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

Andrew Greenland† — Elon University

John Lopresti‡ — College of William and Mary

October 30, 2013

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. We argue that increasing import competition from China eliminates job opportunities for would-be dropouts, thus increasing the relative returns to education and leading to a reduction in dropout rates. For the region with the median dropout rate in 2000, a movement from the 25th to the 75th percentile of change in import exposure per worker corresponds to a reduction in the 2007 dropout rate by 0.491 percentage points. Results are robust to controls for changes in school quality, demographic composition, G.E.D. attainment, and other changes in labor market conditions.

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

JEL CLASSIFICATION NUMBERS: F16, F14, I20

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*We would like thank Autor, Dorn, and Hanson (2013) for making their data publicly available. We would also like to thank David Hummels, Steve Martin, Anson Soderbery, Kevin Mumford, Chong Xiang, Mihai Ion, Steven Bednar, and Robert Lantis for helpful comments.

†email: agreenland@elon.edu

‡email: jwlopresti@wm.edu

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 from China affects the incentives of U.S. students to complete high school. We argue that insofar as imports from China are substitutes for goods produced by low-skilled U.S. labor, increases in Chinese imports will affect the job opportunities available to would-be dropouts, and thus may affect the relative returns to schooling and the decision to remain in school.

To examine whether dropout behavior changes in communities faced with increased import competition, we combine the empirical methodology of Autor et al. (2013) with data from the National Center for Education Statistics (NCES) on annual school district dropout rates. 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 changes in imports per worker reduces the median commuting zone's annual dropout rate by 0.49 students per 100, with a 95 percent confidence region between 0.39 and 0.59. Given that the mean annual dropout rate across commuting zones in our sample is 3.94 students per 100 in the year 2000, this is an economically meaningful effect.

U.S. imports from China increased by 170 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, for instance, rubber and plastic footwear (SIC 3021) imports increased

[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).

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 Chinese import competition across communities, or "commuting zones", that differ in their industrial structure. They find that 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 and wages between 1990 and 2007, as well as an increase in transfer payments. Of perhaps greater significance for the present paper, Autor et al. (2013) find a large increase in the share of low-skilled and young individuals that are not in the labor force as import competition rises.

Understanding the driving forces behind the decision to dropout is an important economic topic. In the United States, nearly one quarter of 9th grade students will fail to earn a high school diploma.[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 $\$209,000$.

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 affect the opportunity cost of continued education. In recent years, scholars have examined changes in dropout rates in response to changes in unemployment 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.

[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.

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

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-intensive imports will reduce the relative returns to low-skilled workers, thereby 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), who 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 plant opening. His 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 wages at the level of the commuting 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 the 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

[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).

[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

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 below.

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 rates, 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.[9]

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 period, respectively.[10] We then calculate the log change between $DropoutRate_{i,2000}$ and $DropoutRate_{i,2007}$. The distribution of the log change in dropout rates can be found in Figure 1.[11]

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

[9] In order to ensure that changes in demographic characteristics and other factors utilized in the analysis are consistently matched with the same set of schools, any school district that changed counties was dropped. This occurs in only 1.5% of our school district-year observations.

[10] We have chosen these intervals to maximize the number of c-zones that we are able to retain in the sample. Unreported specifications use various combinations of the intervals 1999 - 2001 and 2006 - 2008 and produce results nearly identical to those reported here.

[11] 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 or 2006 - 2008 periods, the data were not reported in the NCES database. Consequently, the percentage change in dropout rates could not be calculated.

