

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

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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 Griliches (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 occurred 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).¹

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

¹ Feenstra and Hanson (1996) develop a model in which outsourcing increases the demand for skill in both North and South. Dinopoulos, Syropoulos, Xu (2008) have recently proposed a model in which increased intraindustry trade leads to a higher skill premium. Unlike evidence from the U.S. (Bernard and Jensen, 1999), Verhoogen (2008) and Kandilov (2008) show that exports have a positive impact on the relative high-skilled wages in Mexico and Chile, respectively. Amiti and Davis (2008) document that a decrease in output tariffs in Indonesia lowers wages in import-competing firms, but increases wages in exporting firms. Opposite to what Heckscher-Ohlin predicts, most empirical studies focusing on developing countries find that the wage inequality rises after trade liberalization (Hanson and Harrison, 1999; Goldberg and Pavcnik, 2007).

plus total imports net of total exports), the industry's skill (college) premium would increase about 3.5 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.² 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) 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 (both male and female) from 30 to 60 years of age with either high-school education only (low-skill), or college and higher (high-skill).

I supplement the individual-level Census data with industry information on manufacturing imports from China in 1979 and 1989. The Chinese imports data comes from Feenstra (1996).³ 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), as

² 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>).

³ These data are available at the Center for International Data at University of California, Davis (<http://cid.econ.ucdavis.edu>)

well as data on industry overall exports and imports also available in Feenstra (1996).⁴ 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 further employ 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 information on the relative wage and the relative employment of non-production workers, as well as industry investment in capital from 1974 to 1987.

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 67 manufacturing industries, ASM and CM feature a much higher number (367) 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 do with 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,

⁴ 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.

Bound, and Griliches 1994).

Finally, I also use data on U.S. tariffs from the U.S. International Trade Commission. Prior to 1980, China was subject to tariffs according to Column 2 of the U.S. tariff schedule. To compute industry tariffs for 1979, the year of the labor market data in the 1980 Census of Population, I take tariffs from 1978, as this is before China's MFN adoption in 1980.⁵ Most tariffs are ad valorem. For specific tariffs, I compute their ad valorem equivalent using products' unit values. To aggregate the product tariffs into industry tariff measures I use a product-industry concordance.⁶ Because multiple product tariffs are matched to a single industry, to calculate the industry tariffs, the product tariffs are weighted by their respective product import shares.⁷

Table 2 presents the summary statistics for the sample of workers used. The average industry tariffs for Chinese imports fell from 36.34 percent in 1979 to 4.96 in 1989. The dispersion of tariffs declined as well – from 15.90 in 1979 to 4.01 in 1989. It is evident that the drop in tariffs was quite large and varied across industries.

⁵ There was no Tariff Schedule for 1979 due to the Tokyo Round of Negotiations – there were only minor updates from the 1978 Schedule, which was used throughout 1979.

⁶ Data in the Census of Population is classified according to the CIC (Census Industry Classification) industry classification, while tariff data from the U.S. ITC is classified according to TSUSA/HTS product classification. TSUSA/HTS – SIC concordance is available in Feenstra (1996), and the Bureau of Labor Statistics provides an SIC-CIC concordance.

⁷ For each product that the U.S. has imported from China in 1979 and 1989, the two years with Census of Population data, I calculate the product weight as the average import share.

IV. Econometric specifications

IV.1 Industry-level trade regressions

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.⁸ China was first granted MFN status in 1980 and this extension required an annual review, which was routine until 1989.⁹ 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

⁸ 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.

⁹ 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.

“column 2” rates consider the following examples from 2006 U.S. Tariff Schedule:¹⁰

Product	Description	Unit or Quantity	Rates of duty	
			(1)	(2)
... 1008.20.00	Millet	kg.	0.32¢/kg	2.2 ¢/kg
... 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 substantially decline, 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, 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).¹¹ The impact was largest

¹⁰ This is a small random sample. Source: United State International Trade Commission (<http://www.usitc.gov/tata/hts/bychapter/index.htm>)

¹¹ Formally, import penetration from China in industry j is defined as

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

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 Table 1). 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 other low per-capita GDP countries combined.¹²

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. Industries that experienced larger tariff cuts, also witnessed a greater increase in Chinese imports. To formally document this relationship, I estimate the following regression equation:

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.

