation in employment across industries to analyze the effects of Chinese import competition on labor markets. Following this approach, we examine changes in dropout rates among U.S. public high schools in the face of increased competition from Chinese manufacturing imports. Across a broad range of specifications, we find that as local import competition increases, high school students are less likely to drop out.

Total U.S. imports from China increased by 171 percent between 2000 and 2007, largely due to China's substantial growth over that period. However, these increases were not uniform across industries. While ceramic wall and floor tile imports (SIC 3253) from China increased by a factor of 80, rubber and plastic footwear (SIC 3021) imports increased by only 11 percent, and imports in photographic equipment and supplies (SIC 3861) fell by over 80 percent. Autor et al. (2013) use such variation to examine differential effects of import competition across communities, or "commuting zones" that differ in their industrial structure. Commuting zones in which a large share of employment is accounted for by industries that saw large increases in Chinese imports experienced declines in employment

[1] On the wage gap between skilled and unskilled workers, see Feenstra and Hanson (1996) and Bernard and Jensen (1997). On the decline of U.S. manufacturing, see Autor et al. (2013) and Pierce and Schott (2013).

and wages, as well as an increase in transfer payments.

We combine the Autor et al. (2013) data with data from the National Center for Education Statistics (NCES) on annual school district dropout rates to examine whether dropout behavior changes in commuting zones faced with increased trade competition. Controlling for a wide range of potentially confounding demographic, economic and educational factors, we find a remarkably consistent result: dropout rates decline as import competition increases. A conservative estimate implies that a movement from the 25th to the 75th percentile in imports per worker reduces the median commuting zone's annual dropout rate by 0.46 students per 100, with a 95 percent confidence region between 0.36 and 0.36. Extrapolating the effect on the median community to the entire nation, an increase in import competition equal to the magnitude of a movement from the 25^{th} to the 75^{th} percentile in imports per worker would result in over 68,000 fewer dropouts per year.

The high school dropout rate is of considerable economic interest. In the United States, nearly one quarter of 9th grade students will fail to graduate four years later.[2] For black and Hispanic students, the number rises to one third. The economic costs of such numbers are substantial. Levin et al. (2007) estimate that each additional high school graduate among a cohort of 20-year-olds generates a lifetime net public benefit ranging between $\$65,000$ and $\$150,000$, with a gross public benefit of $\$209,000$. Applying these numbers to our results, each year's 68,000 students provide a total lifetime public benefit between \$4.4 billion and \$14.4 billion.

The factors affecting the high school dropout rate have received a great deal of attention from scholars. A wide range of potential determinants in the decision to drop out have been analyzed, at the level of the student, the family, the school and the community.[3] One factor of particular interest for the present paper is the set of labor market opportunities available to students. As early as Duncan (1965), economists recognized that shifting labor market conditions affected the opportunity cost of continued education. In recent years, scholars have examined changes in dropout rates in response to changes in unemployment

[2]Estimates of this number vary substantially, for reasons addressed at length by Heckman and LaFontaine (2010), who arrive at the estimates given above.

[3]See Rumberger and Lim (2008) for a useful survey of the literature. The authors describe factors affecting the dropout decision as either falling into one of two categories: "individual" or "institutional". Our emphasis will necessarily be on institutional factors.

rates, the number of individual hours worked, and minimum wage laws.[4] Consistent with our results, these authors have generally found that improvements in labor market conditions pull students out of school and into the labor market. To our knowledge, this is the first paper to link the response of dropout rates to changes in international trade in the U.S.

In addition to the literature on dropouts, this paper contributes to the analysis of human capital adjustments in response to trade. Heckscher-Ohlin theory predicts that an increase in low-skill imports will reduce the relative returns to employment in low-skilled industries, increasing the incentive to obtain an education. The skill acquisition process at the level of the individual in a trade setting was modeled explicitly by Findlay and Kierzkowski (1983), and has since received attention both theoretically and empirically.[5] Most directly related to our work is a recent paper by Atkin (2013). Atkin (2013) exploits variation in the timing of manufacturing plant openings across municipalities in Mexico over a fifteen year period to examine the effect of increased job market opportunities on school dropouts. Atkin (2013) finds that local plant openings that provide low-skill employment opportunities increase the rate of dropouts among students of sufficient age to dropout at the time of the opening. These results are analogous to ours, in a setting in which job opportunities for low-skilled individuals are expanding rather than contracting.

The paper proceeds in five sections. Section 2 of the paper describes the separate data sets used in our empirical analysis. Section 3 discusses the estimation strategy and previews the results. Section 4 contains the primary empirical analysis. Section 5 concludes.

2. Data

2.1. Import and Production Data

Our measure of import competition comes from Autor et al. (2013), who examine the impact of changing import competition on employment and income at the level of the commuting

[4]See Rees and Mocan (1997), McNeal (1997), and Chaplin et al. (2003) respectively.