Summary statistics for dropout rates and import competition are presented in Table 2.[12] The annual dropout rate listed implies an approximate average graduation rate of 83% in 1998 and 86.3% in 2007. These estimates are consistent with the common finding in this literature that graduation rates have increased through the last decade.[13] 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 competition from China has strong effects on regional labor market conditions. To the extent that jobs available to high school students are among those affected, this 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 $\mathbf{X}$:

$$\ln\left(\frac{DropoutRate_{i,2007}}{DropoutRate_{i,2000}}\right) = \alpha + \beta_1 \Delta ImportExposure^{U.S.}_{i,00-07} + \mathbf{X}\overline{\beta} + \epsilon_i \qquad (1)$$

To measure changes in import exposure, we return to Autor et al. (2013). Their measure

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

[13] The exact method by which graduation rates are calculated may lead to slightly different estimates. See Heckman and LaFontaine (2010) for a further discussion.

of changes in c-zone import penetration per worker is defined by Equation 2.

$$\Delta ImportExposure^{U.S.}_{it_{(0,1)}} = \sum_j \frac{L_{ijt_0}}{L_{it_0}} \frac{\Delta M^{U.S.}_{jt_{(0,1)}}}{L^{U.S.}_{jt_0}} \tag{2}$$

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 ($L^{U.S.}_{jt_0}$). 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 during the first year, 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 summed across industries. The result is a c-zone-level measure of changes in import exposure that 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 a particular product in the U.S. This increase in demand would likely increase U.S. employment in regions that specialize in production of this product. However, imports of this product 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 also be biased. In order to avoid such concerns, we follow the identification strategy of Autor et al. (2013) by instrumenting for $\Delta ImportExposure^{U.S.}_{it_{(0,1)}}$ with:

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

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 ($\Delta M^{Other}_{jt_{(0,1)}}$).[14] The size of the labor force (L_{ijt-1} and L_{it-1}) 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

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

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 factors 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 by Autor et al. (2013)).

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

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

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 dropout behavior, we first estimate a univariate regression of the log change in dropout rates on changes in import exposure. 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 programs related to either trade or educational assistance, we cluster standard errors at the state level.[15,16] All covariates included will be in log changes from 2000 to 2007 unless explicitly noted. Data sources for all covariates can be found in Table (1). Lastly, to control for unobserved factors across c-zones that affect dropout rates, we will restrict our sample to the 565 c-zones for which we have an initial estimate of the dropout rate in 1998.

Column 1 of Table 3 reports results for an OLS specification using changes in import exposure in the U.S. as the lone explanatory variable, as in Equation 1. As previously discussed, while the coefficient on import exposure is negative and marginally significant, failure to account for demand-side changes in the U.S. is likely to induce bias in this estimate.

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

[16]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)

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. Panel 2 of the table provides the first stage estimates of our instrumental variables regression. Our instrument is significantly and highly correlated with the potentially endogenous covariate. Moreover, the coefficient on our instrumented measure of import exposure, $\widehat{\Delta IPW}^{U.S.}_{i,00-07}$, is negative and significant. It indicates that a $1000 increase in imports per worker leads to a 5.96% reduction in the change in dropout rates.

While our baseline results are consistent with the idea that increases in import exposure may causally reduce drop out rates, we consider three possible sets of covariates which, when omitted, may lead to a biased estimate of the impact of trade on high school dropout rates. First, many studies have considered 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.[17] Insofar as increased import exposure is correlated with changes in school quality, failing to account for this channel will bias our estimates. Second, there are a range of individual and demographic characteristics, such as racial composition and parental education levels, for which changes may be correlated with changes in both import competition and 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 mistakenly assign the effect of manufacturing's decline on employment opportunities to Chinese import competition. We deal with each of these concerns in turn.

4.1. School Quality

First, we attempt to control for cross-sectional differences in c-zones that may bias our results. During our sample there were a number of programs which were implemented, notably No Child Left Behind, which would have affected the dropout rate and whose effect on the dropout rate would have depended on initial dropout rates. For example, Darling-Hammond (2006) argues that because school funding is dependent upon average measured student performance, No Child Left Behind incentivised schools to encourage low ability

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

students to drop out in order to raise average performance. If schools with initially high dropouts rates are those subject to larger increases in import competition, our coefficient will be biased. As such, 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. Inclusion of the lagged dropout rate in Column 1 of Table 4 increases the magnitude of our point estimate of from -5.96% to -6.78% as compared to the estimate found in Table 3. Initial dropout rates are negatively correlated with our dependent variable.