¹² Hanson and Robertson (2008) find that over 1995-2005 period, China’s export expansion was only a modest negative shock to other developing countries specialized in exporting manufacturing goods to the U.S.

$$\Delta ImpPenChina_{1989-1979,j} = \alpha_0 + \alpha_1 \Delta Tariffs_{1989-1979,j} + \varepsilon_j \quad (1),$$

where j indexes CIC (Census Industry Classification) manufacturing industries for which trade information is available, $j = 1, 2, \dots, 67$. The results are presented in column (1) of Table (3). The estimated coefficient of - 0.031 on $\Delta Tariffs_{1989-1979,j}$ implies that as tariffs decline by the sample average of 31 percentage points (31 percent of the product price/unit value, $\Delta Tariffs_{1989-1979,j} = - 0.31$), the import penetration from China would increase by about 0.01, i.e. by one percent of domestic consumption.

For a number of industries that had previously experienced some imports from China before the adoption of the MFN status, the policy was most effective. This is 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 about 0.1 percent to about 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.

To investigate 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, $ImpPenChina_{1979,j}$, I estimate the following regression:

$$\Delta ImpPenChina_{1989-1979,j} = \beta_0 + \beta_1 ImpPenChina_{1979,j} + \gamma_j \quad (2)$$

The results are presented in column (2) of Table 3. The estimate of β_1 (10.116) confirms that there is a positive and statistically significant relationship between the change and the initial (pre-MFN) level of import penetration from China. It implies that industries with some initial imports from China experienced a much larger increase in import penetration than industries that faced no initial import pressures.

Based on the findings in regression equations (1) and (2), one can devise instrumental variables strategies in order to estimate the impact of increased import pressures from China on the demand for skill within U.S. manufacturing industries. The idea is to use either the change in tariffs (going from non-MFN rates in 1979 to MFN rates in 1989), or the initial exposure to Chinese imports in 1979, as instruments for the changes in import penetration from China from 1979 to 1989.¹³ Before I detail the rest of the econometric strategy that deals with the impact of import penetration on labor market outcomes, I estimate the following hybrid equation that combines both potential instruments and estimates their impact on the change in imports from China:

$$\begin{aligned} \Delta ImpPenChina_{1989-1979,j} = & \delta_0 + \delta_1 \Delta Tariffs_{1989-1979,j} + \delta_2 ImpPenChina_{1979,j} + \\ & + \delta_3 \Delta Tariffs_{1989-1979,j} * ImpPenChina_{1979,j} + \omega_j \end{aligned} \quad (3)$$

¹³ Bloom, Draca, and Van Reenen (2008) use the second IV strategy to identify the effect of changing imports from China on European firms' technology and employment.

The results, which are presented in column (3) of Table 3, are just as expected. The larger the tariff cuts, the greater the increase in import penetration; the larger the initial level of Chinese imports, the greater the increase in import penetration. Finally, the estimate of δ_3 implies that for industries with higher initial imports from China, the impact of the tariff cuts was even larger.

IV.2 Individual-level wage regressions with the Census of Population Data

The large and uneven impact of China's MFN status on import penetration across U.S. manufacturing industries lies at the heart 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 specification can be written as:

$$\begin{aligned} \ln(w_{ijt}) = & \psi_j + \tau_{1989} + \gamma_0 \text{College}_{ijt} + \gamma_1 \text{College}_{ijt} * \tau_{1989} + \gamma_2 \Delta \text{Tariffs}_{1989-1979,j} * \text{College}_{ijt} + \\ & + \gamma_3 \Delta \text{Tariffs}_{1989-1979,j} * \tau_{1989} + \gamma_4 \Delta \text{Tariffs}_{1989-1979,j} * \text{College}_{ijt} * \tau_{1989} + \mathbf{X}_{ijt} \boldsymbol{\gamma}_5 + u_{ijt} \end{aligned} \quad (4)$$

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 change (drop) in tariffs from 1979 (non-MFN level) to 1989 (MFN level), $\Delta \text{Tariffs}_{1989-1979,j}$.

