Trade and Wages Revisited: The Effect of the China's MFN Status on the Skill Premium in U.S. Manufacturing

(*Preliminary*)

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Abstract:

I take advantage of an interesting policy experiment – the 1980 U.S. conferral of Most Favored Nation (MFN) status to China – to estimate the effect of increased imports from a less developed country on the U.S. manufacturing wage structure. Previous empirical studies find that trade has little or no effect on wages in the U.S. However, they all rely on the basic version of the factor proportions framework (Heckscher-Ohlin) and consequently only expect to find trade-related changes *across* industries (e.g. Berman, Bound, and Griliches, 1994). In contrast, I use this policy experiment to provide evidence that trade raises the demand for skill and the skill premium *within* U.S. manufacturing industries. My findings are consistent with Schott (2004), who reports that U.S. trade data supports factor proportions specialization within, as opposed to across, industries.

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I. Introduction

Increased globalization over the last 30 years has led many researchers to study the effects of international trade on local labor market outcomes. While disagreement still exists among economists, a commonly held view is that trade does matter but not much, especially compared to other economic forces such as factor-biased technical change. In their seminal work Berman, Bound, and Grliches (1994) found that skill upgrading in the U.S. manufacturing sector is primarily due to skill-biased technical change and not trade because skill upgrading mainly occured within as opposed across industries as the basic version of Heckscher-Ohlin would predict. While Berman et al. (1994) do assess the impacts of trade both across- and within-industry, they do that using data decompositions, which point to very small effects of exports and imports on manufacturing wages and employment. In this study, I challenge the commonly held view that Heckscher-Ohlin type trade only affects labor market outcomes by altering demand for resources across industries as defined in the data. Taking advantage of an interesting policy experiment, I use the exogenous variation in imports from a less-developed country as a result of the U.S. conferral of Most Favored Nation (MFN) status to China to identify the within industry impact of higher import penetration on the demand for skill.

My results support the hypothesis that trade raises the demand for skill and the skill premium *within* U.S. manufacturing industries. These findings are consistent with Schott (2004), who reports that U.S. trade data supports factor proportions specialization within, as opposed to across, industries. The evidence presented here carries important implications for assessing the impact of trade on labor markets – I show that trade alters demand for factors within industries as commonly defined in the data, and not just across industries. The within industry channel has been largely ignored in the empirical literature so far. My estimates suggest, however, that it is economically important in assessing the impacts of trade on the demand for skill and the skill premium in the U.S. manufacturing.

II. Theoretical Framework

The basic version of Heckscher-Ohlin generates trade driven by differences in factor endowments across countries. In the simplest set-up, each nation specializes according to its comparative advantage and opening to trade induces reallocation of resources across industries thereby increasing the demand for the locally abundant factor(s).

In theory, all goods (industries) can be neatly arranged in a chain according to their capital or skill intensity. In common practice, however, researchers are faced with data on industries which aggregate many products with very different factor intensities. This issue is even more important today as international trade is on the rise and countries use different techniques to produce a given good. For example, Schott (2004) examines product-level U.S. import data and reports that importer's unit-values (prices) vary systematically with the partner's capital and skill endowments. Lower value products are, on average, imported from countries with lower capital and skill endowments and from countries which use lower capital or skill intensity to manufacture those products. In practice, imports of many products manufactured in different countries using different techniques are grouped together in the same industry or even in the same product class. In theory, we would have separated lower and higher value varieties of the same product manufactured in different countries into different industries (product classes) and the basic version of Heckscher-Ohlin predicting changes *across* industries would work just fine. In practice, however, all low- and high-value varieties of the same product end up in the same industry (product class). This gives rise to what Schott (2004) refers to as specialization *within* products, and not across as the traditional Heckscher-Ohlin theory would suggest. Factor proportions specialization within industries is the reason why increased industry imports from trade partners who use different production intensities (for products in given industry) would cause the demand for factors, and potentially their returns, to change *within* industries (as defined in the data).

Using the adoption of China's MFN status in 1980, I exploit the exogenous variation of industry's increase in imports from a country which uses less skill intensive manufacturing techniques to estimate the impact of increased imports from such a partner on the within-industry skill premium in the U.S. The theory of factor proportions (Heckscher-Ohlin) specialization within industries predicts that a rise in industry's imports from China would increase the demand for skill and, if workers are not perfectly mobile, the skill premium within manufacturing industries in the U.S. This is exactly what I find my empirical analysis. My results suggest that if imports from China rise by 1 percent of industry's domestic consumption (domestic output plus total imports net of total exports), the industry's skill (college) premium would increase 1.5 to 2 percent.

III. Data

In my empirical analysis I use micro-data on full-time manufacturing employees from the 1980 and the 1990 Decennial Census of Population five-percent samples.[1] These data provide information on workers' personal characteristics, their wages (income), as well as 3-digit CIC (Census Industry Classification) industry of employment. The information on wages (income)

[1] The 5 percent samples I use come from the Integrated Public Use Microdata Series (IPUMS) available at the Minnesota Population Center at the University of Minnesota (*http://www.ipums.umn.edu*).

collected in the 1980 and 1990 Censuses pertains to years 1979, the year before the MFN status was adopted, and 1989 respectively. I consider prime age workers from 25 to 60 years of age.

I supplement the individual-level Census data with workers' industry information on manufacturing imports from China in 1979 and 1989. The Chinese imports data comes from Feenstra (1996).[2] Additionally, to compute industry import penetration ratios for China, I use data on industry output (shipments) from the Manufacturing Industry Database at the National Bureau of Economic Research (NBER) and from the Bureau of Economic Analysis (BEA) and industry overall exports and imports also available in Feenstra (1996).[3] I consider only the manufacturing sector because trade data is available only for that sector and because the policy experiment used for identification affected only trade in manufacturing.

I also use industry-level data from the Annual Survey of Manufactures (ASM) and the Census of Manufactures (CM) to shed additional light on the impact of the China's MFN status on the manufacturing industry's demand for skill. There are both advantages and disadvantages of using ASM and CM compared to employing data from the Census of Population (CP). One advantage of the industry-level data from ASM and CM is its time-dimension. Unlike CP, which occurs only once every ten years, ASM and CM provide annual data – I employ 15 years worth of data from 1974 to 1988 on the relative wage bill, relative wage, and relative employment of non-production workers.

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[2] These data are available at the Center for International Data at University of California, Davis (*http://cid.econ.ucdavis.edu*)

[3] NBER's Manufacturing Industry Database is available on-line at *http://www.nber.org/nberces/nbprod96.htm*, and the BEA's industry data is on-line at *http://www.bea.gov/industry/gdpbyind_data.htm*.

Using annual data before and after the MFN status was adopted in 1980 allows me to control for any pre-existing time trends in imports and the relative demand for skill. Also, unlike CP, which groups workers into 76 manufacturing industries, ASM and CM feature a much higher number (458) of (more finely disaggregated) manufacturing industries. On the other hand, the ASM and CM data is at the industry level and it is not possible to control for individual characteristics as I did when using CP data. Additionally, the industry-level data codes workers as either production or non-production employees. On average, non-production workers have 2 to 3 more years of schooling than production workers. I consider non-production employees as a proxy for high-skilled labor, and production workers as a proxy for of low-skilled labor (see Berman, Bound, and Griliches 1994).