In addition to controlling for initial differences 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, introduced in Column 2 of Table 4. 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.[18] The second control is the percent change in student-to-teacher ratio, introduced in Column 3 of Table 4. 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.[19]

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.[20] If areas that experienced increases in import competition were also those likely to

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

[19] 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."

[20] 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.[21] This variable enters insignificantly, and leaves the estimate of our primary covariate largely unchanged.[22] 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 degree 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 the G.E.D. 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 this 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.[23]

[21]Some c-zones cross state boundaries, consequently we calculate the change in mandatory attendance as the average change in mandatory attendance with weights dictated by the population of the constituent counties.

[22]This finding is not entirely surprising. Oreopoulos (2009) finds that the effect of increasing compulsory attendance ages does have a statistically significant effect on years of education, increasing the average years of education in a cohort by 0.16 years. But, in his words "What is notable about these findings is that the effects are small, given that the strict interpretation of the law implies virtually no teenager should be allowed to leave before age sixteen." This may in part be due to the fact that violating this mandatory attendance policy is treated as a misdemeanor or has no penalty in many states.

[23]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.

4.2. Demographic and Community Changes

Having found that changes in school quality do not explain the effect of increasing import exposure on dropout rates, we now turn to community and regional characteristics. There are two reasons to believe that changes in community-level factors may affect our estimates of the impact of import exposure on dropout rates. The first involves changes in the composition of the c-zone labor force that mimic a causal relationship between import exposure and dropout rates. The second is related to family or community factors that have been shown to affect the individual decision to drop out and that may be affected by increases in Chinese import exposure. We address these each in turn.

Our first concern is that changes in import competition may result in changes in the skill composition of c-zones. In particular, as increased import competition leads to a deterioration 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 cross c-zone 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 in Column 1 of Table 5. This covariate enters our regression insignificantly. Further, the point estimate on import competition is largely unchanged.

Regional labor re-allocations may also result in changes in the demographic composition within a c-zone. Insofar as different racial and ethnic groups are likely to have different job-opportunities, controlling for changes in the racial and ethnic composition is another way to control for cross c-zone labor re-allocation. In Column 2, we include the log change in the share of the population that is foreign born. The coefficient on this variable is negative and marginally significant, suggesting that increases in the share of foreign born individuals lead to reductions in the dropout rate. In Column 3, we account for the racial and ethnic composition of the change as well. Taking data from the U.S. Census, we include log changes the median age in the population, the share of the population that is 15-19 years old, and the log change in the share of the population accounted for by each of the following groups:

males, African Americans, Asians, Other Races (white being the omitted group), and Latino. While suppressed to save space, few of these variables were significant. Further, after we account for changes in particular ethnic groups, the coefficient on foreign born becomes insignificant and the point estimate on our main covariate is still negative and of similar magnitude, and is significant at the 1% level.

In addition to demographic shifts, previous authors have identified changes in family characteristics that may lead students to drop out of school. We consider several family-related determinants of the decision to drop out that may also be affected by increases in import exposure. The first of these is changes in housing 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 effect, we control for the log change of the median rental price, collected from the U.S. Census and shown in Column 4 of Table 5. While sparsity in this variable causes a reduction in sample size, the import exposure measure is unchanged, and remains statistically significant at the 1% level.

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 5 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.

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.[24]

Table 6 addresses this possibility. We introduce two variables to control for changes in the immediate job opportunities in manufacturing available to dropouts. The first is the change in the share of 16-34 year olds employed in manufacturing. This variable enters Column 1 of Table 6 insignificantly, and leaves the point estimate of our primary covariate largely unchanged. This suggests that we are not simply capturing the effect of a general decline in manufacturing employment among young workers. The effect of trade on dropouts may be operating through a reduction in non-manufacturing employment, or through a reallocation of employment within this age group from younger, less skilled workers to older, more skilled workers.