This strategy is warranted in light of the earlier evidence from equation (1) that a manufacturing industry with a larger cut in tariffs for Chinese merchandise faced a much higher increase in import penetration from China after the MFN policy was implemented. The coefficient of interest is γ_4 – it estimates the impact of the change (decrease) in tariffs on the skill (college) premium after the MFN status was implemented. A negative estimate of γ_4 would imply that industries with larger decrease in tariffs would experience a higher increase in the skill premium.

Because I employ a rich individual-level data set from the Census of Population, I am able to control for a large set of personal characteristics in the vector \mathbf{X}_{ijt} – those include 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. For statistical inference, I calculate robust standard errors clustered by industry because the variable of interest, $\Delta Tariffs_{1989-1979,j}$, varies by industry and not by individual.

I focus on the reduced form equation (4) (using the instrument, $\Delta Tariffs_{1989-1979,j}$, as the regressor) as the baseline specification instead of the two-stage IV procedure (with $\Delta ImpPenChina_{1989-1979,j}$ as the endogenous regressor) because reduced tariffs may affect the wage structure directly without affecting actual import penetration. For example, as Freeman (1995) points out, just the threat of foreign competition should be enough to move (relative) wages in the U.S. Further, the exclusion restriction in the two-stage IV procedure may not necessarily be satisfied also because reduced tariffs and thereby increased competition may

affect the within industry wage premium directly as a result of the relationship between import competition and the sensitivity of profits to cost reduction (see Guadalupe, 2007).

In essence, econometric specification (4) 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 decline in tariffs for Chinese imports. Additionally, one can similarly estimate the following equation (5), which employs the initial (pre-MFN in 1979) level of Chinese imports to proxy for rise in import penetration from China in the 1979-1989 period.

$$\begin{aligned} \ln(w_{ijt}) = & \psi_j + \tau_{1989} + \kappa_0 \text{College}_{ijt} + \kappa_1 \text{College}_{ijt} * \tau_{1989} + \kappa_2 \text{ImpPenChina}_{1979,j} * \text{College}_{ijt} + \\ & + \kappa_3 \text{ImpPenChina}_{1979,j} * \tau_{1989} + \kappa_4 \text{ImpPenChina}_{1979,j} * \text{College}_{ijt} * \tau_{1989} + \mathbf{X}\kappa_5 + \nu_{ijt} \end{aligned} \quad (5)$$

This specification is justified in light of the evidence from equation (2), which confirmed that there is a positive and statistically significant relationship between the change and the initial (pre-MFN) level of import penetration from China. In this case, a positive estimate of κ_4 would imply that industries with greater initial imports from China, and hence a larger increase in import penetration over 1979-1989, would experience a larger increase in the skill premium.

To estimate the impact of falling tariffs on the relative quantity of skilled labor, I additionally estimate the following industry-level regression with data from the Census of Population:

$$\Delta \ln(C/HS)_{1989-1979,j} = \mu_0 + \mu_1 \Delta \text{Tariffs}_{1989-1979,j} + \zeta_j \quad (6),$$

where $\Delta \ln(C/HS)_{1989-1979,j}$ is the change in the relative employment of college educated workers in industry j over the 1979-1989 period. If lower tariffs for Chinese imports increase within industry demand for skilled workers and labor is sufficiently mobile, one would expect that $\mu_1 \geq 0$.

V. Results with the Census of Population Data

I start by presenting the results from the baseline specification (4). The estimated coefficients are reported in column (1) of Table 4. As expected the coefficient on $\Delta Tariffs_{1989-1979,j} * College_{ijt} * \tau_{1989}$ is estimated to be negative at - 0.11 and is statistically significant. It implies that the skill premium rose higher in industries that experienced larger tariff cuts after China's MFN status was adopted. The estimate suggests that if industry's tariff for Chinese imports drops by 31 percentage points ($\Delta Tariffs_{1989-1979,j} = - 0.31$), which is the sample average, the industry's college premium would increase by 0.034, or 3.4 percent.

In column (2) of Table 4, I present the results from equation (5), which uses the initial level of imports from China in 1979, the year before the MFN status was enacted, to proxy for the increase in import penetration from China during the 1979-1989 period. The estimates again are as expected – the coefficient on $ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$ is positive and statistically significant suggesting that the college premium was greater after the MFN status was implemented in industries with higher initial imports from China. The estimates imply that if industry's initial import penetration from China is higher by 0.0014, which equals to 2 sample standard deviations, then the industry's college premium would be 0.024, or 2.4 percent, greater once the MFN status is adopted. Note that the impacts of higher imports from China are

estimated to be quite similar using either the change (decrease) in tariffs ($\Delta Tariffs_{1989-1979,j}$) or the initial level of imports ($ImpPenChina_{1979,j}$) as a proxy for increased import penetration from China.