IV. Individual-level data from the Census of Population

IV.1 Econometric specification

Central to my identification strategy is the U.S. adoption of the Most Favored Nation (MFN) status for Chinese imports in 1980. In essence, the MFN status, or Normal Trade Relations (NTR) as it was renamed in 1998, is a trade benefit – when assessing duties on imports, the U.S. applies the MFN rate, or "column 1" duty rate in the U.S. tariff schedule, as opposed to the much higher "column 2" rate applied to imports from non-MFN countries. The U.S. has extended MFN status to almost all of its trading partners except for few nations whose governments are deemed to restrict human freedom.[4] China was first granted MFN status in 1980 and this

[4] All member countries of the World Trade Organization (WTO) are required to apply tariffs on an equal and nondiscriminatory basis to all other WTO members. Under this requirement, U.S. extension of MNF status to non-member countries is optional. Note that China became a WTO member in the end of 2001.

extension required an annual review, which was routine until 1989.[5] Although subject to contentious debates China's MFN has been approved every year from 1989 until it was made permanent in 2000.

To appreciate the magnitude of difference between the MFN tariff rates ("column 1") and "column 2" rates consider the following examples from 2006 U.S. Tariff Schedule:[6]

Product	Description	Unit or Quantity	Rates of duty (1)	Rates of duty (2)
…				
1008.20.00	Millet	kg.	0.32¢/kg	2.2 ¢/kg
…				
3301.13.00	Essential oils of lemon	kg.	3.8%	25%
…				
4202.21.30	Trunks or cases of reptile leather	no.	5.3%	35%
…				
6203.43.35	Water resistant trousers or breeches	doz., kg.	7.1%	65%
…				
7408.11.60	Copper wire (with a maximum cross-sectional dimension over 6 mm but not over 9.5 mm)	kg.	3%	28%
…				
9401.51.00	Seats of bamboo or rattan	no.	Free	60%
…				

Note that tariffs would substantially decline, rather uniformly across products, going from column (2) to column (1) in the sample table above. Arce and Taylor (1997) report that in 1995, the average trade-weighted MFN tariff rate applied to Chinese imports was about 6 percent,

[5] The U.S. and China established diplomatic relations in January of 1979, signed a bilateral trade agreement in July of 1979, and provided mutual Most Favored Nation (MFN) treatment beginning in 1980. Previously, the U.S. had imposed an embargo on all trade with China from the time of the Korean War until mid 1971.

[6] This is a small random sample. Source: United State International Trade Commission (*http://www.usitc.gov/tata/hts/bychapter/index.htm*)

while it would have been about 44 percent under column (2) rates. This implies that on average, China faced 7 to 8 times smaller tariffs on its imports into the U.S. after the adoption of the MFN status in 1980. As a result, import penetration from China, defined as imports from China as a percentage of domestic consumption (output plus total imports net of total exports) rose from 0.02 percent in 1979 to 0.38 percent in 1989, and further up to 1.81 percent in 1999 (see Panel A of Table 1).[7] The impact was largest in the decade following the adoption of the MFN policy – the growth rate of import penetration from China nearly doubled from an annual rate of 20 percent in the late 1970s to an annual growth rate of 37 percent in the 1980s, and back to 16 percent in the 1990s (see Panel B of Table1). The growth rate of import penetration for other U.S. trading partners cannot compare to the growth rate of imports from China. Both more developed nations and countries at a similar stage of development, i.e. countries with per capita GDP of 5 percent or less of the U.S. per capita GDP, experienced much lower import penetration growth rates, especially during the decade after China was granted its MFN status (see Panels A and B of Table 1 as well as Figures 1 and 2). Panel B of Table 1, for example, shows that import penetration from all nations (excluding China), and import penetration from countries similar to China grew about 5 percent annually in the 1980s, while China's import penetration rose 37 percent on average each year during that decade. In particular, note from Figure 2 that while almost non-existent in 1979, imports from China in 1989 were as large as the imports from all

[7] Formally, import penetration from China in industry j is defined as

$$ImpPenChina_j = \frac{M_{China,j}}{(Y_j + M_j - X_j)},$$

where $M_{China,j}$ is imports from China into industry j, Y_j is industry's output (shipments), M_j is industry's total imports, and finally X_j is the industry's total exports.

other low-wage countries combined.

While overall manufacturing imports from China soared in the 1980s after the adoption of the MFN status, not all manufacturing industries experienced the same growth. For a number of them that had already experienced some imports from China before the adoption of the MFN status, the policy was most effective. This is most likely due to the fact that Chinese exporters in those industries had already incurred the fixed cost of establishing market connections (presence) as well as customer base in the U.S. (see Roberts and Tybout, 1998; Melitz, 2003). For example, the leather products, toys, apparel, and footwear industries saw a large increase in imports from China – import penetration in those industries rose from an average of 0.1 percent to an average of 7 percent. Other industries, in which Chinese exporters had no market presence before the policy was adopted, witnessed very modest or almost no increase in import penetration from China. The relationship between the change in import penetration from China between 1979 and 1989, $\Delta ImpPenChina_{1979-1989,j}$, and the initial level of import penetration from China in 1979, $\Delta ImpPenChina_{1979-1989,j}$, is plotted in Figure 3. There is a positive statistically significant relationship between the change and the initial (pre-MFN) level of import penetration from China.

The large and uneven impact of China's MFN status on its import penetration across U.S. manufacturing industries lies at the hart of the identification strategy. The econometric framework below estimates the impact of an increase in import penetration from a "low-wage", low-skilled labor abundant country such as China on the within industry skill premium in U.S. manufacturing. The (reduced form) econometric equation is:

$$ln(w_{ijt}) = \psi_j + \tau_{1989} + \beta_1 College_{ijt} + \beta_2 ImpPenChina_{1979,j} * College_{ijt} + \beta_3 ImpPenChina_{1979,j} * \tau_{1989} +$$

$$+ \beta_4 ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989} + \boldsymbol{X\beta_5} + \varepsilon_{ijt} \qquad (1),$$

where $ln(w_{ijt})$ is the natural logarithm of the annual wage income for worker *i*, employed in industry *j* in year *t*, *t* = 1979, 1989. Industry fixed effects are denoted by ψ_j. The year dummy, τ_{1989}, is one if the year is 1989 and zero for year 1979. As I use college degree as a proxy for skill, $College_{ijt}$ is a dummy variable indicating if worker *i* in industry *j* in year *t* has a college education. To capture the differences across manufacturing industries in the impact of increased import penetration from China as a result of the adoption of China's MFN status in 1980, I use the level of import penetration from China in 1979, $ImpPenChina_{1979,j}$. This strategy is warranted in light of the earlier evidence that a manufacturing industry with a higher initial level of import penetration from China faced a much higher increase in import penetration from China after the MFN policy was implemented. The coefficient of interest here is β_4. It estimates the change in the within industry skill premium from 1979, the period before China's MFN status was adopted, to 1989 given the industry's initial (1979) level of import penetration from China. I interpret the effect estimated by β_4 as the impact of increased imports, as a result of lower tariffs, from a low-skilled labor abundant country as China on the within industry skill premium in a high-skilled labor abundant country as the U.S. Finally, equation (1) includes a number of personal characteristics in ***X***, as well as an individual specific error term ε_{ijt}. To make statistical inferences, I calculate robust standard errors clustered by industry because $ImpPenChina_{1979,j}$ varies by industry and not by individual.