As an additional check, we include the change in the share of non-college-educated persons of working age employed in manufacturing.[25] 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 individuals, the dropout rate increases. This seems intuitive and consistent with much of the previous literature. The coefficient on changes in import competition is reduced slightly with the inclusion of this variable, suggesting that at least part of the decline in dropout rates is due to a reduction in overall manufacturing employment opportunities for low-skilled workers. However, the coefficient on import competition is still strongly negative and statistically significant at the 5% level, suggesting that there is a substantial role for trade beyond any general decline in low-skilled manufacturing employment opportunities. Further, to the extent that the observed decline in manufacturing employment is caused by import competition, rather than simply coincident with it, this estimate can be thought of as a lower bound of the effect of trade on dropout rates.

In Column 3 of Table 6, we include the proxies for school quality found in Columns 1 - 4 of Table 4 as well as census region dummies. In Column 4 we also include all of the variables related to changes in racial, age, education, and gender demographics as in Table

[24]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.

[25]In unreported regressions, we include both of these covariates simultaneously, and our results remain unchanged.The correlation between these two variables is .82, suggesting that there is little information gained by including both variables and that inclusion of both may make identification of either variable difficult.

5. Our main result is robust to simultaneous inclusion of these controls, though the point estimate is reduced slightly. Column 4 implies that a $1,000 increase in imports per worker leads to a 5.36% decrease in the change in c-zone dropout rates. For the c-zone with the median dropout rate in year 2000, this implies that a movement from the 25^{th} to the 75^{th} percentile of the change in import exposure per worker corresponds to a reduction in the 2007 dropout rate of 0.491 percentage points, with a 95 percent confidence interval of 0.39 to 0.59 percentage points. Given that the mean annual dropout rate across commuting zones is 3.94 students per 100 in the year 2000, this is an economically meaningful effect.

5. Conclusion

We find a strong negative effect of Chinese import exposure on dropout rates after controlling for changes in demographic and community 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 intense import competition. Our results are consistent with a re-allocation of employment away from low skill jobs and toward high skill jobs within the manufacturing sector.

As a back of the envelope calculation of the magnitude of such a reduction in dropout rates, consider that there were approximately 15 million students enrolled in public high schools annually during our sample. 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 0.491 percentage points. If we were to extrapolate this 0.491 percentage point reduction to all c-zones, this would correspond to an annual reduction in the number of dropouts by over 73,500 students. These results imply that the impact of trade-induced changes on the decision to drop out is both statistically significant and economically meaningful. These results are consistent with recent work in the literature on the labor market effects of trade, as well as a larger literature demonstrating that changes in labor market conditions affect the decision to drop out of high school.

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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.[26] 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.[27] Finally, the data may be missing because they were not reported by the district for the year in question.

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

[27] 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 Commuting Zone Dropout Rate 2000-2007