Column (3) of Table 4 present the results of specification (4) using the actual changes in import penetration from China, $\Delta ImpPenChina_{1989-1979,j}$, as a measure of import pressures. While the actual changes in import penetration can be endogenous and therefore lead to biased estimates, it is still instructive to compare these results to the estimates from specifications (4) and (5) in columns (1) and (2) of Table 4. The coefficient on $\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$ is estimated at 0.90, and it is not statistically significant. It implies that if industry imports from China rise by 0.0048 ($\Delta ImpPenChina_{1989-1979,j} = 0.0048$, the sample average), the industry's skill premium would increase by 0.004, or 0.4 percent. While this estimate is positive, it is considerably smaller than the estimate obtained using $\Delta Tariffs_{1989-1979,j}$ or $ImpPenChina_{1979,j}$ in place of the actual change in import penetration, $\Delta ImpPenChina_{1989-1979,j}$.

Although the change in tariffs (and the initial imports) may have a direct impact on the wage structure even without affecting actual imports, it is still informative to implement the two IV strategies outlined above and compare the estimated effects of higher import penetration on the relative wage. To this end, I use $\Delta Tariffs_{1989-1979,j} * \tau_{1989}$, $\Delta Tariffs_{1989-1979,j} * College_{ijt}$, and $\Delta Tariffs_{1989-1979,j} * College_{ijt} * \tau_{1989}$ as instruments for the endogenous regressors $\Delta ImpPenChina_{1989-1979,j} * \tau_{1989}$, $\Delta ImpPenChina_{1989-1979,j} * College_{ijt}$, and $\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$. The final estimates from the two-stage IV procedure are reported in column (1) of Table 5. The results imply an elasticity of the college premium

with respect to import penetration from China of 3.52. This estimate is more than 3 times larger than the elasticity of 0.90 in column (3) of Table 4, obtained using the endogenous regressors.¹⁴

The second IV strategy involves employing $ImpPenChina_{1979,j} * \tau_{1989}$, $ImpPenChina_{1979,j} * College_{ijt}$, and $ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$ as instruments for the aforementioned endogenous regressors. The results from this IV setup are presented in column (2) of Table 5. The implied elasticity this time is 1.58, about half of the size of the elasticity in column (1) of Table 5, and about 50 percent larger than the elasticity estimate of 0.90 obtained with the endogenous regressors.

The results from the last IV set-up I present in column (3) of Table 5 involve using both the changes in tariffs (along with the necessary interactions) and the initial import penetration (along with the necessary interactions) to instrument for the endogenous regressors. As expected the estimate of the elasticity of the college premium with respect to import penetration from China is lower than 3.52, but higher than 1.58. At 2.21, the estimate is statistically significant and it implies that if industry's import penetration from China rises by 0.0048 ($\Delta ImpPenChina_{1989-1979,j} = 0.0048$, the sample average), the industry's college premium would increase by 0.011, or 1.1 percent.

I next investigate the impact of increased import competition from China on industry's relative employment of college graduates. The results from equation (6) are presented in column (1) of Table 6. The estimates, which are close to zero and are not statistically significant, indicate that lower tariffs, and therefore higher imports from China, did not change the industry's

¹⁴ The estimate is also about 6 times larger than the estimate of 0.6 implied in Borjas, Freeman and Katz' (1997) factor content analysis.

relative employment of college educated workers. Re-estimating equation (6) with $ImpPenChina_{1979,j}$ and $\Delta ImpPenChina_{1989-1979,j}$ in place of $\Delta Tariffs_{1989-1979,j}$ offers the same conclusion – all of these specifications imply that increased import penetration from China induced no change in the relative employment of college educated workers.