[5]For theoretical examples, see Kreickemeier (2009), Falvey et al. (2010) and Davidson and Sly (2013). Empirical analysis includes Hickman and Olney (2011), and Hummels et al. (2012)

zone (henceforth c-zone).[6] While we download this variable directly from David Dorn's website, Autor et al. (2013) create this variable using data from two main sources.[7] Trade data are taken from U.N. Comtrade Database on imports at the six-digit HS product level. Data on county population, employment, and demographics are taken from the Census Integrated Public Use Micro Samples for 1990 and 2000, and the American Community Survey for the 2006 - 2008 period. We discuss how Autor et al. (2013) create a measure of import competition using these data during model estimation.

2.2. Education Data

Education measures are taken from the National Center for Education Statistics (NCES). The NCES is part of the Institute of Education Sciences, which is a unit of the U.S. Department of Education. To monitor the U.S. educational system, the NCES annually surveys all school districts that receive public funding. The data from these sources are provided as the Annual Common Core of Data Files and are publicly available for download.[8] Dropout measures, student enrollment, and other student-body-specific characteristics are taken from the public use version of the dropouts and completers dataset for the years 1997-2008.

Because we focus on the impact of trade-induced changes in labor market conditions on high school completion decisions, we restrict our attention to dropout rates in the 9^{th}–12^{th} grades. For each year, we create a county-level 9^{th}–12^{th} grade dropout rate, defined as the average dropout rate for all reporting districts in each county-year weighted by the number of 9^{th}–12^{th} grade students in each reporting district. This aggregation smooths out any idiosyncrasies in reporting rates across years related to misreporting of graduates and size of the student body in a given district, while allowing us to keep a larger number of counties in the sample than if we required each district to be in our sample for every year.

We define $DropoutRate_{i,2000}$ and $DropoutRate_{i,2007}$ as the enrollment-weighted average dropout rate for commuting-zone i during the the 2000 - 2001 period and the 2006 - 2008

[6] C-zones are geographic constructs which encompass areas with strong interior labor market ties, but weak ties across c-zones. They were used as the unit of analysis in Tolbert and Sizer (1996) and Autor and Dorn (2013).

[7] http://www.cemfi.es/~dorn/data.htm

[8] http://nces.ed.gov/ccd/ccddata.asp

period, respectively.[9] With this we calculate the log change in dropout rates from 2000 - 2007. The distribution of the log change in dropout rates can be found in Figure 1.[10]

Summary statistics for dropout rates and import competition are summarized in Table 2.[11] It bears repeating that the dropout rate listed is the annual dropout rate. This implies an approximate graduation rate of 85%. The changes in Chinese imports per worker to the U.S. and other countries are in thousands of 2007 USD. We see a modest reduction in the average dropout rate during our sample, and a large increase in Chinese imports per worker. However, as we will discuss in the subsequent section, these simple averages mask the substantial variation that exists across c-zones in both measures.

3. Estimation

As demonstrated by Autor et al. (2013), increased import exposure from China has strong effects on regional labor market conditions. To the extent that jobs available to high school students are among those affected, import competition will affect the opportunity cost of education. However, the direction of this effect is theoretically ambiguous. Deteriorating labor market conditions might reduce demand for low-skilled labor, making it more difficult for dropouts to find employment. This would increase the relative returns to additional schooling and consequently decrease the dropout rate. However, a downturn in the labor market might also reduce family income, leading to a greater need for teenagers to enter the labor force and thereby increasing dropout rates. To sort these effects out, we turn to our main empirical specification, defined in Equation 1. We regress the log change in dropout rates for c-zone i on changes in import exposure per worker and additional covariates $\mathbf{X}$:

[9] Results do not depend on the specific intervals as defined here. Unreported specifications used various combinations of the 1999 - 2001 and 2006 - 2008 intervals and produced results similar to those reported here.

[10] Notably, California, Colorado, Michigan, Nevada, and Vermont are missing from our sample. Due to inconsistencies in how dropouts were recorded for either of the 2000 - 2001 and 2006 - 2008 periods, the data were not reported in the NCES database. Consequently, the percentage change in dropout rates could not be calculated. t-tests of both the instrumented and non-instrumented mean change in import competition fail to reject the possibility that changes in import exposure per worker were greater for the included states than California, Colorado, Michigan, Nevada, and Vermont.