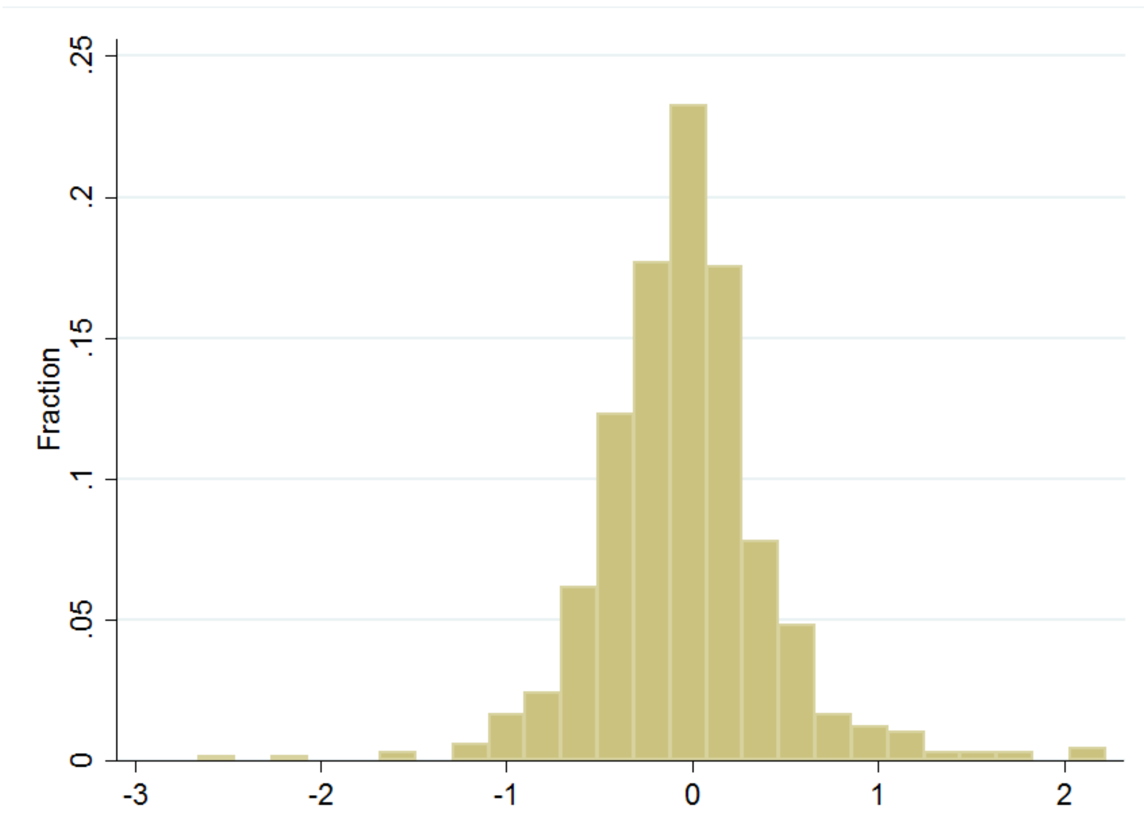

Table 1: Data Sources

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 c-zone 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 Statistics for Main Variables

Variable	N	Mean	Std. Dev.	Min	Max
Initial Dropout Rate	565	4.55	2.3	0	14.73
Dropout Rate 2000	565	3.94	2.22	0.12	22.99
Dropout Rate 2007	565	3.63	1.85	0.33	11.3
(Δ Imports from China to U.S.)/Worker	565	2.74	3.18	-0.39	43.08
(Δ Imports from China to Other)/Worker	565	2.52	2.6	-0.72	28.66
ln Δ $DOR_{00,07}$	565	-0.05	0.48	-2.65	2.23

Values for changes in import exposure per worker are denominated in 2007 USD. Dropout rates are reported at the c-zone level. For full description see Section 2.2.

Table 3: Basline Regressions

Ln Δ Dropout Rate:	Panel 1 OLS	IV
(Δ Imports from China to U.S.)/ Worker	-0.0113* (-1.80)	
(Δ Imports from China to U.S.)/ Worker		-0.0596** (-2.15)
Intercept	-0.0213 (-0.80)	0.162 (1.27)
N	565	565
R^2	0.006	0.036

Panel 2 (First Stage Regression)

	(Δ Imports from China to U.S.)/ Worker
(Δ Imports from China to Other)/ Worker	0.855*** (23.38)
Intercept	0.581*** (4.36)
N	565
R^2	0.490
First Stage F-Statistic	48.10

