**Foreign Trade Policy as Education Policy? The Impact of Import Competition on K-12 Public Education Expenditures**

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**Abstract**

By exploiting variation in Chinese import competition exposure across commuting zones between 1990 and the mid-2000s, I find that rising import competition decreased per-pupil expenditure and revenue in public primary and secondary schools. The decrease in per-pupil revenue was mainly driven by decreases in revenue from state governments. I find no evidence that revenues from federal and local governments helped smooth import-induced shocks. The decreases in per-pupil revenues resulted in decreases in expenditures on instruction, which has been found to be an important determinant of student achievement. Lastly, I find no significant change in school enrollment associated with the import shocks, suggesting that the decreases in per-pupil expenditure were not a result of parents’ migration decisions.

**Keywords:** Import Competition, Public Education, School Financing

**Journal of Economic Literature Classification:** I22, I28

**1. Introduction**

Economic theory suggests that global trade can potentially raise the living standards of all participant countries, but the benefits are not distributed evenly within each country. In fact, recent studies document the decline in average household income (Autor et al., 2013), business activity, and house values (Feler and Senses, 2017) in places with more exposure to import competition from China. These decreases are likely to result in lower tax revenues for local and state governments, the main sources of funding for public education. In this paper, I examine whether and how rising import competition from China has impacted public education expenditures.

Increasing import competition in the US has been found to widen the wage gap between skilled and unskilled workers (Feenstra and Hanson, 1996), decrease labor market opportunities for high-school dropouts (Greenland and Lopresti, 2016) and impose more labor adjustment costs on low-skilled workers (Autor et al., 2014). With a shift in the relative return of education, economic theory predicts that people should invest more in education. However, because public schools in the U.S. rely heavily on local government revenue for funding, the very areas hit hardest by import shocks may at the same time have more difficulty collecting tax revenue to pay for school expenses. How much hardship this causes students depends on the ability of school districts to seek different sources of funding to compensate for any losses. It also depends on how much slack they have in their budgets. For example, if districts can postpone major capital investments to better economic times, the quality of student instruction may remain about the same despite decreases in overall expenditures. However, if school districts respond by decreasing expenditures on instruction, then all students living in areas affected by import shocks may experience learning deficiencies even if their own families had no job loss.

 Exploiting variation in exposure to Chinese import shocks, Feler and Senses (2017) show that local governments in areas hit hardest by import shocks spend less per capita on public welfare, public transport, public housing, and public education. They also find that state and federal intergovernmental transfers are not able to compensate local areas for their losses in revenue and so the quality of locally-supplied public services decreases. Given the importance of providing quality education to future workers who can no longer rely on high paid manufacturing jobs, I look more carefully at the relationship between import shocks and expenditures on public schools. After replicating Feler and Senses’ result that rising import competition decreases general expenditures on public education using my data, I provide evidence that the bulk of the decrease is driven by state funding decreases and then go on to examine which types of school spending are most sensitive to import induced revenue losses.

I start with data from the National Center for Education Statistics (NCES) on school expenditures and revenues at the school district level between 1991 and 2007.[[2]](#footnote-2) Using a crosswalk between schools districts and commuting zones (an often-used measure of local labor markets), I then assign to each district a commuting-zone level measure of Chinese import exposure per worker, developed in Autor et al. (2013), which exploits variation in initial industry composition across local labor markets and variation in magnitudes of trade shocks across industries.

Consistent with the findings of Feler and Senses (2017), I find that exposure to Chinese import competition is associated with decreases in per pupil school expenditures. Using the commonly used instrumental variables technique for identifying the impact of Chinese import exposure (Autor et al., 2018, Balsvik et al, 2015, Feenstra et al., 2017, Feler and Senses, 2017, Greenland and Lopresti, 2016, Greenland et al., 2019, Yi et al., 2018), I find that for every $1000 increase in a commuting zone’s import exposure per worker, per-pupil total expenditures in school districts in that commuting zone decrease by $250 and per-pupil total revenues decrease by $262. Given the evidence causally linking school expenditures and test scores and graduation rates (see Jackson 2018 for a review), this decrease is likely to have substantial impacts on the ability of students to adjust to the changing labor market.

For making policy recommendations on how to address these types of funding decreases, it is important to know whether they are driven by changes in school district revenue from the local government, state government or federal government. Local governments primarily rely on property taxes for revenue, while state and federal governments rely on mostly income and sales taxes. Given the evidence that Chinese import shocks decrease housing values (Feler and Senses 2017), we may expect school district revenue from local governments to decrease if tax rates do not increase. Similarly, given the evidence that rising import competition increases unemployment rates (Acemoğlu et al., 2016; Charles et al., 2013), decreases household incomes, and increases government transfer payments (Autor et al., 2013), states that are more negatively affected by Chinese import shocks are likely to collect less revenue and so will have less to distribute to school districts throughout the state. At the same time, it is possible that the federal government compensates districts with large losses in local and state-generated revenue. My analysis suggests that the decrease in per-pupil revenue is mainly driven by decreases in state revenue, presumably a result of decreases in sales and state income tax. I also find no evidence suggesting that state governments compensate those school districts within the state that are most negatively affected by import shocks. The loss in revenue from local governments is small and statistically insignificant suggesting that either the decreases in property values do not quickly result in large changes in tax collection or, if they do, local governments prioritize school funding over other typesof expenditures. There are also no statistically significant changes in school district revenues from the federal government suggesting that the federal government does not increase funding to school districts most negatively affected by the loss of manufacturing jobs. All of these findings are robust to using different measures of import exposures.

Next, I examine which types of school district expenditures are most sensitive to the decrease in revenues. After all, if there is slack in school district budgets, then school districts may be able to weather temporary losses in revenue by simply decreasing community outreach activities or postponing capital investments. My estimates, however, suggest that Chinese import induced school district revenue losses result in decreases in per-pupil instruction expenditure including salaries and benefits for teachers and teacher aides, textbooks, and supplies and purchased services, which has been found to be crucial to student achievement (Jacques and Brorsen, 2002).

 The paper ends with an examination of the channels through which trade shocks may affect school district resources. One possibility is that, facing poor labor market prospects and worse funded public schools, the relatively high-income residents leave states with more exposure to Chinese import exposure. This type of migration would exacerbate any direct effects of Chinese import exposure on state and local revenues. To examine whether this is likely to play a role, I consider the impact of import exposure on the total number of students enrolled in the school district. I find that enrollment does not significantly change with rising import competition, a result consistent with the findings of Autor et al. (2013) that migration responses to trade shocks are rather small or non-existent.

 This paper contributes to a growing literature that studies the effect of international trade on labor market outcomes. Existing papers document various negative local labor market effects (Autor et al., 2013, Acemoğlu et al., 2016; Charles et al., 2013, Pierce and Schott, 2016). This paper complements this literature by looking at how trade shocks may have harmful impacts not only on those who personally suffer job losses as a result of the shock, but because of how public schools are financed, also on those who are not directly impacted but happen to live in states with significant job loss. By paying particular attention to how federal, state, and local revenues respond to the import-induced changes to labor demand, this paper can inform policy makers interested in the optimal ways to fund public schools.

 The rest of the paper is organized as follows. Section 2 provides background information on the rise of Chinese imports to the U.S. as well as the U.S. K-12 public education system. Section 3 describes the data, section 4 introduces my empirical model, section 5 discusses empirical results, section 6 discusses results from several robustness checks, section 7 discusses potential mechanisms, section 8 discusses the effect of selective migration, and section 9 concludes.