[11] A more detailed discussion of variable construction and data sources for additional covariates can be found in the data appendix.

$$\ln\left(\frac{DropoutRate_{i,2007}}{DropoutRate_{i,2000}}\right) = \alpha + \beta_1 \Delta ImportExposure_{ui,00-07} + \mathbf{X}\overline{\beta} + \epsilon_i \tag{1}$$

To measure changes in import exposure, we return to Autor et al. (2013). Their measure of import penetration per work is defined by Equation 2.

$$\Delta ImportExposure^{U.S.}_{it_{(0,1)}} = \sum_j \frac{L_{ijt_0}}{L_{it_0}} \frac{\Delta M^{U.S.}_{jt_{(0,1)}}}{L_{ujt_0}} \tag{2}$$

In Equation 2, the change in imports from China to the U.S. in industry j ($\Delta M^{U.S.}_{jt_{(0,1)}}$) is scaled by the national labor force in industry j (L_{ujt_0}). This provides an average increase in import exposure per worker in the U.S. This change in import exposure per worker is weighted by the fraction of the labor force in c-zone i engaged in production in industry j, to account for the fact that c-zones are not equally affected by changes in the competitive environment of each industry. Finally, the industry-c-zone-specific value is then summed across industries. The result is a c-zone level measure of changes in import exposure which varies according to a c-zone's concentration in sectors competing with Chinese imports.

As noted by Autor et al. (2013), OLS estimates of Equation 1 are subject to bias if there are demand shocks that simultaneously affect both labor market conditions and imports. To see this, imagine an exogenous increase in the demand for tennis shoes in the U.S. This increase in demand would likely increase employment in regions that specialize in tennis shoe production. However, tennis shoe imports from China may rise simultaneously. By failing to control for the change in demand, estimates of the effect of imports on domestic employment would be biased upwards. To the extent that labor market conditions affect dropout rates, estimates of the effect of import competition on dropout rates would thus also be biased. In order to avoid such concerns, we follow Autor et al. (2013) identification strategy by instrumenting $\Delta ImportExposure^{U.S.}_{it_{(0,1)}}$ with:

$$\Delta ImportExposure^{Other}_{it_{(0,1)}} = \sum_j \frac{L_{ijt-1}}{L_{it-1}} \frac{\Delta M^{Other}_{jt_{(0,1)}}}{L_{ujt-1}} \tag{3}$$

In this variable, the change in Chinese imports to the U.S. in industry j is replaced with the increase in imports to a set of other large developed countries ($\Delta M^{Other}_{jt_{(0,1)}}$).[12] All employment variables are also replaced with their values lagged 10 years. This is done in order to avoid understating the import exposure a particular c-zone faces due to simultaneous reductions in employment in sectors affected heavily by import exposure.

This instrument is valid if changes in Chinese exports are due to supply side factors. Such examples include the reduction in trade barriers China was granted upon its entrance into the World Trade Organization in 2001, as well as its general transition from a command to a market economy (as argued in Autor et al. (2013)).

Having instrumented our changes in import exposure, regressions are of the form in Equation 4. $\widehat{\Delta IPW}^{US}_{i,00-07}$ is the fitted value of a first stage regression of $\Delta ImportExposure^{US}_{ui,00-07}$ on $\Delta ImportExposure^{Other}_{i,00-07}$ and exogenous control variables, $\mathbf{X}$.

$$\ln\left(\frac{DropoutRate_{i,2007}}{DropoutRate_{i,2000}}\right) = \alpha + \beta_1 \widehat{\Delta IPW}^{US}_{i,00-07} + \mathbf{X}\overline{\beta} + \epsilon_i \tag{4}$$

We now turn to our baseline results as well as a discussion of the specific controls in $\mathbf{X}$.

4. Results

In order to gain a sense of the raw correlation between trade and student behavior, we first estimate a univariate regression of the log change in dropout rates on changes in import exposure. Column 1 of Table 3 reports results for an OLS specification using changes in import exposure in the U.S. as the explanatory variable, as in Equation 2. As discussed above, failure to account for demand-side changes in the U.S. is likely to induce bias in this estimate. We include it here only as a point of comparison. Column 2 reports results for a two-stage-least-squares regression of the log change in dropouts on the instrumented change in import exposure, as in Equation 4.[13] In these and all subsequent regressions, c-zone observations are weighted by their share of the U.S. population at the beginning of the sample. To account for any intra-state correlation in our error terms due to state-backed

[12]The other countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland.

[13]All subsequent regressions will be two-stage-least-squares. Reported F-stats are valid under clustered standard errors, as shown by Kleibergen and Paap (2006)

programs related to either trade or educational assistance, we cluster standard errors at the state level.[14] Consistent with the notion that students may be drawn out of school by increased employment opportunities, we see that increases in import exposure leads to a decline in the dropout rate. While the direction of the effect is the same in each regression, the magnitude of the two-stage-least-squares estimate is more than three times as large as the OLS estimates. Without controlling for additional covariates, a $1,000 increase in imports per worker in a c-zone is accompanied by a 4% lower change in dropout rates in that c-zone.