In essence, econometric specification (1) is a difference-in-differences analysis with two periods and multiple groups of industries which faced increased import penetration from China at varying intensities depending on the industry's initial import penetration from China. Another useful way to recast equation (1) is to use Instrumental Variables (IV) framework. The equation that we want to estimate is

$$ln(w_{ijt}) = \psi_j + \tau_{1989} + \alpha_1 College_{ijt} + \alpha_2 \Delta ImpPenChina_{1979-1989,j} * College_{ijt} + \alpha_3 \Delta ImpPenChina_{1979-1989,j} * \tau_{1989} + $$

$$+ \alpha_4 \Delta ImpPenChina_{1979-1989,j} * College_{ijt} * \tau_{1989} + \boldsymbol{X\alpha_5} + \upsilon_{ijt} \qquad (2),$$

where $\Delta ImpPenChina_{1979-1989,j}$ is the change in import penetration from China from 1979 to 1989 for industry *j*. Because $\Delta ImpPenChina_{1979-1989,j}$ can be driven by factors that cannot be controlled but can potentially change industry wages, the ordinary least squares (OLS) estimate may be biased and inconsistent estimate of the effect of increased import penetration on the within industry skill premium. Taking advantage of the MFN policy adoption for China and the fact that it affected manufacturing industries differently based on their initial, pre-existing, level of imports from China, I use the level of industry's import penetration from China in 1979, $ImpPenChina_{1979,j}$, as an instrument for the change in import penetration from China from 1979 to 1989, $\Delta ImpPenChina_{1979-1989,j}$. There are two ways to approach this IV set-up. The first one is to perform the following first-stage regression:

$$\Delta ImpPenChina_{1979-1989,j} = \gamma_0 + \gamma_1 ImpPenChina_{1979,j} + \zeta_j \qquad (3),$$

using industry data with appropriate weights based on industry employment and then calculate the predicted values $\overline{\Delta ImpPenChina_{1979-1989,j}}$ to use in the second-stage regression

$$ln(w_{ijt}) = \psi_j + \tau_{1989} + \delta_1 College_{ijt} + \delta_2 \overline{\Delta ImpPenChina_{1979-1989,j}} * College + \delta_3 \overline{\Delta ImpPenChina_{1979-1989,j}} * \tau_{1989} +$$

$$+ \delta_4 \overline{\Delta ImpPenChina_{1979-1989,j}} * College_{ijt} * \tau_{1989} + \boldsymbol{X\delta_5} + \omega_{ijt} \qquad (4).$$

Alternatively, I can use the individual level data for the first-stage regression and create three instruments: $ImpPenChina_{1979,j} * College$, $ImpPenChina_{1979,j} * \tau_{1989}$, and $ImpPenChina_{1979,j} College_{ijt} * \tau_{1989}$, for the potentially endogenous $\Delta ImpPenChina_{1979-1989,j} College$, $\Delta ImpPenChina_{1979-1989,j} * \tau_{1989}$, and $\Delta ImpPenChina_{1979-1989,j} * College_{ijt} * \tau_{1989}$. The second stage-regression is then

$$ln(w_{ijt}) = \psi_j + \tau_{1989} + \pi_1 College_{ijt} + \pi_2 \overline{\Delta ImpPenChina_{1979-1989,j} * College} + \pi_3 \overline{\Delta ImpPenChina_{1979-1989,j} * \tau_{1989}} +$$

$$+ \pi_4 \overline{\Delta ImpPenChina_{1979-1989,j} * College_{ijt} * \tau_{1989}} + \boldsymbol{X\pi_5} + \eta_{ijt} \qquad (5).$$

The results from both approaches are very similar, almost identical. Because the first-stage regression results of the first approach are more informative, but it is easier to calculate the correct (robust and clustered by industry) standard errors using the second method, I will report estimates of equation (3) and the second-stage results obtained from the second approach. Finally, note that specification (1) represents the reduced-form equation for both IV approaches.

V. Results with the Census of Population Data

I start by looking at the aggregated industry-level data from the Census of Population and estimating the first-stage regression equation (3). I first estimate equation (3) without weights reflecting the share of industry employment. The results reported in column (1) of Table 3 indicate that industries with higher pre-MFN import penetration from China experienced a much higher increase in import penetration from China following the adoption of the MFN policy. After appropriately weighing the estimated effect is still large, positive and statistically significant, indicating that if industry import penetration in 1979 was larger by 0.01 (i.e. imports from China as a fraction of domestic industry consumption were higher by 1 percent), industry's increase in import penetration from 1979 to 1989 would be larger by about 0.1 (i.e. the increase in imports from China as a fraction of domestic industry consumption would be higher by 10 percent). To check if imports from countries similar to China (countries with per capita GDP of 5 percent (20 percent) or less of the per capita GDP in the U.S.) experienced a similar growth in imports after 1980, I estimate regression equation (3) using imports from these nations.[8] The results presented in columns (3) and (4) (columns (5) and (6)) of Table 3 indicate that that is not the case.

Using the 1980 and 1990 Census data, I next calculate industry level high-skilled and low-skilled wages. I use college degree as a proxy for skill, such that workers with some years of college but no degree, with high-school degree, with no high-school education or high-school drop-outs are all considered low-skilled. The results are quite similar if I instead calculate the skill premium as the wage premium of college graduates over high-school graduates. I then reformulate the previous IV set-up for use with industry-level data and perform the following second-stage regression:

[8] See Table 8 for a list of the countries with per capita GDP of 5 percent or less of the U.S. per capita GDP.

$$\Delta ln(w^h / w^l)_{1979-1989,j} = \mu_0 + \mu_1 \overline{\Delta ImpPenChina_{1979-1989,j}} + \kappa_{jt} \qquad (6),$$

where $\overline{\Delta ImpPenChina_{1979-1989,j}}$ is the predicted value of $\Delta ImpPenChina_{1979-1989,j}$ from the first stage regression (3) and w^h / w^l is the wage of relative wage of high-skilled workers proxied by the college premium.[9] Results from equation (6) are reported in column (4) of Table 4. The estimate of μ_1 is positive and statistically significant. It implies that when imports from China increase by 0.1 or 10 percent of the industry's domestic consumption, the industry's college premium rises by 0.187, or 18.7 percent. Column (3) of Table 4 reports the results from the reduced form regression corresponding to the IV set-up of equations (3) and (6), while the column (5) shows results from the OLS regression which uses $\Delta ImpPenChina_{1979-1989,j}$ as a dependent variable. Note that unlike in the IV set-up, in the OLS regression, while positive the effect of import penetration from China on the college premium is small and not statistically significant.

In the last three columns of Table 4, using industry-level data and the IV set-up as well as OLS I check how import penetration from China affects the relative employment of high-skilled (college-educated) workers. Both, the IV and OLS estimates are positive and close in magnitude; however the IV estimate is not statistically significantly different from 0, implying that the increased demand for skill due to higher import penetration from China raised the skill

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[9] I denote the high-skilled wage and the employment of high-skilled workers by w^h and H respectively, whereas the low-skilled wage and the employment of low-skilled workers are w^l and L.

premium but it may have not increased the relative employment of high-skilled workers.

I next consider the individual-level data and first estimate the reduced-form equation (1). Using the individual-level data allows me to control for a rich set of personal characteristics including education, age, race, gender, marital and metropolitan status, as well as worker's geographic location, industry, and occupation fixed effects. For efficiency considerations I pool both males and females together but allow for interactions between the female indicator and the education, age, race, marital and metropolitan status covariates in order to capture the difference in impacts they may have on female versus male wages.

The results from the second stage of the second IV set-up, regression (5), are shown in column 1 of Table 5. The estimate of the coefficient of interest, π_4, is positive and statistically significantly different from 0 at the one percent level. At 1.57 (0.59), it indicates that as industry's import penetration from China rises by 0.01, i.e. as industry's imports from China increase by 1 percent of industry's domestic consumption, the industry's college premium increases by 1.57 percent. This estimate is similar to, yet more than two times larger then the estimate of 0.6 implied in Borjas, Freeman and Katz' (1997) factor content analysis.