**2. Background**

*2.1. Economic Rise in China*

The People’s Republic of China had a planned economy–decisions regarding the allocation of labor and resources as well as the output of production were made by the central government between 1949 and 1978. Because without market competition, producers had little incentive to innovate, the GDP growth rate was much slower in China than it was in market economy countries. The average annual real GDP per capita growth rate in China between 1953 and 1978 was only around 2.3% (Maddison 2007).

 In 1978, the leader of China started to introduce market economy elements into the economy system, beginning with the agriculture sector. Farmers were allowed to sell some of their crops on the market, and so while responsible for any losses, they were also able to keep any profits. The agriculture growth rate in the following years increased dramatically (Cheng, 2007).[[3]](#footnote-3) Starting in 1984, this type of reform was implemented in other sectors as well. The set-up of Special Economic Zones enabled local governments to experiment with various free market reforms with the goal of attracting foreign investment. The privatization of state-owned enterprises also promoted productive efficiency. In 1992, the chief architect of China's reform, Deng Xiaoping, gave a series of speeches which outlined an unequivocal path for the country's further opening-up. With the advanced technologies brought in by foreign investment or via incentivized producers, productivity in China has increased steadily since then this time.

 In December 2001, China joined the World Trade Organization (WTO) thereby lowering the transactions costs of international trade for China and further increasing the competitiveness of Chinese products. The average annual real GDP per capita growth rate in China between 1978 and 2003 was around 6.6%, nearly three times that the growth rates in the years prior to the reforms. As displayed in figure 1, the real GDP per capita in China increased slightly before 1978, but then the increase accelerated after 1992 and 2001. By comparison, the average annual real GDP per capita growth rates in US during 1952-1978 and 1978-2003 were 2.2% and 1.8% respectively.[[4]](#footnote-4) Because of the increase in productivity and decrease in transactions cost, Chinese goods became more competitive in the world market.

*2.2. The K-12 Educational Finance System in the United States*

Public schools in the U.S. are financed by federal, state and local governments.[[5]](#footnote-5) Figure 2 shows that prior to the 1970s, local governments provided the majority of the resources spent on public K–12 schools. Because of the high levels of residential segregation by socioeconomic status, the heavy reliance on local resources was associated with inequality in per-pupil spending (Jackson et al., 2016). Facing this, from 1970 to 2010, state supreme courts heard cases on the constitutionality of school finance systems, and this resulted in many of them implementing legislative reforms to reduce within state differences between wealthy and poor districts. As a result, state governments started to contribute larger shares of total public-school funding. As can be seen from figure 2, the average share of state tax revenue in total school revenues increased from 39.1% in school year 1970-71 to 48.3% in school year 2006-2007, but there is considerable variation in state funding by state. For example, in the school year 2006-2007, the highest share of public-school funds from state government was 57% in Vermont and the lowest share was 15% in South Dakota.[[6]](#footnote-6)

 To get a clear understanding of the composition of local and state tax revenues, in Table 1, I calculate using tax data from the year 2000, how different types of taxes contribute to total tax revenues at the local, state, and federal level. [[7]](#footnote-7) As displayed in the table, local property tax accounts for 72% of total local tax revenue, local general sales tax is the second largest part and contributes 13% of total local tax revenue. According to the column 3 and 4 in Table 1, individual income tax makes up 37% of total state tax revenue, and the second largest component is general sales tax which contributes another 33%.

Public schools in areas that are more negatively affected by Chinese import competition may face decreased funding from three different sources. First, local governments may receive smaller tax revenues and so would have less money to provide to school districts. Feler and Senses (2017) find that for every $1000 increase in Chinese import exposure per worker, median house values decrease by 5.4% or $7660, so, unless local governments increase the property tax rates, the local tax revenue will decrease.

Second, tax revenues for state governments are mostly collected as individual income taxes and general sales taxes. Given that import competition results in decreases in employment and wages (Autor et al. 2013), states with a larger initial share of employment in the industries facing more Chinese competition are likely to have smaller income and sales revenues and so will have less funding available to distribute to school districts in the state. If states do not change their formulas for funding the different school districts, then all school districts in states experiencing trade-induced income shocks are likely to receive less state funding—regardless of amount of job loss in the local area.

 The last major revenue source for school districts is the federal government. Because most of the best identified papers examining trade shocks exploit within country variation in exposure to the shocks (e.g. Autor et al. 2013), it is difficult to determine how Chinese import exposure has affected federal tax revenues. Regardless of whether or even how much federal tax revenues change and despite the fact that federal revenue only accounts for less than 10 percent of total school funding (Howell and Miller 1997), the federal government may be able to at least somewhat compensate school districts experiencing the largest import induced funding losses.

**3. Data and Measurement**

In this paper, commuting zones (CZs) are used to measure local labor markets. Developed by Tolbert and Sizer (1996), CZs are similar to metropolitan statistical areas, but the 741 CZs cover the entire US. Each CZ is a cluster of counties with strong commuting ties within and weak commuting ties across. Following Autor et al. (2013), I use the 722 CZs in the continental 48 states.

 The measure of Chinese import exposure in each local labor market is constructed following Autor et al. (2013):

$$∆IPW\_{it}^{u} =\sum\_{j}^{}\frac{L\_{ijt}}{L\_{it}}\frac{∆M\_{ucjt}}{L\_{ujt}}$$

where $L\_{ijt}$ is the start of period *t* employment in industry[[8]](#footnote-8) *j* in CZ *i*, $L\_{it}$ is the start of period employment in CZ *i*, and so the ratio of $L\_{ijt}$ to $L\_{it}$ depicts the industrial employment structure of CZ *i* in year *t*.$ ∆M\_{ucjt}$ is the change in imports from China to the entire U.S. (u) in industry *j* between year *t* and ten years later (or the equivalent of ten years later) and $L\_{ujt}$ is the start of period *t* employment in industry *j* in the entire US. Thus, the second ratio represents the average import exposure change per worker in each industry in the US. In this way, the variation in Chinese import exposure across CZs in the same period comes from variation in start-of-period industrial structure.

 Just as in Autor et al. (2013), I use international trade data obtained from the UN Comrade Database to construct $∆M\_{ucjt}$. I take the value (in 2007 US dollars) of imports from China to the US in 1991, 2000 and 2007.[[9]](#footnote-9) All values and prices are inflated using the personal consumption expenditure deflator which is provided by the U.S. Bureau of Economic Analysis. The employment in each industry in each CZ is constructed using County Business Patterns data.[[10]](#footnote-10) The measure that I created from these original sources is almost a perfect match to Autor et al.’s (2013) import exposure measure made available on the *American Economic Review* webpage.[[11]](#footnote-11) Commuting zone level demographic characteristics including population, race and gender share are obtained constructed from the Integrated Public Use Micro Samples (IPUMS) database. I use 1990, 2000 census and 2006-2008 combined three-year American Community Survey (ACS) data. Because of confidentiality reasons, the smallest geographic unit in IPUMS is Public Use Micro Areas (PUMAs) since 1990. Here, I use the crosswalk files provided on David Dorn’s website.

 For the school expenditure and revenue data, I use Local Education Agency Finance (F-33) Survey Data. It contains detailed data on enrollment, expenditures and revenues for all school districts in the U.S. providing public education to pre-kindergarten to 12th grade students. The data are reported annually starting in fiscal year 1990. F-33 does not provide data for private schools, but public schools in the US account for around 90%[[12]](#footnote-12) of total elementary and secondary enrollment. I use the FIPS county code provided in F-33 to crosswalk school districts to 1990 CZs which I then merge to the commuting zone-level variables on import exposure.[[13]](#footnote-13) I use data from 1989-1990 (fiscal year 1990), 1999-2000 (fiscal year 2000), and 2006-07 (fiscal year 2007) to construct the ten-year equivalent changes in per-pupil expenditure and revenue. All of the expenditures and revenues are inflated to 2007 US$. Most of the empirical specifications used in the analysis are conducted at the CZ level. To construct CZ level averages, I calculate average expenditures over all school districts in each commuting zone using enrollment rates as weights.