While these simple specifications seem to corroborate the view that increases in Chinese import exposure reduce dropout rates, we consider three possible alternative explanations for this finding. First, many studies have debated the extent to which the quality of the education available to students affects the returns to schooling, which may in turn affect the decision to drop out.[15] Insofar as increased import exposure may affect school quality, failing to account for these channels will bias our estimates. Second, there are a range of individual and demographic characteristics, such as education levels, that may be correlated with changes in import competition and changes in dropout rates. Finally, given the aggregate decline in U.S. manufacturing during our sample, it is possible that there is a decline in employment opportunities for high school dropouts unrelated to but coincident with the rise in Chinese exports. Were this the case, we would again mistakenly attribute a causal relationship to changes in Chinese import exposure and high school dropout rates. We deal with each of these concerns in turn.

4.1. School Quality

We first attempt to control for cross-sectional differences in unobservable factors affecting dropout rates, including school quality. To do so, we include the lagged c-zone dropout rate in our regressions, where the lagged rate is defined as the average dropout rate in a c-zone between 1997 and 1999.

This will control for persistent, unobservable differences across regions affecting dropout rates such as teacher quality, early childhood development programs, specialized retention

[14] Results are qualitatively unchanged without clustering standard errors.

[15] See for example Card and Krueger (1992); Angrist and Lavy (1999); Ehrenberg and Brewer (1994).

programs, and parental engagement. Inclusion of the lagged dropout rate in Column 1 of Table 4 nearly doubles our estimate of the effect of import exposure on dropout rates. A $1000 increase in imports per worker in a c-zone now leads to a 6.78% lower change in dropout rates. Initial dropout rates are negatively correlated with our dependent variable.[16] This is intuitive, given that a higher initial dropout rate limits the possible increase in dropout rates.

In addition to such unobservables in school quality, we would like to control for observable, time-varying measures of quality. In particular, if trade-induced changes in the local economy make it more difficult to fund and adequately staff schools, school quality may deteriorate as import competition increases. To account for such changes, we include two additional covariates. The first is the log change in expenditures per student. Increases in import exposure may lead to a reduction in income and property values, thus reducing the ability of affected communities to fund schools. While this covariate enters with a negative sign (increases in expenditures per student, which presumably increase the quality of the education, decrease the dropout rate) it does so insignificantly.[17] The second control is the percent change in student-to-teacher ratio. This covariate also enters insignificantly. Inclusion of these covariates has no substantial effect on the coefficient of import competition. The lack of significance of these variables is not surprising, given the relatively narrow time frame we are examining, and the aggregate nature of our data.[18]

An additional concern is that we may be picking up changes in mandatory attendance laws occurring during our sample period. As states increase the age at which students are legally able to drop out, they reduce the ability of students to respond to changes in local labor market conditions. During our sample period, 25 states changed the compulsory attendance age.[19] If areas that experience increases in import competition are also those likely to

[16]It is worth mentioning that we do see a reduction in sample size because some c-zones do not have education data available for the 1997-1999 interval.

[17]Results are qualitatively unchanged if we substitute revenue per student for expenditure per student.

[18]A long string of researchers, beginning with Coleman et al. (1966), has struggled to tie student outcomes to school resources. Hanushek (1997), examining nearly 400 studies of student outcomes, claims that "there is not a strong or consistent relationship between student performance and school resources." Rumberger and Lim (2008), focusing specifically on factors affecting dropouts, note that in any particular study it is difficult to demonstrate a causal relationship between any single factor and the decision to quit school."

[19]24 states increased the compulsory age during our sample, while one state, Minnesota, lowered it.

increase the compulsory attendance age, the effect identified in previous specifications may be spurious. We thus include the change in the mandatory age of attendance in Column 4. This variable enters insignificantly, and leaves the estimate of our primary covariate largely unchanged. Changes in import exposure are still negatively and significantly correlated with the log change in dropout rates.

Finally, while our results suggest a decrease in the dropout rate as import exposure increases, we pause to note that some students may choose to complete their requirements by obtaining a G.E.D. By the definition employed here, G.E.D. completers will not be counted as dropouts. However, Heckman et al. (2012), among others, argue that the societal returns to G.E.D.'s are nearly zero. It may be that changes in import competition cause marginal dropouts to transition to the G.E.D. track. To account for this possibility, we include the log change in G.E.D.s awarded as a fraction of total completers at the c-zone level in Column 5. The coefficient is positively correlated with changes in the dropout rate and is statistically significant. This suggests that areas with increases in dropouts may also see increases in G.E.D.s. However, this effect does not drive our results, as the coefficient on import competition remains negative and significant at the 10 percent level. We caution against any strong interpretation of the reduced statistical significance of final result given the substantial reduction in our sample size, which is due to limited reporting of G.E.D. attainment in our data. Due to this large reduction and the G.E.D.'s lack of effect on the magnitude of our primary covariate, we drop it from future regressions.[20]

4.2. Demographic and Individual Changes

While changes in school quality measures do not seem to explain the impact of trade on dropout rates, there are other economy-wide changes that may. We first consider several family-related determinants of the decision to drop out that may also be affected by increases in trade. The first of these is changes in rental costs. If living with one's parents decreases the likelihood of dropping out, then trade-induced changes in rental prices may affect students' ability to move out and consequently the number who choose to drop out. To identify this

[20]Repeating the specification using only those c-zones for which we have G.E.D. data and excluding the G.E.D. covariate, our point estimates are qualitatively unchanged.

effect, we control for the log change of the median rental price, collected from the U.S. Census and shown in Column 1 of Table 5. The median rental price is positively correlated with dropout rates. To the extent that rental prices serve as a proxy for general economic conditions in the local economy, this is consistent with the notion that improved economic conditions increase dropout rates. In this sense, the result corroborates the finding of the effect of imports on dropout rates. While sparsity in this variable causes a reduction in sample size, the import exposure measure remains strongly and significantly negative.