The relative wage and employment results above support the conclusion that the greater demand for skill as a result of falling tariffs for Chinese merchandise increased the skill premium in U.S. manufacturing industries and did not change the relative employment of college educated workers. Such an outcome implies that there are labor market frictions which prevent (skilled or unskilled) workers from freely moving between industries in response to higher rents. This is interesting, given that the time period of this study is about 10 years, which can be considered medium (to long) run time frame. The results are in line with previous work by Neal (1995) and Kandilov (2007) who provide evidence of imperfect worker mobility in the U.S. (due to industry-specific human capital and training);¹⁵ they are also consistent with Campa and Goldberg (2001) who show that both wages and employment are affected by international trade (exchange rates) in the medium to long run. The findings here are, however, different from Revenga (1992), who documents that import competition affects employment more than it affects wages. The estimated impact on the skill premium is further similar to the results found in Guadalupe (2007) and Falvey, Greenaway, and Silva (2008). In what follows, I present further evidence on the impact of increased imports from China on the demand for skill in the U.S. manufacturing.

¹⁵ Artuç, Chaudhuri, and McLaren (2008) also show that it takes at least eight years for an economy that experienced a large trade shock to move to a new equilibrium.

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 14 years, before and after China's MFN was adopted, containing information on the manufacturing industries' demand for skill as proxied by the relative wage, and the relative employment of non-production workers. Heckscher-Ohlin specialization within products implies that larger (threat of) 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 (time) trend in the demand for skill in industries which experienced a higher (threat of) import penetration from China. As before, I identify such industries by the decrease in tariffs for Chinese merchandise following the MFN status adoption. More formally, the identification strategy can be written as:

$$\begin{aligned} \log(w^{NP}/w^P)_{jt} = & \eta_1 Time_t * I_{Year \geq 1980} + \eta_2 Time_t * \Delta Tariffs_{1989-1979, j} + \eta_3 \Delta Tariffs_{1989-1979, j} * I_{Year \geq 1980} + \\ & + \eta_4 Time_t * \Delta Tariffs_{1989-1979, j} * I_{Year \geq 1980} + \lambda_j + \gamma_t + \xi_{jt}, \end{aligned} \quad (7)$$

where $\log(w^{NP}/w^P)_{jt}$ is the logarithm of the wage of non-production workers relative to that of production workers in industry j in year t ; $Time_t$ is a time trend; $I_{Year \geq 1980}$ is a indicator variable that is equal to unity for 1980 and thereafter; as before, $\Delta Tariffs_{1989-1979, j}$ is the change (decline) in tariffs for Chinese merchandise as a results of the MFN status adoption; λ_j and γ_t are

industry and year fixed effects, and finally, ξ_{jt} is a random error term.¹⁶ To estimate the impact of falling tariffs on the relative quantity of skilled labor, I additionally use the relative employment of non-production, $\log(NP/P)_{jt}$ workers as dependent variable in (7).

Furthermore, to test the hypothesis that within-industry specialization has occurred due to increased import pressures from China after 1980, I use ASM and CM industry data on investment. As China's MFN status is adopted, higher (threat of) 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, $\log(I/Q)_{jt}$) as a dependent variable.

VI.2 Industry-level Results

The results from estimating equation (7) are presented in Table 7. The first two columns report the results from equation (7) using annual import penetration from China, $ImpPenChina_{jt}$ as a dependent variable. The estimates in column (1) imply that industries with larger drop in tariffs for Chinese merchandise also experienced higher growth (trend) in import penetration after 1980 when the MFN status was adopted (the estimate of η_4 is negative at - 0.0004). In column (2), I add industry-specific time trends to specification (7) – the results do not change much. The

¹⁶ Note that the industry classification (SIC, Standard Industrial Classification) (and the number of industries with available trade information, 367) using the CM and ASM data is different from the industry classification using the Census of Population.

magnitude of the estimate of η_4 implies that if industry's tariffs for Chinese products fell by 0.31, or 31 percentage points ($\Delta Tariffs_{1989-1979, j} = -0.31$), the industry would experience 0.002 or 0.2 percentage points increase in the annual growth in import penetration from China after 1980.