 To get a sense for whether school districts in commuting zones hit hardest by Chinese import shocks have very different characteristics, for each year, I split the commuting zones in my sample into two groups based on the import exposure per worker levels. Table 2 provides descriptive statistics of the main variables in the analysis based on this split. As can be seen in Table 2, in CZs with high import exposure, the average share of workers in the manufacturing sector is more than 45% higher than the share in those with low import exposure. There are no clear differences in my main dependent variables: average per-pupil expenditure as well as the per-pupil revenue from different sources. Similarly, no clear differences can be found in the differences in demographic characteristics such as share female, share foreign born, share of different races, share of elderly (age above 65) and youth (age between 5 and 18). However, in CZs with low import exposure, total enrollments tend to be lower by around 20,000 students, the median family income is more than $1,000 lower, the share of residents who have at least some college experience is around 1 percentage point higher, and the share of people with income below the 1980 poverty line is also around 1 percentage point higher.

**4. Empirical Specification**

To examine the effect of changes in import exposure on public school expenditures, I take a first difference approach:

$∆Edu\_{i,t}^{}=β\_{1}∆IPW\_{it}^{u} +X\_{it}^{'}β\_{2}+γ\_{t}+e\_{i,t}$ (1)

where *i* denotes commuting zone and *t* denotes year. The dependent variable $∆Edu\_{i,t}^{}$ is the decadal change in per-pupil expenditure on public schools in commuting zone *i* starting from year *t.* The expenditure variables are all measured in thousands of dollars. The independent variable of interest is $∆IPW\_{it}^{u}$, the decadal change in Chinese import exposure as defined in the previous section. $X\_{it}^{}$ includes the following CZ level start of period characteristics: manufacturing share, share of the population with any college experience, foreign born share, female population share, share of the population between the ages of 4 and 18, share of the population above age 65, share Hispanic, share non-Hispanic Black, share Asian, share of the population with income below the 1980 poverty line, and local median family income. Year fixed effects are denoted $γ\_{t}$. Because my dependent variable is measured in changes, the year fixed effects will control for different trends.

 One potential threat to this identification strategy is that changes in exposure to Chinese imports might be correlated with the demand shocks in the US. For example, during the housing bubble in the US, which began in 2005, the increase in imports of cement and steel from China was mainly driven by the positive domestic demand shock instead of exogenous increases in competitiveness of China’s cement and steel. If imports from China and production in US manufacturing industries are both caused by domestic demand shocks, the manufacturing sector in both countries will thrive. If imports from China are mainly driven by domestic demand shocks, the OLS estimated effect of an increase in Chinese imports on education expenditure will understate the true effect. To alleviate this problem, I use the contemporaneous growth of Chinese imports in eight other high-income countries to instrument for the growth of Chinese imports in the U.S.[[14]](#footnote-14) As in Autor et al. (2013), the instrument is constructed as follows:

$$∆IPW\_{it}^{o} =\sum\_{j}^{}\frac{L\_{ijt-1}}{L\_{ujt-1}}\frac{∆M\_{ocjt}}{L\_{it-1}}$$

where $∆M\_{ocjt}$ is the change in Chinese imports in other high-income countries. To address the concern that the US industrial structure might be affected by anticipated import competition from China, instead of using start of period employment in CZ *i*, I use ten-year-lagged employment $L\_{it-1}$. The instrument variable is created based on the assumption that growth in Chinese imports in the US is not driven by a worldwide demand shock, but mainly because of the rising competitiveness in Chinese manufacturing products as a result of institutional reforms in China and China’s accession to the WTO.

 The instrumental variables estimate may still be biased for several reasons. First, if demand shocks in the eight high-income countries are correlated with demand shocks in the US, the IV estimator will underestimate the true effect.[[15]](#footnote-15) Another potential threat to identification arises if productivity growth is slow in the US and consumers’ demand cannot be met by domestic supply. If the increases in Chinese imports are driven by unmet U.S. consumer demand, as opposed to exogenous changes in productivity in China, then even large increases in imports may not imply job or wage loss for U.S. workers. Estimates of the impact of Chinese imports on school budgets would therefore be biased towards zero. It is unlikely, however, that the large increases in Chinese imports were in fact driven by changes in U.S. productivity. Using a value-added production function, Brandt et al. (2012) estimate ﻿that firm-level ﻿total factor productivity (TFP) growth of manufacturing firms in China averaged 7.96% from 1998 to 2007. Meanwhile, TFP growth in the U.S. during that time, as measured by Bureau of labor Statistics, was only 3.9%.[[16]](#footnote-16) These figures suggest that rising Chinese imports was mainly driven by China’s productivity shocks.

**5. Results**

*5.1. Baseline Results*

In Table 3, I present OLS and 2SLS estimates of the effect of changes in local Chinese import exposure on local per-pupil total expenditure using equation (1). In response to the concern that the variation in the import exposure variable is actually measuring more general declines in manufacturing employment for reasons unrelated to trade, even in the most parsimonious specification, I control for start-of-period manufacturing employment share as well as year fixed effects. As can be seen in column (1), the estimated coefficient on import exposure is negative and statistically significant at the 0.05 level. In column (2), I add census division fixed effects, and the estimated coefficient of interest decreases slightly and becomes significant at the 0.01 level. After controlling for CZ level demographic characteristics, including college educated share, foreign born share, share female among the working-age population, share of elderly population, and share of young population, the estimated coefficient of interest coefficient becomes even larger in magnitude.

 In column (3), I add the initial share of different races, educational levels, the estimated coefficient of interest does not change much. Interestingly, column (3) also shows that more educated and younger commuting zone populations are associated with increased expenditures on public schools. In column (4) I further control for two indicators of local economic conditions: the start-of-period share of the population with incomes below the 1980 poverty line and the start-of-period median family income. The estimated coefficient of interest decreases in magnitude even further. The final result in column (4) suggests that a $1,000 decadal rise in a CZ’s import exposure per worker reduces per-pupil expenditures in school districts in that commuting zone by $118.[[17]](#footnote-17)

 In column (5), I employ the instrument variables technique described above. The first stage F-statistic is greater than 10 suggesting that the instrument variable is a strong predictor of the variable of interest. As predicted, the 2SLS estimate of our coefficient of interest is larger in magnitude than the OLS estimate suggesting that in US, the rising imports in some industries are endogenously caused by demand shocks. Column (5) in Table 3 suggests that a $1,000 rise in a CZ’s import exposure per worker reduces per-pupil expenditure by $262, around 2.56% of the average per-pupil expenditures during my sample period.

 These changes in expenditures might be reflecting changes in revenues school districts receive from different sources. After all, for each school district, the total revenue does not always equal total expenditures. There are two reasons for this: (1) total revenue does not include bond sales or the sale of property or equipment, in which case total expenditures could exceed total revenue, and (2) public schools can cut the services they provide students in which case total revenue would exceed total expenditure. When looking at the effect of import competition on per-pupil total revenue, results are similar to those reported in Table 3. Column (1) of Table 4 shows that for every $1,000 increase in per worker import exposure, per-pupil revenue decreases by $250. The merely $12 gap between results in column (1) of Table 4 and column (5) of Table 3 suggests that the changes in school district expenditures are indeed driven by changes in school district revenues.