Column 2 of Table 5 presents the reduced form equation (1). Note that the reduced form estimate is about 10 times larger the second-stage coefficient in line with the first stage effect of 10 presented in column 2 of Table 3. Additionally the last column, column 3, of Table 5 reports the estimate from the OLS specification (2). Just as in the case of industry-level data the effect of import penetration on the industry's college premium is much smaller in the OLS specification than in the IV regression. Also, in both cases the OLS estimate is not statistically significantly different from 0.

VI. Industry-level Evidence from the Annual Survey of Manufactures and Census of Manufactures

VI.1 Identification Strategy

The ASM and CM data allow me to construct an industry-level panel spanning 15 years, before and after China's MFN was adopted, containing information on the manufacturing industries' demand for skill as proxied by the relative wage bill, the relative wage, and the relative employment of non-production workers. Heckscher-Ohlin specialization within products implies that higher industry imports from a low-skilled labor abundant nation (China) would lead to higher within-industry specialization in skill intensive products in the U.S. manufacturing sector. In particular, I test if the adoption of China's MFN status in 1980 led to an increase in the trend in the demand for skill in industries which experienced a higher import penetration from China. As before, I identify such industries by their level of imports from China in 1979, the year the MFN status was adopted. More formally, the identification strategy can be written as:

$$ln\left(\Psi_{jt}^{NP}\right) = \delta_1 Time_t * I_{Year\ \geq 1980} + \delta_2 Time_t * ImpPenChina_{1979,j} + \delta_3 ImpPenChina_{1979,j} * I_{Year\ \geq 1980} + \\ + \delta_4 Time_t * ImpPenChina_{1979,j} * I_{Year\ \geq 1980} + \lambda_j + \gamma_t + \xi_{jt}, \quad (7),$$

where $ln\left(\Psi_{jt}^{NP}\right) = ln[(w_{jt}^{NP} NP_{jt}) / (w_{jt}^{P} P_{jt})]$ is the logarithm of the wage bill of non-production workers relative to that of production workers; $Time_t$ is a time trend; $I_{Year\ \geq 1980}$ is a indicator variable that is equal to unity for 1980 and thereafter; $ImpPenChina_{1979,j}$ is the level of industry import penetration from China in 1979; λ_j and γ_t are industry and year fixed effects, and finally, ξ_{jt} is a random error term. Additionally, I use both the relative wage and the relative employment of non-production workers as dependent variables.

Furthermore, to test the hypothesis that within-industry specialization due to increase imports pressures from China has occurred after 1980, I use ASM and CM industry data on investment. As China's MFN status is adopted, higher imports from this low-skilled labor abundant nation will induce higher within-industry specialization in not only high-skill intensive but also capital intensive products in the U.S. This would lead to faster capital accumulation in industries which experience a higher import penetration from China. To test this, I estimate specification (7) with investment (as a fraction of total capital) as a dependent variable.

VI.2 Industry-level Results

I start by estimating equation (7) with import penetration from China, $ImpPenChina_{jt}$, as a dependent variable. The results are presented in column 6.1 and 6.2 of Table 6. The estimates in Column 6.1 imply that industries with higher initial, pre-MFN, level of imports from China experienced higher growth (trend) in import penetration after 1980 when the MFN status was adopted (the estimate of δ_4 is positive (and statistically significant) at 0.377). In column 6.2, I add industry-specific time trends specification (7) – the results do not change much. The magnitude of the estimate of δ_4 implies that if an industry's import penetration from China was 0.002 percentage points (one standard deviation) higher in 1979, it experienced 0.001 percentage points (= 0.002* 0.377) increase in annual growth in import penetration from China after 1980.

Next, I investigate how imports from other low-skilled labor abundant (and capital scarce) nations similar to China changed after the adoption of China's MFN status. To this end, I calculate import penetration from all countries whose GDP per capita is 5 percent of less of the

U.S. per capita GDP (see Table 8) excluding China. I then use this new import penetration measure as a dependant variable in equation (7). The results are presented in columns 6.3 and 6.4 of Table 5. The estimates imply that import penetration from countries similar to China has increased after 1980, but by less than half of the growth of imports from China. The specifications in Columns 6.5 and 6.6 use the difference in import penetration from China and other countries similar to China as dependant variable. Consistent with the adoption of China's MFN status in 1980, specifications 6.5 and 6.6 confirm that imports from China after 1980 rose much faster than imports other similar, low-skilled labor abundant (and capital scarce) nations.

To check if the increase in imports from China may have depressed imports from other nations, I calculate overall industry import penetration excluding imports from China and estimate (7) using this measure as a dependant variable. The results, presented in 6.7 and 6.8, while imprecise, show evidence that the growth of imports from countries other than China has declined after 1980 when China's MFN status was adopted. In 6.9 and 6.10, I use the difference in import penetration from China and all other nations as dependant variable – it is clear that imports from China grow at a much faster rate after 1980 than overall imports. The results in columns 6.3 - 6.6 show that the growth rate of imports from countries similar to China rose after 1980, but by much less than imports from China. Combined with the evidence in columns 6.7-6.10, this implies that the growth of imports from China after 1980 most likely depressed the growth rate of imports from nations not very similar to China, i.e. countries with per capita GDP that is higher than 5 percent of U.S. per capita GDP.

I next present evidence that the growth in the demand for skill in industries with higher pre-MFN import penetration from China rose faster after 1980. To this end, I estimate regression equation (7) using the logarithm of the relative wage bill, the relative wage, and the relative employment of non-production workers as dependent variables. The results are presented in Table 7. The estimates in 7.1 and 7.2 imply that the relative wage bill of non-production workers in industries with higher initial import penetration from China experienced a higher growth after 1980. The magnitude of the estimate of δ_4 suggests that if an industry's import penetration from China was 0.002 percentage points (one standard deviation) higher in 1979, it experienced 0.006 percent (= 0.002* 2.885) increase in annual growth in the relative wage bill after 1980.

To decompose the increase in the growth rate in the relative wage bill into wage and employment effects, I estimate equation (7) using the relative wage and the relative employment of non-production workers as dependent variables. Columns 7.3 - 7.4 present the relative wage results and 7.5 - 7.6 the relative employment results. The estimates show a larger relative wage effect than relative employment effect. This implies that at least one type of workers – production or non-production – is imperfectly mobile so that when the relative demand for non-production labor rose in response to the increase in Chinese imports after 1980, relative wage differences across manufacturing industries persisted, at least for the period of nine years (1980-1988) that I consider. Imperfect mobility may be due to industry specific human capital and is consistent with previous work by Neal (1995), Michaels (2007), and Kandilov (2007).[10]

Finally, because China is not only low-skilled labor abundant but also capital scarce compared to the U.S., one would expect that a rise in Chinese imports would encourage within industry specialization towards more capital intensive products in the U.S. Thus, one would expect that manufacturing industries with higher pre-MFN import penetration should experience a rise in capital accumulation, i.e. investment, after 1980. To test this, I re-estimate equation (7)

[10] Revenga (1992), on the other hand, finds larger employment effects and smaller wage effects.

with $ln(I/K)_{jt}$, the logarithm of investment as a fraction of total capital stock, as a dependent variable. As expected, the results, shown in the last two columns of Tables 7, indicate that industries with higher initial import penetration from China, experienced a higher growth in investment after 1980, when China's MFN status was adopted.