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***	-0.0699***	-0.0714***	-0.0702***	-0.0521*
	(-2.80)	(-2.86)	(-2.87)	(-2.84)	(-1.83)
Initial Dropout Rate	-0.0850***	-0.0837***	-0.0843***	-0.0863***	-0.122***
	(-3.63)	(-3.47)	(-3.38)	(-3.58)	(-3.41)
ln Δ Expenditures Per Student		-0.214	-0.256	-0.284	0.435
		(-0.58)	(-0.63)	(-0.72)	(1.06)
ln Δ Student to Teacher Ratio			-0.349	-0.416	-0.917**
			(-0.65)	(-0.81)	(-2.21)
Change in Compulsory Attendance Age				0.0884	0.0214
				(1.23)	(0.24)
ln Δ G.E.D.s Awarded					0.126**
					(2.17)
Intercept	0.643***	0.713***	0.717***	0.721***	0.552**
	(2.95)	(3.11)	(3.06)	(3.18)	(2.14)
N	565	565	548	548	206
R^2	0.282	0.282	0.286	0.298	0.442
Weak Instrument F-statistic	46.47	43.39	36.48	36.45	18.67

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). P-values of .01, .05, and .1 are indicated by ***, **, and * respectively.

Table 5: Community Characteristics

Ln Δ Dropout Rate :	(1)	(2)	(3)	(4)	(5)
(Δ Imports from China	-0.0625***	-0.0634***	-0.0669***	-0.0669***	-0.0640***
to U.S.)/ Worker	(-2.99)	(-2.94)	(-3.21)	(-3.29)	(-3.30)
Initial Dropout Rate	-0.0862***	-0.0884***	-0.0940***	-0.0978***	-0.102***
	(-3.50)	(-3.49)	(-3.50)	(-3.19)	(-3.14)
Δ Share College Edu.	0.0124	0.00241	0.00118	-0.00499	-0.00278
Employment	(0.53)	(0.12)	(0.07)	(-0.24)	(-0.14)
ln Δ Share of Population		-0.403*	-0.255	-0.327	-0.335
Foreign Born		(-1.87)	(-1.34)	(-1.52)	(-1.52)
ln ΔRent				0.572	0.427
per Month				(0.68)	(0.56)
ln Δ in Divorced					-0.745
Adults per Capita					(-1.53)
Intercept	0.642***	0.739***	0.864***	0.731***	0.826***
	(3.02)	(3.11)	(2.68)	(2.66)	(2.70)
Demographic Controls	N	N	Y	Y	Y
N	565	564	559	433	426
R^2	0.291	0.311	0.334	0.347	0.359
Weak Instrument F-statistic	39.52	40.17	36.74	35.04	34.15

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). P-values of .01, .05, and .1 are indicated by ***, **, and * respectively.

Table 6: Employment Conditions

Ln Δ Dropout Rate :	(1)	(2)	(3)	(4)
(Δ Imports from China to U.S.)/ Worker	-0.0624**	-0.0569**	-0.0574**	-0.0536***
	(-2.34)	(-2.48)	(-2.41)	(-2.67)
Initial Dropout Rate	-0.0854***	-0.0868***	-0.120***	-0.129***
	(-3.63)	(-3.63)	(-2.90)	(-2.94)
Δ Percentage of Employment in Mfg. Ages(16,34)	0.00653			
	(0.50)			
Δ Percentage of Employment in Mfg. Non-College Educated		0.0161	-0.00981	-0.00585
		(1.44)	(-0.88)	(-0.50)
Intercept	0.651***	0.667***	0.503**	0.616
	(2.98)	(2.98)	(2.01)	(1.42)
School Quality Controls	N	N	Y	Y
Region Dummies	N	N	Y	Y
Demographic Controls	N	N	N	Y
N	565	565	547	542
R^2	0.288	0.296	0.379	0.439
Weak Instrument F-statistic	22.08	31.51	23.27	21.61

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). P-values of .01, .05, and .1 are indicated by ***, **, and * respectively.