In order to make appropriate policy recommendations regarding how school districts might mitigate the impacts of changes in revenues, it is important to consider which level of government is most responsible for these changes. In columns (2)- (4) of Table 4, I consider the impact of Chinese import exposure on the three different sources of revenues for school districts separately. As can be seen in the table, the decrease in per-pupil revenue is mainly driven by the decrease in revenues from state governments; estimated coefficients for revenues from federal and local governments are much smaller in magnitude and not statistically significant.

This makes sense since states mainly collect tax money via income and sales taxes. Given that Chinese import exposure increases unemployment (Autor et al, 2013), the tax base decreases, and so state tax revenues overall decrease. Unless states change the way they distribute their (lower) tax revenues, we should expect school district funding from states negatively affected by trade shocks to decrease. Local governments mainly collect taxes via property taxes. Although there is evidence that Chinese import exposure decreases housing values (Feler and Senses 2017), the impact of these changes may be smaller or less immediate than impacts on state tax revenues. Alternatively (or in addition), local governments may continue supporting schools despite lower revenues understanding the importance of education for coping with trade shocks. Given that this analysis exploits variation in import exposure in commuting zones across the U.S., we cannot identify the impact of trade shocks on taxes collected at the federal level. The fact that school districts in commuting zones hit hardest by import shocks receive no increases in revenues from the federal government suggests that the federal government does not compensate for any losses in revenues from local and state governments.

 Next, I consider what the changes in school funding implies for the actual expenditures school districts make. After all, if there is slack in school districts budgets, they may weather trade-induced revenue shocks by simply decreasing expenditures on things like adult education or postponing new construction projects. In Table 5, I consider the impacts of import on three major categories of expenditure: current primary and secondary expenditures, current non-primary/secondary expenditures and capital outlays.[[18]](#footnote-18) Prior research has shown that facing budget reductions, public schools mitigate negative effects on students by disproportionately cutting more from construction expenditures and less from expenditures on K-12 core-operations (Jackson et al., 2018). The results in Table 5 show that in response to a $1,000 rise in a CZ’s import exposure per worker, per-pupil current expenditure on non-primary/secondary education is reduced by $7, per-pupil capital outlay expenditure is reduced by $82, but per-pupil expenditure on current primary and secondary expenditure is reduced by $164; all of the estimates are statistically significant. This reduction in capital outlay spending accounts for 32.4% of the total reduction and the reduction in current primary and secondary expenditure account for 64.8% of the total reduction. Considering the fact that on average capital spending accounts for around 9% of overall spending and primary and secondary expenditure account for more than 80% of overall spending, these results imply that school districts are making an effort to shield the core-operations spending from import shocks.

 Next, in Table 6, I further split the broad expenditure on current elementary and secondary education category into three sub-categories: instruction, support service and other expenditures. Previous research (Loeb and Page, 2000; Lucas and Samardzic, 2014; Britton and Propper, 2016) finds evidence that students’ performance in schools improves in response to increases in teachers’ wages. As can be seen in the table, expenditures on instruction and support service are significantly reduced in districts hit hardest by Chinese import competition; per-pupil expenditures on instruction are reduced by $119, almost three times the decrease in per-pupil expenditures on support services, , when the CZ’s import exposure per worker is increased by $1000. This result, taken together with the results in the prior literature, implies that students’ performance is very likely to be negatively affected by rising import competition.

**6. Falsification Tests and Robustness Checks**

*6.1. Falsification Test*

 Although the results above are certainly suggestive of a causal relationship between import competition and per-pupil expenditures, cautious readers may be concerned that some other factor, correlated with initial industry structure of a commuting zone, is what is actually driving the decreases in funding for public schools. For example, imagine that in the period under investigation policy makers in industrial cities started imposing environmentally friendly legislation which decreased the profitability of local manufacturing firms and might result in more imports from China of products produced by those firms. This would result in local job loss and therefore lower taxes collected by state governments, but would not be a direct consequence of Chinese imports

 To address this issue and others like it, I take advantage of the timing of Chinese imports. Specifically, I regress changes in the major dependent variables between 1990 and 2000 on future changes, changes between the year 2000 and 2007, in import exposure per worker. If the decline in public school expenditures is driven by some other factor that is generally increasing over time in a way that is not perfectly correlated with the timing of imports from China, then I would expect positive and statistically significant estimates. However, if the import competition is the cause of the decrease in school expenditure, then future changes in import competition would not be able to explain past changes in school expenditures. Results are reported in Table 10. None of the estimates is statistically significant providing evidence that it is import competition decreasing the education expenditures.

*6.2. Alternative Measures of Import Exposure*

 In this section, I use alternative measures of import exposure to check the robustness of the results. First, I create a variable measuring the change in *net* import exposure per-worker by subtracting US exports to China from US imports from China. The instrument is also then changed to measure the net import exposure per worker in the other eight high income countries. Results are reported in Panel B of Table A1. As can be seen in the table, after taking exports into account, the results are still consistent with my former results.

 I then use other two alternative measures to check the validity of the IV. The validity of the instrument used in the paper relies on the assumption that in the other eight high income countries, the increase in import from China is not driven by any U.S. driven demand shocks, but rather by exogenous supply shocks stemming from changes in China. If this condition is violated, the coefficient estimates will be biased.

 Following Yi et al. (2018), I consider two import shocks that happened during 1990-2007. The first shock is the increase in demand for computers. In this period, high-income countries not only imported computers from China but also developed their own computer industries. In Panel C of Table A1, I exclude computer as well as related equipment industries when creating the import exposure variable. The table shows that the magnitude of the estimates increases suggesting that if anything, changes in computer demand are making it more difficult to identify an effect of trade shocks. The second shock is the housing boom in high-income countries. With this shock, the demand for raw materials used in construction increased, thus encouraging all countries to develop related industries. In Panel D, I exclude the industries related to construction, and again the estimates are also greater in magnitude than the baseline results. Together these results may be viewed as evidence that demand shocks are not likely to be major drivers of our results. They may attenuate our results but not by that much.

**7. Do Different Levels of Government Compensate School Districts for Lost Revenues?**

*7.1. Do States Provide More Funding to Districts within the State Hardest Hit by Trade Shocks?*

 As discussed previously, a main mechanism through which import competition negatively affects per-pupil revenue is via decreases in school district funding from state governments. States that were more negatively affected by Chinese import exposure have fewer funds to support public education. However, one of state governments’ tasks may be to smooth changes in public spending among different areas by reallocating sources. So, it is possible that within a state, commuting zones that are mostly negatively affected by Chinse import competition are compensated with a larger share of the potentially lower state revenue. To examine whether this is the case, I add state-by-year fixed effects[[19]](#footnote-19) to equation (1):

$∆Edu\_{i,t}^{}=β\_{1}∆IPW\_{it}^{u} +X\_{it}^{'}β\_{2}+γ\_{st}+e\_{i,t}$ (2)

 In equation (2), if states do compensate the districts, then I expect the coefficient of interest to be positive, but if they do not, I expect the coefficient of interest to be close to zero. Results are displayed in Table 7. Column (1) shows that after controlling for state-by-year fixed effects, the magnitude of the estimated coefficient of total expenditure decreases, from -0.262 in Table 3 to -0.098, a more than 60% drop. This implies that the bulk of the impacts on school expenditures is driven by cross-state variation in commuting zone exposure to Chinese import competition. However, even making comparisons within the same state, school districts in CZs hit harder by import shocks ended up spending less on their students than school districts in parts of the state that were not as affected by Chinese imports.