An additional predictor of dropouts is the family structure of students, in particular whether or not a student's parents have gone through a divorce, as noted by Rumberger and Lim (2008). Lacking student-level data, we control for this possibility by accounting for the log change in divorces per capita, as found in the Census and American Community Survey. As seen in Column 2 of Table 5, this variable enters our specification insignificantly, and does not substantially alter our estimate of the effect of imports on change in dropout rates.

From these individual determinants, we turn our attention to demographic characteristics that may be affected by changing labor market conditions and that may also be correlated with dropout behavior. In particular, as changes in import competition lead to changes in local labor market conditions, workers may move to regions where relative factor demands, and thus wages, are more favorable. If those who are most likely to relocate are also those most likely to drop out, then the correlation we have observed thus far may be driven by labor re-allocations rather than a causal effect of trade on dropout rates. In order to capture changes in the relative skill of the labor force that may occur as a result of labor mobility in the face of import competition, we control for the change in the share of employment accounted for by college educated workers Column 3 of Table 5. We also include the initial share of the population that is college educated in Column 4. While neither of these covariates enters the specification significantly, they do reduce the effect of import competition slightly, particularly in the specification in which both are included.

Finally, in Column 5 and Column 6, we include the lagged share of the c-zone population that is foreign born. In Column 6 we also include additional demographic data from the Census to account for changes in the racial and ethnic composition, percent of the population accounted for by males, and the median age in the population. While the output of these demographic controls was suppressed to save space, few were statistically significant predictors of the dropout rate. As can be seen from Columns 5 and 6, c-zones with higher proportions of foreign born workers tend to have higher dropout rates. However, these do not drive our primary result, as the magnitude of our main covariate in fact increases when all demographic controls are included. The estimate in Column 6 implies that a $1,000 increase in imports per worker in a c-zone lead to a 5.84% lower change in dropout rates.

4.3. Coincidental Changes in Labor Market Conditions

A final concern pertains to economic declines unrelated to trade in sectors that are particularly susceptible to import competition from China. In particular, changes in technology during this period might have led to a decline in low-skilled employment in certain manufacturing industries. If the industries most affected by such technological shifts also faced rising import competition from China, it would lead us to overstate the impact of trade on dropout rates.[21]

Table 6 addresses this possibility. First, we introduce two variables to control for changes in the immediate job opportunities available to dropouts. The first is the change in the percent of employment for 16-34 year olds accounted for by manufacturing. While we would ideally like a measure of the change in the share of employment among 16-18 year-olds accounted for by manufacturing, 16-34 is the most refined age group for which we have data. This variable enters Column 1 insignificantly. Because of the relative breadth of this age group, this may be an extremely noisy measure of the decline in manufacturing jobs available for our dropouts. Thus, as an additional check we include the change in the share of non-college educated persons employed in manufacturing. This variable enters Column 2 positively but insignificantly. A positive correlation would suggest that as there are more jobs available in manufacturing for non-college educated persons, the dropout rate increases. This seems intuitive and consistent with much of the previous literature. In unreported regressions, we include both of these covariates simultaneously, and our results

[21]While Pierce and Schott (2013) provide evidence that the decline in U.S. manufacturing was at least partly caused by increased import competition from China, this decline may have been expedited by a technological shift in U.S. manufacturing away from low-skill-intensive production.

remain unchanged.[22]

Lastly, Autor et al. (2013) provide a variable that measures the share of employment in a c-zone engaged in routine tasks. As dropouts are likely to be employed in routine sectors, a greater share of these sectors implies a larger base of outside options for students. If c-zones with higher initial shares of employment in these sectors were likely to decline more rapidly, then controlling for this lagged effect would capture part of the cross-sectional difference in dropout rates. We include this measure with the change in percent of non-college educated persons employed in manufacturing in Column 3. The share of employment in routine occupations is positively and significantly related to dropout rates, as hypothesized. Further, we find that increases in the manufacturing opportunities available to non-college graduates are significantly positively related to the dropout rates. However, our primary covariate remains statistically significant and of a comparable magnitude. the estimate in Column 3 implies a $1,000 increase in imports per worker in a c-zone lead to a 5.05% lower change in dropout rates.