VII. Conclusions

I take advantage of an interesting policy experiment – the 1980 U.S. conferral of Most Favored Nation (MFN) status to China – to estimate the effect of increased imports from a less developed country on the U.S. manufacturing wage structure. The tariff reduction for Chinese manufacturing imports resulting from the MFN status was substantial – the average tariff dropped from about 45 percent to about 5 percent (Arce and Taylor, 1997). I show that, consistent with the incentive adopted in 1980, Chinese imports into the U.S. increased nearly 20-fold in the decade from 1979 to 1989, whereas imports from other countries hardly doubled in the same period. Although the MFN status lowered tariffs across all industries rather uniformly, it had a much larger impact on those industries which had already experienced imports from China prior to the adoption of the policy. A first-stage regression reveals that the initial (pre-MFN) 1979 levels of industry imports had a large positive effect on the change in industry imports from 1979 to 1989.

First, using data from the 1980 and 1990 decennial Censuses, I estimate the effect of the MFN policy on the college premium within U.S. manufacturing industries. I find that industries which experienced a higher import competition shock due to the MFN adoption also experienced a greater increase in the college premium. The instrumental variables (IV) estimate, using the 1979 levels of industry imports as an instrument for the 1979-1989 change in industry imports, yields an elasticity of the college premium with respect to ($Imports^{CHINA}$/Output) between 1.5 and 2. This estimate is, for example, about 3 times larger than the magnitude implied by Borjas, Freeman, and Katz' (1997) factor content analysis. The impact on the relative employment of skilled labor is somewhat larger than the impact on the relative wage, although the former is estimated less precisely.

Further, I use annual industry-level data form the Annual Survey of Manufactures and the Census of Manufactures to provide evidence that the relative wage bill of non-production (high-skilled) workers in industries with higher initial (pre-MFN) import penetration from China experienced a higher annual growth after 1980, the year the MFN status was adopted. Additionally, industries with higher initial import penetration from China, experienced a higher growth in investment after 1980. These results support the hypothesis that trade raises the demand for skill and the skill premium *within* U.S. manufacturing industries. My findings are consistent with Schott (2004), who reports that U.S. trade data supports factor proportions specialization within, as opposed to across, industries. The evidence presented here carries important implications for assessing the impact of trade on labor markets – I show that trade alters demand for factors within industries as commonly defined in the data, and not just across industries. The within industry channel has been largely ignored in the empirical literature so far. My estimates suggest, however, that it is economically important in assessing the impacts of trade on the demand for skill and the skill premium in the U.S. manufacturing.

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TABLES

Table 1. Import Penetration

Panel A: Import Penetration over Time

Year	Import Penetration from all countries (excluding China)	Import Penetration from countries with per capita GDP of 20 percent or less of the U.S. per capita GDP (excluding China)	Import Penetration from countries with per capita GDP of 5 percent or less of the U.S. per capita GDP (excluding China)	Import Penetration from China
1975	0.0644	0.0107	0.0025	0.0001
1979	0.0792	0.0129	0.0027	0.0002
1985	0.1161	0.0171	0.0031	0.0012
1989	0.1346	0.0215	0.0042	0.0038
1995	0.1603	0.0354	0.0078	0.0118
1999	0.1832	0.0483	0.0106	0.0181

Panel B: Import Penetration – Growth Rates

	Average Annual Growth Rate			
	Import Penetration from all countries (excluding China)	Import Penetration from countries with per capita GDP of 20 percent or less of the U.S. per capita GDP (excluding China)	Import Penetration from countries with per capita GDP of 5 percent or less of the U.S. per capita GDP (excluding China)	Import Penetration from China
1976-1979	0.05	0.05	0.02	0.20
1980-1989	0.06	0.05	0.05	0.37
1990-2001	0.03	0.08	0.09	0.16

Note: Author's calculations using trade data from Feenstra (1996) and output (shipments) data from BEA and NBER.

Table 2. Summary Statistics

	All		1979		1989	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Wage (constant 1983 $)	24,191.36	15,686.43	23,941.75	14,037.14	24,448.94	17,219.71
- College Graduate	38,281.22	22,816.30	37,308.69	19,447.82	39,060.29	25,164.79
- High School Graduate	21,515.28	12,208.90	21,769.45	11,569.02	21,240.12	12,860.12
log Wage	9.92	0.63	9.91	0.65	9.92	0.60
- College Graduate	10.40	0.58	10.39	0.59	10.41	0.58
- High School Graduate	9.83	0.59	9.83	0.63	9.82	0.55
College	0.16	0.37	0.14	0.35	0.18	0.38
Age	40.36	9.98	40.66	10.36	40.04	9.57
Female	0.29	0.45	0.28	0.45	0.30	0.46
Black	0.09	0.29	0.09	0.29	0.09	0.29
Married	0.75	0.43	0.78	0.42	0.72	0.45
Metropolitan	0.68	0.47	0.69	0.46	0.67	0.47
τ_{1989}	0.49	0.50	0	0	1	0
$\Delta ImpPenChina_{1979-1989,j}$	0.0048	0.0123	0.0051	0.0127	0.0045	0.0119
$ImpPenChina_{1979,j}$	0.0003	0.0007	0.0003	0.0007	0.0003	0.0007
Count	1,380,233		695,412		684,821	
Weighted Count	27,405,966		13,917,932		13,488,034	

Note: Author's calculations using the 1980 and the 1990 Census data, as well as trade data from Feenstra (1996) and output data from BEA and NBER.

Table 3. Industry-level regressions with the Census of Population Data.

Variable	$\Delta ImpPenChina_{1979-1989,j}$		$\Delta ImpPen5\%excludingChina_{1979-1989,j}$		$\Delta ImpPen20\%excludingChina_{1979-1989,j}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$ImpPenChina_{1979,j}$	7.979**	9.944***	-	-	-	-
	(3.316)	(1.270)				
$ImpPen5\%excludingChina_{1979,j}$	-	-	-0.015	1.270	-	-
			(0.330)	(0.809)		
$ImpPen20\%excludingChina_{1979,j}$	-	-	-	-	0.115	0.567
					(0.250)	(0.392)
Constant	0.005**	0.002**	0.002**	0.000	0.008***	0.008***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
R-square	0.06	0.31	0.00	0.26	0.21	0.14
F(1, 75)	5.79	61.28	0.00	2.46	0.01	2.10
N	76	76	76	76	76	76
Weights	No	Yes	No	Yes	No	Yes

Note: Robust standard errors in parenthesis. *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 4. Industry-level regressions with the Census of Population Data.

Variable	$\Delta ImpPenChina_{1979-1989,j}$		$\Delta ln(w^h/w^l)_{1979-1989,j}$			$\Delta ln(H/L)_{1979-1989,j}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpPenChina_{1979,j}$	7.979**	9.944***	18.591***	-	-	23.870	-	-
	(3.316)	(1.270)	(3.691)			(33.197)		
$\overline{\Delta ImpPenChina_{1979-1989,j}}$	-	-	-	1.869***	-	-	2.400	-
				(0.409)			(3.081)	
$\Delta ImpPenChina_{1979-1989,j}$	-	-	-	-	0.302	-	-	3.416**
					(0.557)			(1.552)
Constant	0.005**	0.002**	0.031***	0.027***	0.034***	0.202***	0.196***	0.191***
	(0.002)	(0.001)	(0.006)	(0.007)	(0.006)	(0.024)	(0.026)	(0.021)
R-square	0.06	0.31	0.07	0.07	0.01	0.01	0.07	0.07
F(1, 75)	5.79	61.28	25.37	20.92	0.29	0.52	0.61	4.84
N	76	76	76	76	76	76	76	76
Weights	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 5. Individual-level regressions using the 1980 and 1990 Census of Population data.