 I then further examine the effects on revenues from different resources in column (2) – (5). Column (2) shows that the estimated impact of import exposure on total revenue drops from -0.250 in Table 4 to -0.100. The magnitude of the change is consistent with the result in column (1). Interestingly, when exploiting within state variation, the estimated impact of Chinese import exposure on school district revenues from local sources decreases in magnitude slightly when compared to estimates from models without the state-year fixed effects but becomes statistically significant. This finding that local governments in areas hit hardest by trade shocks spend less on schools is consistent with the result in Feler and Senses (2017) that the import shocks are associated with decreases in spending on schools by local governments. In column 4, I show estimates of the impact of export shocks on school funding from federal sources constructed from models with state-year fixed effects. Just like in Table 4, the estimate is practically zero and statistically insignificant reinforcing the conclusion that the federal government does not compensate school districts in areas hit hardest by trade shocks. I next examine whether states compensate school districts in commuting zones suffering more from Chinese import exposure. The estimate in column (5) is close to zero and statistically insignificant. Taken together, this evidence indicates that, generally, federal and state governments do not help smooth funding levels for school districts in commuting zones suffering trade induced job losses.

*7.2. Does State Revenue Play the Main Role?*

 For further evidence that our baseline results are driven by changes in state funding of school districts, I next estimate a state-level, instead of commuting zone, level model. For this model, I create a state-level measure of Chinse import exposure using the same basic method described in data section but replacing commuting-level employment in the different industries with state-level employment in these industries. If the decrease in overall state revenue is the main mechanism driving the variation in school expenditures, then a state level regression, as shown in equation (3) will yield estimates of the impact of trade shocks that are similar to those estimated in our baseline regression:

$∆Edu\_{st}^{}=β\_{1}∆IPW\_{st}^{u} +X\_{st}^{'}β\_{2}+γ\_{t}+e\_{st}$ (3)

Here, *s* represents state, so $∆IPW\_{st}^{u}$ is the change in import exposure in state *s*, The left-hand side variable $∆Edu\_{st}^{}$ is the per-pupil public education expenditure or revenue from state, federal, or local governments. The set of start-of-period control variables $X\_{st}^{'}$ are the same as in equation (1) but created at the state level.

 Results of equation (3) are displayed in Table 8. Column (1) in Table 8 shows that a $1,000 increase in the state’s import per worker will decrease per-pupil total expenditure by $2,348, a much larger number than what was estimated using a commuting-zone level regression.[[20]](#footnote-20) Column (2) implies that for every $1,000 increase in the state’s import per worker, there is a decrease in per-pupil total revenue by $2,177. Looking at the three sources of revenue separately, again the estimate of the impact of trade shocks on state revenue is largest in magnitude and it is the only estimate that is statistically significant. Table 8 further supports my former conclusion that decreases in total revenue in response to a rising import is mainly caused by the decrease in funding from state governments.

*7.3. Do Local Governments Compensate for the Lost in Property Values?*

 While it is rather clear that state sales and income tax revenues decrease in states with more job loss due to exposure to Chinese imports, it is unclear how local governments respond to these changes. Local governments may be more flexible in adjusting tax rates than are state governments. While people living in areas suffering more from import competition may vote to decrease spending on local schools because of their decreased incomes, it is also possible that they will vote to increase education spending to compensate for the losses in state funding especially given the higher education premiums in these areas. To test whether people vote for more local revenue going to schools, I examine whether school districts where more voters are employed in the manufacturing sector increase or decrease local spending on schools.

I obtain 1990 school district level manufacturing share data from the School District Data Book 1990 and then I interact it with CZ level import exposure variable as shown in the following regression equation:

$∆Edu\_{i,t,d}^{}=β\_{1}∆IPW\_{it}^{u} \*MN\_{d,90}+β\_{2}MN\_{d,90}+β\_{3}∆IPW\_{it}^{u} +X\_{i,t,d}^{'}β\_{4}+e\_{i,t,d}$ (4)

Since school district level data is only available in 1990, only 1990 and 2000 data are used in this equation. In model (4), $∆Edu\_{sd,i,t}^{}$ is the decadal change in per-pupil revenue in school district *d* in CZ *i*. $MN\_{d,90}$ is the manufacturing share in school district *d* in CZ *i* in year 1990. $X\_{d,i,t}^{'}$ includes the same controls used in the baseline model but constructed at the school district level instead of the commuting zone level. The control variables are: share high skilled, share foreign born, share of working age women who are employed, share between the ages of 5 and 18, share above age 65, share Hispanics, share black, share Asian, share of the population with incomes under the 1980 poverty line and local median family income.

 Table 9 shows the results from estimating equation (4). Different school districts in the same CZ share the same import exposure per worker, but they have different start of period manufacturing employment shares. If local governments compensate for the lost revenue in property values by increasing property tax rates or if they allocate more of their lower tax revenues to schools, then we expect to estimate a positive coefficient on the interaction term or at least for it to be close to zero. If the local governments do not compensate the loss in property value and do not reallocate more funding to schools, then we expect the coefficient of the interaction term to be negative.

 Results are shown in Table 9. The results in column 1 of table 9 suggest that districts in which many people are employed in the manufacturing sector do not experience different in expenditures compared to districts where few are employed in manufacturing. Column (2) implies that the story also holds for total revenue per-pupil. The positive but statistically insignificant estimated coefficient on the interaction shown in column (3) suggests that there is no evidence of local governments compensating school districts hit harder by import competition. In the specification considering impacts on state funding, shown in column (5), again there is no evidence that states compensate school districts with presumably more manufacturing job loss (given higher initial employment shares in manufacturing) by providing more state funding.

**8. Does Selective Migration Exacerbate the Impact of Trade Shocks?**

 Thus far, I have implicitly assumed that people in commuting zones hit hardest by Chinese imports do not leave these commuting zones looking for better opportunities elsewhere. This assumption is backed by the evidence in Autor et al. (2013) that import shocks were not associated with changes in commuting zone population sizes. However, Greenland et al. (2017) show ﻿that local labor markets with more exposure to trade shock experienced a relative reduction in population growth over the following decade.

 In the context of this paper, migration could be a potential mechanism if high income people leave states hit hardest by Chinese import competition. Highly educated, high income parents may migrate to other states, even without suffering any trade-induced job loss, in response to worsening education quality. If high income parents, who are likely to contribute more to tax revenue, are more likely to leave school districts with import-induced decreases in funding, then this will amplify the effect of rising import competition on education expenditure and revenue. To examine this issue, I empirically test whether student enrollment changes in response to trade shocks. As displayed in Table 11, none of the estimates of coefficients on import exposure on Fall semester enrollment is statistically significant. The magnitudes of the estimates in column (1) and (2) are relatively small, which suggests no or little migration across CZs in response to changes in local labor market exposure to Chinese imports, among families with children. This result is consistent with the result of Autor et al. (2013), in which they find no significant effect of trade exposure on population flow.

**9. Conclusion**

This paper examines how rising import competition from China affected per-pupil public education expenditure in the US. Results suggest that in places with more local labor market import exposure per worker, per-pupil public education expenditures decreased. The reduction in expenditures appear driven by reductions in the revenue school districts received from state governments. These decreases in funding from the state were not compensated by increases in funding from local governments or the federal government. Interestingly, although states started providing more funding to schools specifically to equalize educational quality across school districts, because state funding is more sensitive to labor market shocks, school districts relying more on state funding suffered more from Chinese import shocks.

 Autor (2010) shows that in response to the steep rise in wages for college graduates relative to non-college graduates over the past three decades, four-year college attainment has only increased modestly, especially for males. One possible explanation is that K-12 education is not adequately preparing enough students to go to college. Several studies find that students’ K-12 school performance is highly correlated with college continuation (Manski and Wise, 1983; Rivkin 1995; Behrman et al., 1998) and college completion (Hanushek and Pace, 1995). If school spending has a causal impact on education quality (Hyman 2016, Lafortune et al., 2018) and Chinese import competition decreased school spending, then this may provide an explanation for Autor’s puzzle: While Chinese import competition increases the returns to college, it may also simultaneously decrease the ability of K-12 school districts to prepare students for college.