In Columns 4 and 5 of Table 6, we include all of our labor market controls, school quality variables, and census region dummies. In Column 5 we also include all of our variables related to changes in racial, age, education, and gender demographics as in Table 5. Our main result is robust to these controls. The estimates in Column 5 indicate that for the region with the median dropout rate in year 2000, a movement from the 25^{th} to the 75^{th} percentile of change in import exposure per worker corresponds to a reduction in the 2007 dropout rate of 0.456 percentage points, with a 95 percent confidence interval of 0.359 to 0.554 percentage points.

To place this number in context, consider that there were approximately 15 million students enrolled in public high schools annually during our sample. A reduction in the high school dropout rate across all c-zones of 0.456 percentage points corresponds to an annual reduction in the number of dropouts by over 68,000 students. As noted above, estimates from Levin et al. (2007) regarding the value provided by each additional graduate implies that the lifetime net public value provided by each year's reduction in dropouts exceeds $4.4

[22]The correlation between these two variables is .82, suggesting that there is little information gained by including both variables and that inclusion of both variables may make identification of either variable difficult.

billion, and is perhaps as large as $14.4 billion.[23]

5. Conclusion

We find a strong negative effect of Chinese import exposure on dropout rates after controlling for changes in demographic characteristics, school quality, and coincident employment opportunities available to high school dropouts. We take this as evidence of increases in the relative returns to education as outside options for high school dropouts decline. The industries likely to face the most competition from an increase in Chinese imports are also those which are likely to employ low-skilled labor. As these jobs begin to disappear, so do the outside options available to potential high school dropouts. Consequently, they stay in school longer, perhaps in the hopes of moving to a higher skill industry which faces less Chinese import competition. These results are consistent with recent observations by Atkin (2013) as well as a larger literature which demonstrates that changes in labor market conditions affect the decision to drop out. Our finding provides evidence of a causal relationship between an increase import exposure and the returns to education.

[23]The gross public benefits are over $200,000 per student. The net benefits include the explicit costs of programs examined by Levin et al. (2007), and thus likely an understatement of the benefits in our case.

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6. Data Appendix

6.1. Dropout Definition

For the purpose of this paper, we follow the NCES Common Core of Data definition of a dropout.[24] A dropout is defined as an individual who:

- Was enrolled in school at some time during the previous school year;
- Was not enrolled at the beginning of the current school year;
- Has not graduated from high school or completed a state- or district-approved education program; and
- Does not meet any of the following exclusionary conditions: transfer to another public school district, private school, or state- or district-approved education program; temporary absence due to suspension or school-recognized illness; or death.

The district dropout rate is defined as the number of 9^{th}–12^{th} grade dropouts divided by the number of students enrolled in the same grades. These data are reported with 3 possible exceptions. First, either the number of dropouts is within three of the number of number of students enrolled, in which case both the number of students enrolled as well as the number of dropouts are suppressed to protect confidentiality of student education information. These data are coded as missing. Second, the number of students that dropout is between zero and three inclusive. Again to protect student confidentiality the actual number of dropouts is not reported, consequently, the number of dropouts is coded is presumed to be the median of this range.[25] Finally, the data may be missing because they were not reported by the district for the year in question.

[24] Full documentation regarding caveats to the following definition may be found at `http://nces.ed.gov/ccd/drpagency.asp`

[25] The results are unchanged coding these as one, two, or three dropouts.

6.2. Demographic Data and Variable Construction

As additional controls for factors affecting the dropout rate, county-level data on revenue, expenditures, and aggregate enrollment for the years 2000 and 2007 are also taken from the NCES website. Data on the median county-level monthly rent expenditure are taken from the U.S. Census. Additionally, to control for unobservable county-level determinants of dropout rates, we define the initial dropout rate as the average the county-level dropout rate for 1997-1999. Information on divorces, pregnancies, and G.E.D. completion, all of which have been shown to be significant predictors of dropouts and may also be correlated with increased import penetration were collected from the Census, NCES, and CDC respectively. All variable were then aggregated to the commuting zone by taking a population-weighted average of the county level variables. All data sources and years sampled can be found in Table (1).