Variable		$ln(w_{ijt})$	
	(1)	(2)	(3)
$\overline{\Delta ImpPenChina_{1979-1989,j} * \tau_{1989}}$	-1.12** (0.47)	-	-
$\overline{\Delta ImpPenChina_{1979-1989,j} * College_{ijt}}$	7.76*** (1.33)	-	-
$\overline{\Delta ImpPenChina_{1979-1989,j} * College_{ijt} * \tau_{1989}}$	1.57*** (0.59)	-	-
$ImpPenChina_{1979,j} * \tau_{1989}$	-	-11.10** (5.27)	-
$ImpPenChina_{1979,j} * College_{ijt}$	-	70.64*** (13.50)	-
$ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$	-	17.57*** (5.68)	-
$\Delta ImpPenChina_{1979-1989,j} * \tau_{1989}$	-	-	-0.29 (0.42)
$\Delta ImpPenChina_{1979-1989,j} * College_{ijt}$	-	-	2.82*** (1.07)
$\Delta ImpPenChina_{1979-1989,j} * College_{ijt} * \tau_{1989}$	-	-	0.89* (0.54)
College	0.17*** (0.01)	0.18*** (0.01)	0.18*** (0.01)
$College * \tau_{1989}$	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)
Black	-0.15*** (0.01)	-0.15*** (0.01)	-0.15*** (0.01)
Married	0.143*** (0.005)	0.143*** (0.005)	0.143*** (0.005)
Age	0.054*** (0.002)	0.054*** (0.002)	0.054*** (0.002)
Age Squared	-0.0005*** (0.0000)	-0.0005*** (0.0000)	-0.0005*** (0.0000)

Metropolitan	0.08***	0.08***	0.08***
	(0.01)	(0.01)	(0.01)
Female	0.33***	0.33***	0.33***
	(0.04)	(0.04)	(0.04)
*Female*Married*	-0.16***	-0.16***	-0.16***
	(0.01)	(0.01)	(0.01)
*Female*Black*	0.13***	0.13***	0.13***
	(0.01)	(0.01)	(0.01)
*Female*Age*	-0.027***	-0.027***	-0.027***
	(0.002)	(0.002)	(0.002)
*Female*Age Squared*	0.0003***	0.0003***	0.0003***
	(0.0000)	(0.0000)	(0.0000)
*Female*After*	0.05***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)
*Female*Metropolitan*	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)
*Female*College*	-0.03*	-0.03*	-0.02*
	(0.02)	(0.01)	(0.01)
*Female*College**τ_{1989}	0.06***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)
N	1,380,233	1,380,233	1,380,233
Weighted Count	27,405,966	27,405,966	27,405,966
R^2	0.41	0.41	0.31

Note: Census of Population data on manufacturing workers age 25 to 60. All regressions include state, industry, and occupation fixed effects. *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 6. Industry-level regressions using data from the Annual Survey of Manufactures, the Census of Manufactures and Feenstra (1996).

Variable	$ImpPenChina_{jt}$		$ImpPen5\%exclChina_{jt}$		$ImpPenDiff\ 5\%$		$ImpPenAllexclChina_{jt}$		$ImpPenDiff\ All$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Time_t * I_{Year\ \geq 1980}$	- 0.000***	- 0.000**	0.000	0.000	-0.000**	-0.000**	-0.000***	-0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Time_t * ImpPenChina_{1979,\ j}$	0.128***	-	0.156***	-	- 0.028	-	1.038**	-	- 0.909**	-
	(0.037)		(0.025)		(0.030)		(0.464)		(0.476)	
$ImpPenChina_{1979,\ j} * I_{Year\ \geq 1980}$	- 7.801***	- 7.801***	- 3.747***	- 3.747***	- 4.054***	- 4.054***	12.085	12.084	- 19.886	- 19.886
	(0.894)	(0.928)	(1.051)	(1.091)	(0.864)	(0.896)	(11.981)	(12.433)	(12.434)	(12.902)
$Time_t * ImpPenChina_{1979,\ j} * I_{Year\ \geq 1980}$	0.377***	0.377***	0.170***	0.170***	0.208***	0.208***	- 0.650	- 0.650	1.028*	1.028*
	(0.040)	(0.042)	(0.040)	(0.042)	(0.037)	(0.038)	(0.592)	(0.614)	(0.610)	(0.633)
Industry-specific Time Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.57	0.85	0.82	0.95	0.70	0.90	0.90	0.97	0.90	0.97
N	6,870	6,870	6,870	6,870	6,870	6,870	6,870	6,870	6,870	6,870

Note: Robust standard errors clustered by industry are in parenthesis. *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 7. Industry-level regressions using data from the Annual Survey of Manufactures, the Census of Manufactures and Feenstra (1996).

Variable	$ln(w^{NP} NP / w^{P} P)_{jt}$		$ln(w^{NP} / w^{P})_{jt}$		$ln(NP/P)_{jt}$		$ln(I/K)_{jt}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Time_t * I_{Year \geq 1980}$	0.002***	0.002***	0.001***	0.001***	0.003***	0.003***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Time_t * ImpPenChina_{1979, j}$	-1.562*	-	- 1.602	-	0.040	-	- 0.483***	-
	(0.943)		(1.151)		(1.350)		(0.172)	
$ImpPenChina_{1979, j} * I_{Year \geq 1980}$	- 63.229**	- 65.486**	- 51.626	- 51.532	- 11.603	- 13.954	- 8.309	- 10.645*
	(26.776)	(29.413)	(32.417)	(33.432)	(31.056)	(33.425)	(5.401)	(5.818)
$Time_t * ImpPenChina_{1979, j} * I_{Year \geq 1980}$	2.885**	2.984***	2.352	2.337	0.532	0.647	0.385*	0.485*
	(1.144)	(1.260)	(1.474)	(1.521)	(1.459)	(1.557)	(0.234)	(1.253)
Industry Specific Time Trend	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.98	0.99	0.90	0.92	0.98	0.99	0.63	0.75
N	6,870	6,870	6,870	6,870	6,870	6,870	6,870	6,870

Note: All regressions are weighted by industry employment. Robust standard errors clustered by industry are in parenthesis.
*** Denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 8. Countries with less than 5 percent of US per capita GDP (in alphabetical order) based on averaged 1985-1990 United Nations data (non-PPP adjusted per capita GDP)

Afghanistan	Liberia
Albania	Madagascar
Angola	Malawi
Bangladesh	Maldive Islands
Benin	Mali
Bolivia	Mauritania
Burkina	Morocco
Burundi	Mozambique
Cambodia	Nepal
Cape Verde	Nicaragua
Central African Republic	Niger
Chad	Nigeria
China (Mainland)	Pakistan
Comoros	Papua New Guinea
Congo	Philippines
Djibouti	Rwanda
Dominican Republic	Sao Tome and Principe
El Salvador	Senegal
Equatorial Guinea	Sierra Leone
Gambia	Solomon Islands
Ghana	Somalia
Guatemala	Sri Lanka
Guinea	Sudan
Guinea-Bissau	Tanzania
Guyana	Togo
Haiti	Tuvalu Island
Honduras	Uganda
India	Vanuatu
Indonesia	Vietnam
Ivory Coast	Yemen Arab Republic
Kenya	Zambia
Kiribati	Zimbabwe
Laos	

FIGURES

Figure 1. Imports by partner groups.