 Although recent evidence suggests that the negative impact of Chinese imports disappears after 2007 (Bloom et al., 2019), US industries are still facing potential challenges from countries all over the world. In addition, technological change may also result in job losses for those with low skill levels. Given the importance of education, the finding of this paper suggests the US government need a more stable public-school financing system to combat these potential future shocks.

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# Figure 1 GDP Per Capita Growth Rate (Annual %)

Source: The world bank

Figure 2 Public K-12 School Revenue by Sources

﻿Source: U.S. Department of Education, National Center for Education Statistics, 2010 Digest of Education Statistics, Table 180 Revenues for public elementary and secondary schools, by source of funds: Selected years, 1919-20 through 2007-08

**Table 1. Local and State Revenue by Source, 2000**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |   | State | Local | State & Local |
| Tax Type | Tax Source | Total | Share | Total | Share | Total | Share |
| Income  | Individual | 204,554 | 37.05% | 17,340 | 5.28% | 221,894 | 25.21% |
|  | Corporate | 33,813 | 6.12% | 3,273 | 1.00% | 37,086 | 4.21% |
| Property |  | 9,495 | 1.72% | 235,182 | 71.66% | 244,677 | 27.79% |
| Sales | General | 180,771 | 32.74% | 41,674 | 12.70% | 222,445 | 25.27% |
|  | Motor fuels | 29,874 | 5.41% | 904 | 0.28% | 30,778 | 3.50% |
|  | Tobacco | 8,005 | 1.45% | 196 | 0.06% | 8,201 | 0.93% |
|  | Alcohol | 4,101 | 0.74% | 284 | 0.09% | 4,385 | 0.50% |
| Motor Vehicle operator's license |  | 16,122 | 2.92% | 1,092 | 0.33% | 17,214 | 1.96% |
| Other Taxes |  | 65,436 | 11.85% | 28,235 | 8.60% | 93,671 | 10.64% |
| Total |   | 552,171 | 100.00% | 328,180 | 100.00% | 880,351 | 100.00% |

Source: ﻿Quarterly Summary of State and Local Taxes, US. Census Bureau. Numbers measured in millions of dollars.

**Table 2. Descriptive Statistics**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1990 |  | 2000 |  | 2007 |  |
|  | Low Exposure | High Exposure | Low Exposure | High Exposure | Low Exposure | High Exposure |
| Import exposure (level) | 0.12 | 0.3 | 0.58 | 1.23 | 1.38 | 3.01 |
|  | (0.04) | (0.13) | (0.16) | (0.39) | (0.37) | (1.02) |
| Manufacturing employment share | 0.14 | 0.2 | 0.1 | 0.18 | 0.08 | 0.14 |
|  | (0.05) | (0.06) | (0.03) | (0.05) | (0.03) | (0.05) |
| Total revenue per pupil (in k$) | 7.09 | 7.57 | 9.45 | 9.39 | 12.07 | 11.16 |
|  | (1.3) | (2.16) | (1.86) | (1.72) | (3.32) | (2.45) |
| Total federal revenue per pupil (in k$) | 0.4 | 0.42 | 0.68 | 0.59 | 1.01 | 0.83 |
|  | (0.19) | (0.14) | (0.27) | (0.17) | (0.47) | (0.21) |
| Total state revenue per pupil (in k$) | 3.23 | 3.36 | 4.38 | 4.62 | 5.22 | 5.36 |
|  | (1.03) | (0.98) | (0.95) | (1.14) | (1.62) | (1.61) |
| Total local revenue per pupil (in k$) | 3.46 | 3.78 | 4.39 | 4.18 | 5.84 | 4.97 |
|  | (1.52) | (1.93) | (1.84) | (1.76) | (2.61) | (2.15) |
| Total expenditure per pupil (in k$) | 7.21 | 7.67 | 9.64 | 9.57 | 12.2 | 11.26 |
|  | (1.29) | (2.16) | (2.14) | (1.74) | (3.41) | (2.4) |
| Total enrollment | 260004.36 | 554456.16 | 440379.1 | 603753.46 | 435702.38 | 658495.43 |
|  | (241417.59) | (691520.36) | (488193.73) | (855737.27) | (483050.69) | (901914.75) |
| Share of female | 0.51 | 0.51 | 0.51 | 0.51 | 0.51 | 0.51 |
|  | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Share of foreign born | 0.07 | 0.11 | 0.13 | 0.12 | 0.15 | 0.13 |
|  | (0.05) | (0.1) | (0.11) | (0.1) | (0.11) | (0.1) |
| Share of age (>65) | 0.13 | 0.13 | 0.13 | 0.12 | 0.13 | 0.12 |
|  | (0.04) | (0.02) | (0.04) | (0.02) | (0.03) | (0.02) |
| Share of age (4-18) | 0.18 | 0.18 | 0.19 | 0.19 | 0.17 | 0.18 |
|  | (0.02) | (0.02) | (0.02) | (0.01) | (0.02) | (0.01) |
| Share of people below the 1980 poverty line  | 0.16 | 0.15 | 0.15 | 0.14 | 0.16 | 0.15 |
|  | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) | (0.04) |
| Share of Hispanics | 0.07 | 0.1 | 0.13 | 0.12 | 0.16 | 0.15 |
|  | (0.11) | (0.13) | (0.13) | (0.15) | (0.16) | (0.15) |
| Share of Black | 0.12 | 0.12 | 0.15 | 0.1 | 0.15 | 0.1 |
|  | (0.1) | (0.09) | (0.11) | (0.09) | (0.11) | (0.09) |
| Share of white | 0.77 | 0.75 | 0.66 | 0.72 | 0.63 | 0.68 |
|  | (0.14) | (0.17) | (0.16) | (0.19) | (0.17) | (0.19) |
| Share of Asian | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 |
|  | (0.03) | (0.03) | (0.03) | (0.05) | (0.03) | (0.05) |
| Median family income | 32562.16 | 33906.09 | 44755.19 | 47116.66 | 54298.46 | 55639.11 |
|  | (6263.81) | (6523.22) | (7773.25) | (8335.05) | (10797.64) | (10020.45) |
| Share of people with college experience | 0.38 | 0.36 | 0.36 | 0.35 | 0.39 | 0.38 |
|  | (0.07) | (0.07) | (0.06) | (0.07) | (0.06) | (0.06) |

Note: School data are collected from the F33 School District Finance survey. CZ level demographic characteristics data are collected from IPUMS. Samples are split based on the median import exposure level in each year. Weighted means and standard deviation reported in the table.