Figure 1: Log Change in Dropout Rate 2000-2007

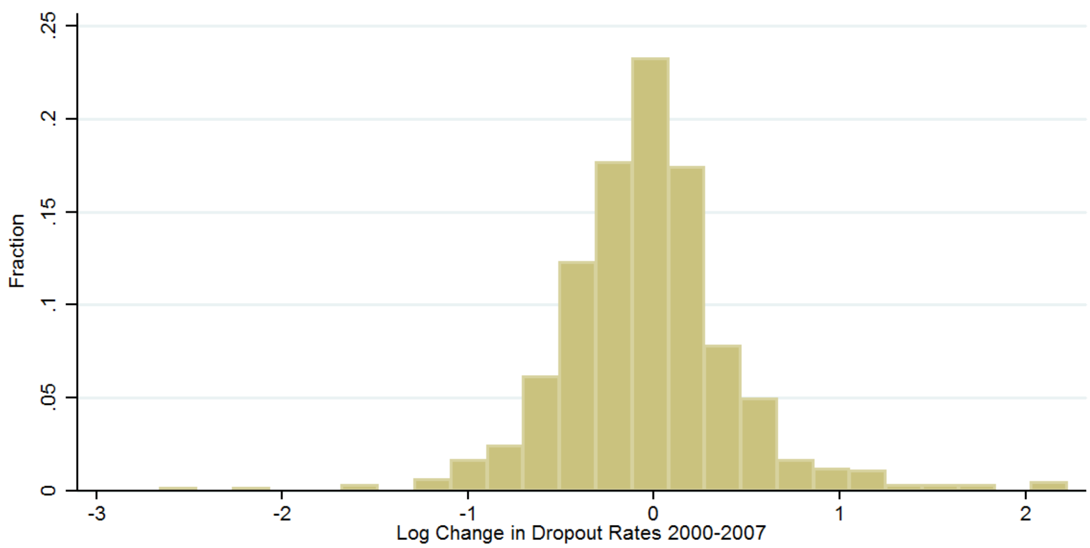

Table 1: Data Sources

Data	Unit of Observation	Source	Years
Dropout Data	School District	NCES Common Core of Data	1998 – 2008
		(Dropouts and Completers Annual Public Use)	1998 – 2008
Student to Teacher Data	County	NCES Common Core of Data (Build A Table)	2000; 2007
School Financial	County	NCES Common Core of Data (Build A Table)	2000; 2007
G.E.D. Data	County	NCES Common Core of Data (Build A Table)	2000; 2007
Compulsory Attendance	State	Digest of Education Statistics (NCES)	2000 – 2008
Competition/Demographic Measures	Commuting Zone	County Business Patterns Data	1990; 2000; 2007†
Population	County	Census	1990†
Trade Values	National	U.S. COMTRADE DATABASE	2000; 2007†
Rental Prices	County	Census	2000
	County	American Community Survey	2007*
Divorce	County	Census	2000
	County	American Community Survey	2007*
Demographics	County	Census	2000; 2010
Birth Data	County	National Vital Statistics System (CDC)	2000; 2007*

Data taken from various sources on indicated years. * Indicates that there is substantial missing data for this variable at the CZONE level. † indicates the original data-source for data taken from Autor et al. (2013) from http://www.cemfi.es/~dorn/data.htm

Table 2: Summary of Main Variables

Variable	N	Mean	Std. Dev.	Min	Max
Dropout Rate 1998	574	4.53	2.31	0	14.73
Dropout Rate 2000	677	3.87	2.2	0	22.99
Dropout Rate 2007	717	3.78	2.07	0	23.73
(Δ Imports from China to U.S.)/Worker	722	2.64	3.02	-0.63	43.08
(Δ Imports from China to Other)/Worker	722	2.51	2.54	-0.72	28.66

Summary statistics for dropout rates at the commuting zone as well as our main explanatory variable and instrument.

Table 3: Basline Regressions

Ln Δ Dropouts:	Panel 1 OLS	IV
(Δ Imports from China to U.S.)/ Worker	-0.0113*	
	(-1.91)	
(Δ Imports from China to U.S.)/ Worker		-0.0399*
		(-1.69)
Intercept	-0.00747	0.114
	(-0.31)	(-1.06)
N	667	667
R^2	0.005	0.015
First Stage F-Statistic		58.43

Panel 2 (First Stage Regression)

	(Δ Imports from China to U.S.)/ Worker
(Δ Imports from China to Other)/ Worker	0.850***
	(-25.74)
Intercept	0.539***
	(-4.48)
N	667
R^2	0.499

Regressions are two-stage-least-squares with observations weighted by the percent of the population accounted for by a c-zone in 1990. Standard errors are clustered at the state. Dependent variable is log change in dropout rate from 2000-2007.The F-Statistic for weak instruments is adjusted for clustered standard errors and is included in the final row of each column (Kleibergen and Paap; 2006).

Table 4: School Quality

Ln Δ Dropout Rate :	(1)	(2)	(3)	(4)	(5)
(Δ Imports from China to U.S.)/ Worker	-0.0678***	-0.0688***	-0.0703***	-0.0692***	-0.0521*
	(-2.80)	(-2.84)	(-2.87)	(-2.83)	(-1.84)
Initial Dropout Rate	-0.0850***	-0.0848***	-0.0838***	-0.0854***	-0.121***
	(-3.63)	(-3.58)	(-3.61)	(-3.80)	(-3.31)
ln Δ Expenditures Per Student		-0.0904	-0.103	-0.129	0.438
		(-0.28)	(-0.30)	(-0.39)	(1.06)
ln Δ Student to Teacher Ratio			-0.177	-0.226	-0.832**
			(-0.41)	(-0.55)	(-2.05)
Change in Compulsory Attendance Age				0.0822	0.0210
				(1.15)	(0.23)
ln Δ G.E.D.s Awarded					0.122**
					(2.10)
Intercept	0.643***	0.674***	0.670***	0.673***	0.551**
	(2.95)	(3.01)	(3.05)	(3.18)	(2.12)
N	565	565	548	548	206
R^2	0.282	0.282	0.281	0.292	0.437
Weak Instrument F-Statistic	46.47	42.91	35.84	35.76	18.66