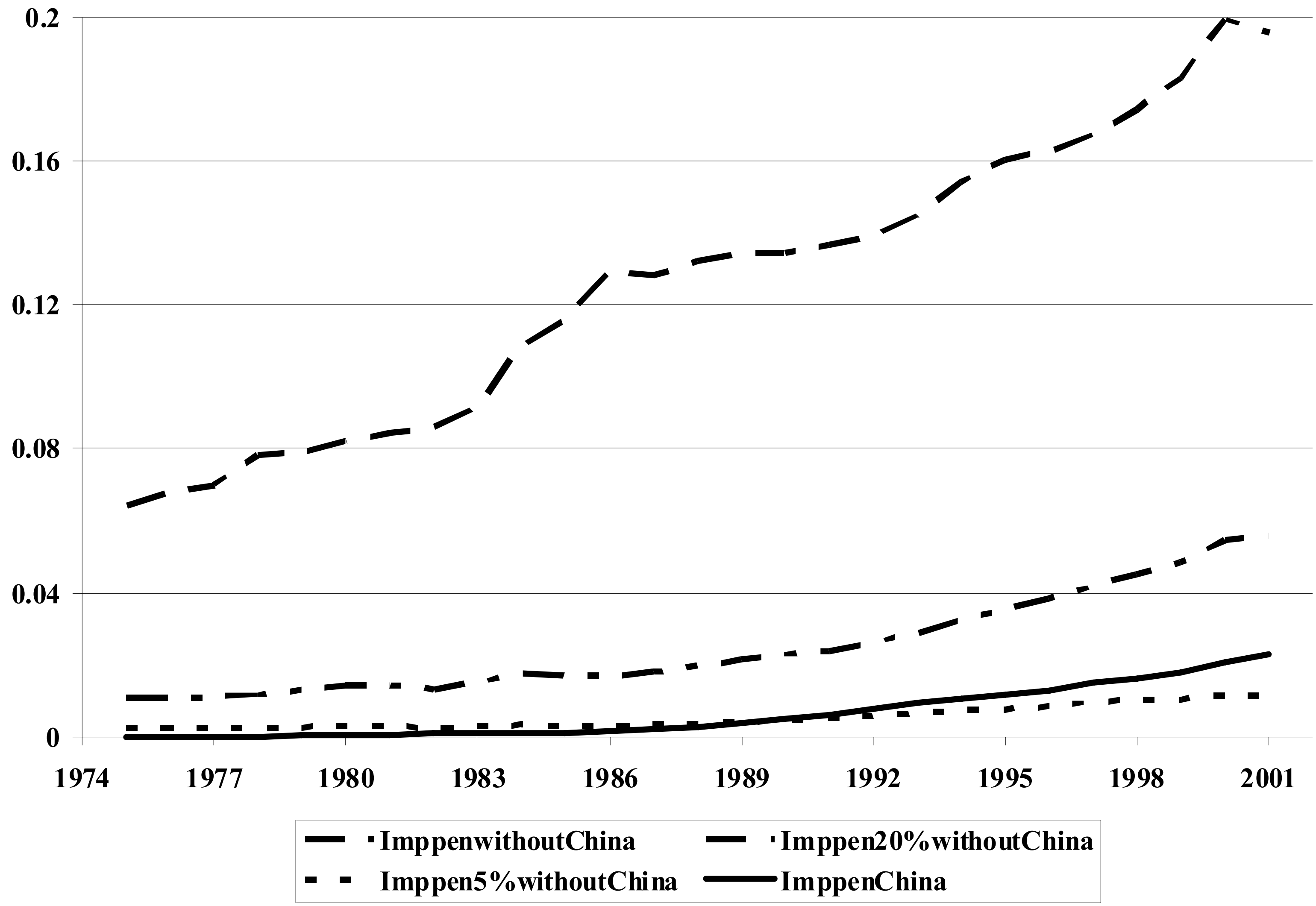

Figure 2. Imports by partner groups.

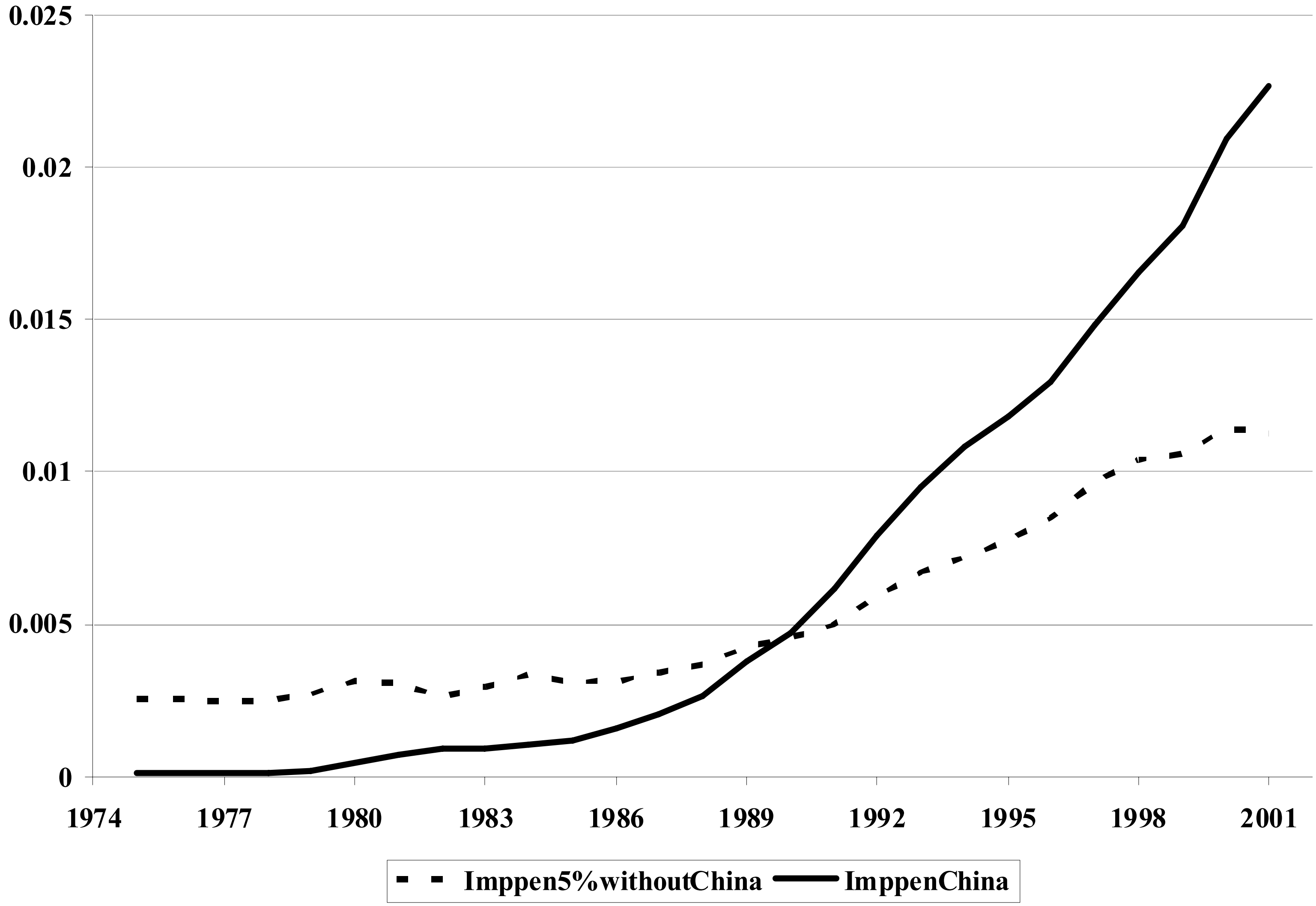

Figure 3. Change in industry import penetration from China vs. Pre-MFN level of industry import penetration from China.