**Table 3 Import from China and per-pupil expenditure, CZ Level, 1990-2007**

Dependent Variable: Ten-year equivalent changes in per-pupil expenditure / $1000

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | (1) | (2) | (3) | (4) | (5) |
|   | OLS | OLS | OLS | OLS | 2SLS |
| Δ Import Exposure | -0.097\* | -0.109\*\* | -0.110\*\* | -0.118\*\* | -0.262\*\*\* |
|  | (0.037) | (0.040) | (0.034) | (0.034) | (0.064) |
| Manufacturing Employment Share | -0.001 | -0.002 | 0.010 | 0.011 | 0.027\* |
|  | (0.011) | (0.008) | (0.009) | (0.009) | (0.011) |
| College Educated Share |  |  | 0.022 | 0.027 |
|  |  |  | (0.014) | (0.015) | (0.015) |
| Foreign Born Share |  |  | 0.019 | 0.026 |
|  |  |  | (0.016) | (0.015) | (0.014) |
| Female Share |  |  | -0.056\*\* | -0.030 | -0.027 |
|  |  |  | (0.016) | (0.023) | (0.022) |
| Elderly (>65) Share |  |  | 4.405\* | 3.981\* | 3.250 |
|  |  |  | (1.895) | (1.898) | (1.710) |
| Young (4-18) Share |  |  | 20.340\*\* | 20.300\*\* | 19.009\*\*\* |
|  |  |  | (5.918) | (5.935) | (5.553) |
| Hispanic Share |  |  | -2.466\* | -2.958\* | -2.774\*\* |
|  |  |  | (1.191) | (1.115) | (1.036) |
| Black Share |  |  | -1.192 | -1.507\* | -1.764\*\* |
|  |  |  | (0.625) | (0.674) | (0.652) |
| Asian Share |  |  | 14.070\*\*\* | 15.619\*\*\* | 16.629\*\*\* |
|  |  |  | (3.068) | (4.032) | (3.821) |
| Poverty Share |  |  |  | 3.731 | 3.895 |
|  |  |  |  | (3.059) | (2.904) |
| Median Family Income |  |  |  | -0.000 |
|  |  |  |  | (0.000) | (0.000) |
| Census Division FE  | No | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 1444 | 1444 | 1444 | 1444 | 1444 |
| R-squared | 0.016 | 0.185 | 0.302 | 0.311 | 0.287 |
| First Stage |  |  |  |  |  |
| Δ Import Exposure to OTH | 0.664\*\*\* | 0.652\*\*\* | 0.631\*\*\* | 0.627\*\*\* | 0.632\*\*\* |
|  | (0.089) | (0.094) | (0.093) | (0.095) | (0.090) |
| F-Statistic | 55.5 | 48.39 | 45.76 | 43.41 | 49.77 |

Notes: Control variables also include a “2000-2007” time dummy. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 4 Import from China and per-pupil revenue from different sources and enrollment within CZs, 1990-2007, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil revenue from different sources / $1000

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1) $∆$Total  | (2)$ $$∆$Local Source | (3)$ $$∆$Federal Source | (4)$ ∆$State Source  |
|  |  |  |  |  |
| $$∆IPW\_{uit}$$ | -0.250\*\*\*  | -0.064 | -0.002 | -0.183\*\* |
|  | (0.075) | (0.048) | (0.008) | (0.062) |
|  |  |  |  |  |
| Average Dependent Variable | 8.874 | 3.648 | 0.787 | 4.440 |
| Observations | 1444 | 1444 | 1444 | 1444 |
| R-squared | 0.285 | 0.252 | 0.202 | 0.258 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 5 Import from China and per-pupil expenditures on different sectors within CZs, 1990-2007, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil expenditures on different sectors / $1000

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) $∆$Current elementary & secondary  | (2)$ $$∆$Current Non elementary & secondary  | (3)$ $$∆$Capital Outlay  |
|  |  |  |  |
| $$∆IPW\_{uit}$$ | -0.164\*\*  | -0.007\*\* | -0.082\*\*\* |
|  | (0.058) | (0.003) | (0.024) |
|  |  |  |  |
| Average Dependent Variable | 6.628 | 0.078 | 0.728 |
| Observations | 1444 | 1444 | 1444 |
| R-squared | 0.404 | 0.240 | 0.155 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3. “Current Non elementary & secondary” includes expenditures on community service, adult education, transfer to retirement system-instruction – other, and other non-elementary and secondary expenditure. “Capital Outlay” includes construction, land and existing structures, instructional equipment, and other non-specified equipment. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 6 Import from China and per-pupil expenditures on different current elementary and secondary sector 1990-2007, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil expenditures on different sectors / $1000

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) $∆$Instruction  | (2)$ ∆$Support service  | (3)$ ∆$Other  |
|  |  |  |  |
| $$∆IPW\_{uit}$$ | -0.119\*\*  | -0.042\* | -0.002 |
|  | (0.041) | (0.018) | (0.003) |
|  |  |  |  |
| Average Dependent Variable | 4.053 | 2.212 | 0.362 |
| Observations | 1444 | 1444 | 1444 |
| R-squared | 0.444 | 0.325 | 0.124 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3. “Instruction” includes expenditures on instruction, transfer to retirement system-instruction. “Support service” includes support service for pupils, instructional staff, school/general administration, business support, operation and maintenance of plant, student transportation, central support service, transfer to retirement system-support and other non-specified support service. “Other” includes food service, enterprise operation and other elementary and secondary expenditures. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 7 Import from China and per-pupil revenue from different sources within the Same States, 1990-2007, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil expenditure and revenue from different sources / $1000

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1)$∆$Total Expenditure | (2) $∆$Total Revenue  | (3)$ $$∆$Local Revenue  | (4)$ $$∆$Federal Revenue  | (5)$ ∆$State Revenue  |
|  |  |  |  |  |  |
| $$∆IPW\_{uit}$$ | -0.098\*\*\* | -0.100\* | -0.041\* | -0.007 | -0.051 |
|  | (0.025) | (0.039) | (0.016) | (0.007) | (0.036) |
|  |  |  |  |  |  |
| Observations | 1444 | 1444 | 1444 | 1444 | 1444 |
| R-squared | 0.759 | 0.766 | 0.784 | 0.453 | 0.879 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3 and state-period fixed effects. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 8 Import from China and per-pupil revenue from different sources, State Level, 1990-2007, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil revenue from different sources / $1000

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) $∆$Total Expenditure  | (2) $∆$Total Revenue  | (3)$ $$∆$Local Revenue  | (4)$ $$∆$Federal Revenue  | (5)$ ∆$State Revenue  |
|  |  |  |  |  |  |
| $$∆IPW\_{ust}$$ | -2.348\*\*\* | -2.177\*\*\*  | 0.077 | -0.055 | -2.199\* |
|  | (0.625) | (0.632) | (0.875) | (0.064) | (0.967) |
|  |  |  |  |  |  |
| Observations | 96 | 96 | 96 | 96 | 96 |
| R-squared | 0.577 | 0.573 | 0.314 | 0.527 | 0.438 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3 but at CZ level. Robust standard errors in parentheses. Models are weighted by start of period state share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 9 Import from China and per-pupil revenue from different sources, School District Level, 1990-2000, 2SLS**

Dependent Variable: Ten-year equivalent changes in per-pupil expenditure and revenue from different sources / $1000

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) $∆$Total Expenditure  | (2) $∆$Total Revenue  | (3)$ $$∆$Local Revenue  | (4)$ $$∆$Federal Revenue  | (5)$ ∆$State Revenue  |
| $$∆IPW\_{u,i,t}\*Manu\%\_{d}$$ | -0.206 | -0.170 | 0.649 | 0.121 | -0.940\*\* |
|  | (0.437) | (0.390) | (0.442) | (0.121) | (0.336) |
| $$∆IPW\_{u,i,t}$$ | 0.083 | 0.051 | 0.079 | -0.052 | 0.023 |
|  | (0.111) | (0.099) | (0.099) | (0.034) | (0.074) |
| $$Manu\%\_{d}$$ | 1.079 | 1.110 | -2.369\* | -0.244 | 3.722\*\*\* |
|  | (0.986) | (0.865) | (1.026) | (0.240) | (0.824) |
| Observations | 9866 | 9866 | 9866 | 9866 | 9866 |
| R-squared | 0.130 | 0.155 | 0.050 | 0.185 | 0.221 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3 but at school district level. Robust standard errors in parentheses are clustered on state level. Models are weighted by start of period school district share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 10 Falsification Test**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1. $∆$Total Expenditure