Regressions are two-stage-least-squares with observations weighted by the percent of the population accounted for by a c-zone in 1990. Standard errors are clustered at the state. Dependent variable is log change in dropout rate from 2000-2007.The F-Statistic for weak instruments is adjusted for clustered standard errors and is included in the final row of each column (Kleibergen and Paap; 2006).

Table 5: Demographic and Individual Changes

Ln Δ Dropout Rate :	(1)	(2)	(3)	(4)	(5)	(6)
(Δ Imports from China to U.S.)/ Worker	-0.0597**	-0.0543***	-0.0539***	-0.0483**	-0.0477***	-0.0584***
	(-2.53)	(-2.73)	(-3.11)	(-2.36)	(-2.63)	(-2.83)
Initial Dropout Rate	-0.0698***	-0.0818***	-0.0817***	-0.0792***	-0.0743***	-0.0607***
	(-3.01)	(-2.85)	(-2.86)	(-2.73)	(-3.40)	(-3.52)
ln ΔRent per Month	0.997***	1.497**	1.489*	1.516*	1.655**	1.707**
	(2.99)	(2.03)	(1.90)	(1.94)	(2.05)	(2.15)
ln Δ in Divorced Adults per Capita		-0.662	-0.653	-0.613	-0.102	0.208
		(-1.33)	(-1.26)	(-1.18)	(-0.20)	(0.66)
Δ Share College Edu. Employment			0.00135	0.00305	-0.0214	-0.0196*
			(0.06)	(0.14)	(-1.55)	(-1.69)
Share of Population College Edu.$_{-1}$				0.00372	0.000407	0.00130
				(0.80)	(0.08)	(0.29)
Share of Population Foreign Born$_{-1}$					0.0104*	0.0117**
					(1.88)	(2.25)
Intercept	0.294	0.249	0.250	0.0163	-0.0579	-0.539
	(1.22)	(1.06)	(1.01)	(0.04)	(-0.16)	(-1.34)
Demographic Controls	N	N	N	N	N	Y
N	426	426	426	426	426	423
R^2	0.320	0.321	0.325	0.347	0.346	0.370
Weak Instrument F-Statistic	43.07	41.22	37.48	30.20	30.55	29.72

Regressions are two-stage-least-squares with observations weighted by the percent of the population accounted for by a c-zone in 1990. Standard errors are clustered at the state. Dependent variable is log change in dropout rate from 2000-2007. The F-Statistic for weak instruments is adjusted for clustered standard errors and is included in the final row of each column (Kleibergen and Paap; 2006).

Table 6: Employment Conditions

Ln Δ Dropout Rate :	(1)	(2)	(3)	(4)	(5)
(Δ Imports from China to U.S.)/ Worker	-0.0624**	-0.0569**	-0.0505***	-0.0470***	-0.0531***
	(-2.34)	(-2.48)	(-2.93)	(-2.65)	(-2.76)
Initial Dropout Rate	-0.0854***	-0.0868***	-0.0907***	-0.137***	-0.105***
	(-3.63)	(-3.63)	(-3.63)	(-3.10)	(-4.11)
Δ Percentage of Employment in Mfg. Ages(16,34)	0.00653				
	(0.50)				
Δ Percentage of Employment in Mfg. Non-College Educated		0.0161	0.0209**	-0.00658	-0.00137
		(1.44)	(2.06)	(-0.52)	(-0.09)
Percentage of Employment in Routine Occupations$_{-1}$			0.0335*	0.0364**	0.0257*
			(1.75)	(2.19)	(1.91)
Intercept	0.651***	0.667***	-0.385	-0.636	-1.281***
	(2.98)	(2.98)	(-0.78)	(-1.39)	(-2.65)
Region Dummies	N	N	N	N	Y
School Quality	N	N	N	Y	Y
Demographics	N	N	N	Y	Y
N	565	565	565	548	508
R^2	0.288	0.296	0.335	0.415	0.457
First Stage F- Statistic	22.08	31.51	32.85	23.62	23.26

Regressions are two-stage-least-squares with observations weighted by the percent of the population accounted for by a c-zone in 1990. Standard errors are clustered at the state. Dependent variable is log change in dropout rate from 2000-2007. The F-Statistic for weak instruments is adjusted for clustered standard errors and is included in the final row of each column (Kleibergen and Paap; 2006).