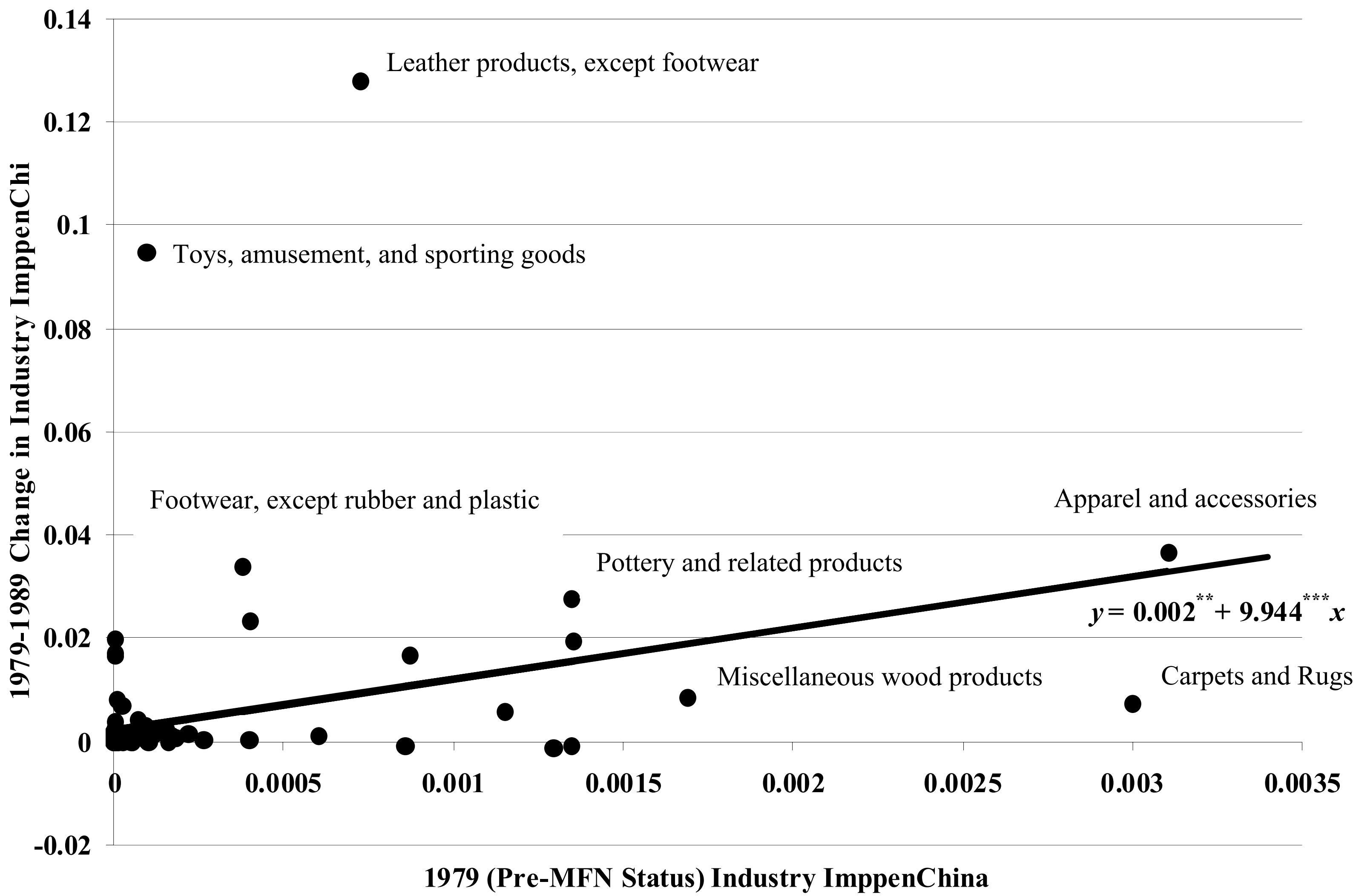

Figure 4. Change in the within-industry college premium vs. industry's pre-MFN import penetration from China.

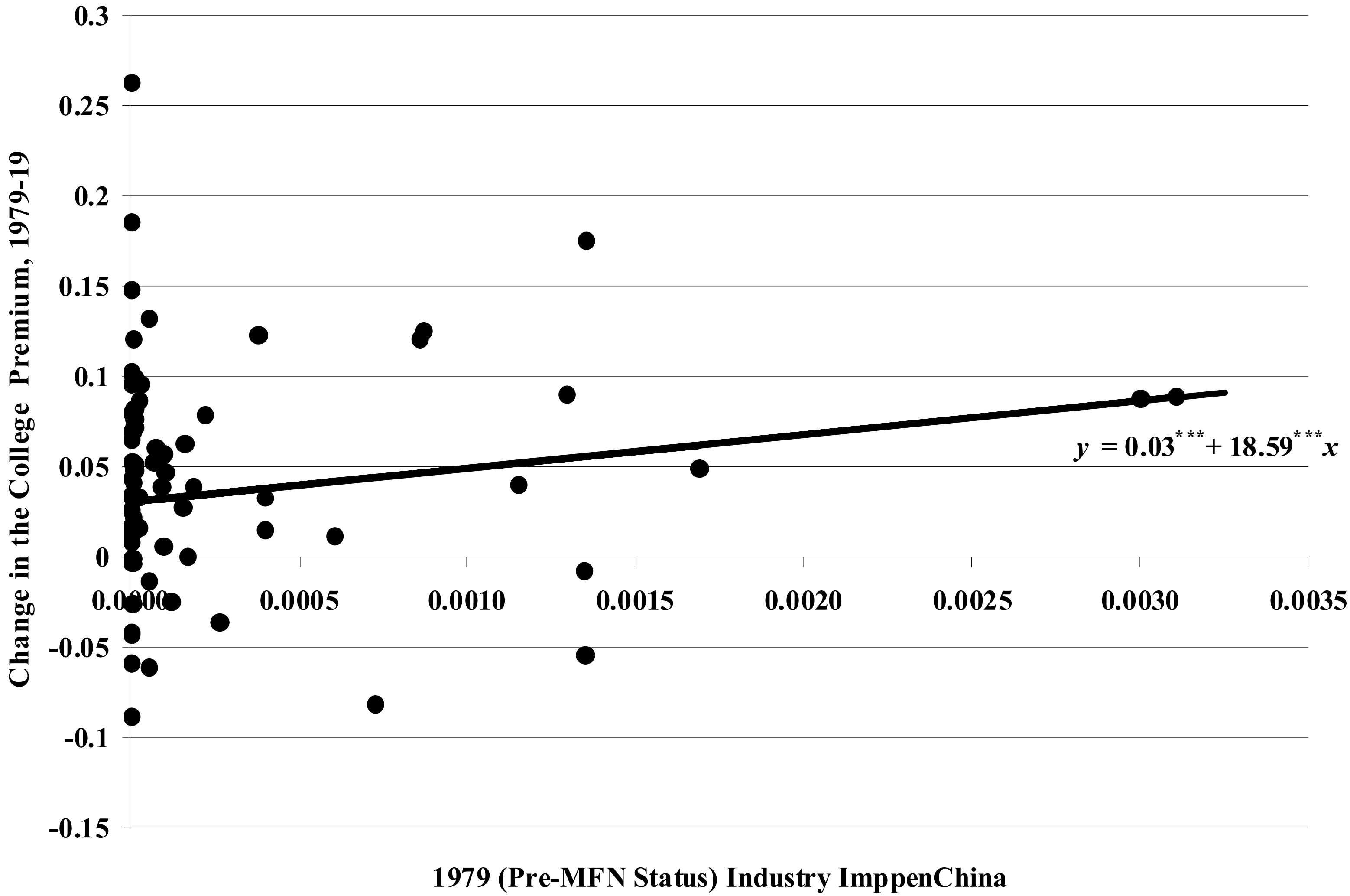

Figure 5. Change in the within-industry relative employment of college graduates vs. industry's pre-MFN import penetration from China.