(1990-2000)  | (2) $∆$Total Revenue (1990-2000)  | (3)$ $$∆$Local Revenue (1990-2000)  | (4)$ $$∆$Federal Revenue (1990-2000)  | (5)$ ∆$State Revenue (1990-2000)  |
| $$∆IPW\_{uit} Future$$$$(2000-2007)$$ | -0.01 | -0.06 | 0.33 | -0.01 | -0.38 |
|  | (0.10) | (0.07) | (0.20) | (0.01) | (0.21) |
| Average Dependent Variable | 2.23 | 2.24 | 0.48 | 0.24 | 1.53 |
| Observations | 722.00 | 722.00 | 722.00 | 722.00 | 722.00 |
| R-squared | 0.43 | 0.46 | 0.26 | 0.35 | 0.38 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3 except the time fixed effects. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Table 11 Test of Migration, Changes in Fall Enrollment (measured in thousands of students)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | $∆$Fall Enrollment | $∆$Fall Enrollment | $∆$Fall Enrollment |
|  |  |  |  |
| $$∆IPW\_{uit}$$ | -1.06 | 0.20 | 115.926 |
|  | (13.42) | (7.13) | (83.741) |
|  |  |  |  |
| Observations | 1,444 | 1444 | 96 |
| R-squared | 0.541 | 0.686 | 0.797 |
| Average Dependent Variable | 5.81 | 5.81 | 87.14 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. Column (1) (2) (3) have the same specification as equation (1) (2) (3) respectively. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

**Appendix**

**Table A1 Alternative Measures of Import Exposure**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) $∆$Total Expenditure  | (2) $∆$Total Revenue  | (3)$ $$∆$Local Revenue  | (4)$ $$∆$Federal Revenue  | (5)$ ∆$State Revenue  |
| Panel A: Baseline result: Gross Chinese imports per worker (2SLS)  |
| $$∆IPW\_{uit}$$ | -0.262\*\*\* | -0.250\*\*\* | -0.064 | -0.002 | -0.183\*\* |
|  | (0.064) | (0.075) | (0.048) | (0.008) | (0.062) |
| R-squared | 0.287 | 0.285 | 0.252 | 0.202 | 0.258 |
| Panel B: Net Chinese import per worker (2SLS)  |
| $$∆IPW\_{uit}$$ | -0.95\*\* | -0.87\* | -0.03 | 0.01 | -0.84\*\* |
|  | (0.32) | (0.37) | (0.30) | (0.04) | (0.30) |
| R-squared | 0.28 | 0.29 | 0.25 | 0.22 | 0.27 |
| Panel C: Excluding computers and related equipment  |
| $$∆IPW\_{uit}$$ | -0.96\*\*\* | -0.88\*\* | 0.06 | -0.02 | -0.92\*\* |
|  | (0.26) | (0.31) | (0.29) | (0.03) | (0.29) |
| R-squared | 0.32 | 0.32 | 0.25 | 0.22 | 0.30 |
| Panel D: Excluding flat glass, cement, concrete, construction and material handling machine  |
| $$∆IPW\_{uit}$$ | -0.52\*\* | -0.49\* | 0.02 | 0.00 | -0.52\*\* |
|  | (0.18) | (0.21) | (0.18) | (0.02) | (0.18) |
| Average Dependent Variable | 2.01 | 2.12 | 0.71 | 0.29 | 1.12 |
| Observations | 1444.00 | 1444.00 | 1444.00 | 1444.00 | 1444.00 |
| R-squared | 0.31 | 0.32 | 0.25 | 0.22 | 0.29 |

Notes: All regressions include the full vectors of control variables from column (5) of Table 3. Robust standard errors in parentheses are clustered on CZ. Models are weighted by start of period CZ share of national population. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

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2. Feler and Senses (2017) use data on school finances per resident gathered from the U.S. Census Bureau’s historical data on State and Local Government Finances. The school expenditure data in the NCES is calculated on a per pupil basis providing a better measure of the funds available for the students needing them. [↑](#footnote-ref-2)
3. During the period 1978-1984, China’s grain production grew by an average of 5% annually in real terms, vegetables by 7.5%, fruit by 7.2%, and cotton by 19.3%, much higher than the growth rates in the 1960s and 1970s, details in *China’s Agriculture within the World Trading System, Table 2*. [↑](#footnote-ref-3)
4. For comparison with other countries, refer to *Chinese Economic Performance in the Long Run: 960–2030 AD, Table 3.4.* [↑](#footnote-ref-4)
5. While in the U.S., K-12 students can attend public schools, charter schools, private schools and home schools, about 90% of primary and secondary students attend public schools. According to National Center for Education Statistics, The Condition of Education, students enrolled in private school has decreased from 11.4% in 1999 to 10.2% in 2015. [↑](#footnote-ref-5)
6. Details can be found in North America EdCentral and U.S. Census Bureau, Public Elementary-Secondary Education Finance Data. [↑](#footnote-ref-6)
7. Detailed 2000 tax data is taken from <https://www.census.gov/data/tables/2001/econ/qtax/historical.html>. From 1990 to 2010, the share of property tax in total local tax declined from 76% to 59%, while the shares of individual income tax and sales tax increased. [↑](#footnote-ref-7)
8. There are 397 manufacturing industries defined by the 1987 version of Standard Industrial Classification (SIC). [↑](#footnote-ref-8)
9. Data on imports are only available starting in the year 1991 because of lags in countries’ adoption of the HS classification. [↑](#footnote-ref-9)
10. The crosswalk from counties in different years to 1990 commuting zones is available on David Dorn’s website: http://www.ddorn.net/data.htm [↑](#footnote-ref-10)
11. My estimates are within 5 percent of the measures created in Autor et al.’s (2013). [↑](#footnote-ref-11)
12. According to National Center for Education Statistics, in the fall of 2018, about 56.6 million students attended elementary and secondary schools, among them, 50.7 million were enrolled in public schools. [↑](#footnote-ref-12)
13. The crosswalk file can be downloaded from <https://www.ers.usda.gov/data-products/commuting-zones-and-labor-market-areas/>. Some school districts and counties have changed their names, split into different parts, or disappeared. Details on how I addressed these issues will be provided in the appendix. [↑](#footnote-ref-13)
14. The eight other high-income countries are: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. These are the rich countries with detailed trade data available from 1991. [↑](#footnote-ref-14)
15. In Autor et al. (2013), the authors adopt a gravity-based measurement of import exposure to capture the changes in productivity and transport costs of Chinese producers relative to US producers. This measure helps to neutralize demand conditions in import countries. Their results using this measure are similar to their results from IV estimation suggesting that the correlated import demand shocks across countries are not very important. [↑](#footnote-ref-15)
16. Detailed data on productivity growth can be found on the BLS website: <https://www.bls.gov/opub/mlr/2018/article/multifactor-productivity-slowdown-in-us-manufacturing.htm>. [↑](#footnote-ref-16)
17. $1,000 is the difference between the 25th and 75th percentile in CZ level import exposure growth during the period of 2000 and 2007. [↑](#footnote-ref-17)
18. Current non-elementary/secondary expenditures include expenditures on community service, adult education, transfers to retirement system, and things like interest payments. [↑](#footnote-ref-18)
19. 1990 commuting zones can cross state boundaries. Here, I use the crosswalk file provided by David Dorn in which each commuting zone has been matched with the state which has the largest population share of that commuting zone. [↑](#footnote-ref-19)
20. Note that there is less variation across states in the change in Chinese import exposure than across commuting zones. The CZ level measure ranges from 0 to10, while the state level measure ranges from 0 to\-2. This is likely to be behind the larger estimated impact at the state level. [↑](#footnote-ref-20)