I next present evidence that after 1980, there was a faster growth in the demand for skill in industries with larger tariff cuts for Chinese merchandise. To this end, I estimate regression equation (7) using the logarithm of the relative wage, and the relative employment of non-production workers as dependent variables. The results are presented in columns (3), (4), (5), and (6) of Table 7. The estimates in columns (3) imply that the relative wage of non-production workers in industries with larger tariff cuts experienced a higher growth after 1980. The magnitude of the estimate suggests that if industry's tariffs for Chinese products fell by 0.31, or 31 percentage points ($\Delta Tariffs_{1989-1979, j} = -0.31$), the industry experienced 0.002 percent increase in the annual growth of the relative wage after 1980. This would imply that the increase in skill premium would be 0.02 in about 10 years – very close to the estimate obtained with the decennial Census of Population data.

Columns (5) and (6) of Table 7 present the relative employment results. While the estimates imply that lower tariffs depress the relative employment level of non-production workers, they are quite imprecisely estimated. Consistent with estimates from the Census of Population, the results here imply 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 drop in tariffs after 1980, the 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).

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. Hence, one would further expect that manufacturing industries with larger decline in tariffs should experience a rise in capital accumulation, i.e. investment, after 1980. To test this hypothesis, I re-estimate equation (7) with the logarithm of investment as a fraction of total capital stock, $\log(I/Q)_{jt}$, as a dependent variable. As expected, the results, shown in the last two columns of Tables 7, indicate that industries with greater decline in tariffs 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 36.34 percent in 1979 to 4.96 in 1989 – and the decline varied widely across industries. 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.

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 larger cut in tariffs for Chinese imports, i.e. higher import competition shock, due to the MFN adoption also experienced a greater increase in the college premium. My

estimates imply that the college premium in U.S. manufacturing rose about 3.4 percent as a result of the 31 percentage points drop in tariffs for Chinese imports following the adoption of the MFN status. The instrumental variables estimate, using the change in tariffs as an instrument for the change in industry imports from 1979 to 1989, yields an elasticity of the college premium with respect to import penetration from China of 3.52. This estimate is, for example, about 6 times larger than the magnitude implied by Borjas, Freeman, and Katz' (1997) factor content analysis. The decrease in tariffs appears to have almost no impact on the relative employment of college workers.

Further, I use annual industry-level data from the Annual Survey of Manufactures and the Census of Manufactures to provide evidence that the relative wage of non-production workers in industries with larger tariff cuts experienced a higher annual growth after 1980, the year the MFN status was adopted. Additionally, industries with greater drop in tariffs also experienced 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

	Import Penetration from all countries (excluding China)	Average Annual Growth Rate		
		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

	<u>All</u>		<u>1979</u>		<u>1989</u>	
	<u>Mean</u>	<u>St. Dev.</u>	<u>Mean</u>	<u>St. Dev.</u>	<u>Mean</u>	<u>St. Dev.</u>
Wage (constant 1983 \$)	27,247.31	17,995.46	27,374.86	15,840.08	27,124.26	19,853.53
- College Graduate	41,208.41	24,022.14	40,360.15	20,055.71	42,077.55	27,159.59
- High School Graduate	22,213.62	11,701.36	23,274.84	11,536.04	21,119.00	11,769.63
log Wage	10.03	0.63	10.05	0.63	10.02	0.62
- College Graduate	10.47	0.59	10.47	0.58	10.48	0.60
- High School Graduate	9.87	0.56	9.92	0.59	9.82	0.52
College	0.27	0.44	0.24	0.42	0.29	0.45
Age	42.34	8.59	42.53	8.79	42.09	8.36
Female	0.28	0.45	0.27	0.44	0.30	0.46
Black	0.08	0.27	0.07	0.27	0.09	0.29
Married	0.78	0.42	0.81	0.39	0.75	0.43
Metropolitan	0.68	0.47	0.70	0.46	0.66	0.47
τ_{1989}	0.51	0.50	0	0	1	0
<i>Tariff</i>	0.21	0.20	0.36	0.16	0.05	0.04
$\Delta Tariffs_{1989-1979,j}$	- 0.31	0.14	- 0.31	0.14	- 0.31	0.14
$\Delta ImpPenChina_{1989-1979,j}$	0.0048	0.0122	0.0049	0.0122	0.0048	0.0123
$ImpPenChina_{1979,j}$	0.0002	0.0007	0.0002	0.0006	0.0002	0.0007
Count	571,411		277,189		294,222	
Weighted Count	11,290,211		5,543,780		5,746,431	

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	$\Delta ImpPenChina_{1989-1979,j}$		
	(1)	(2)	(3)
$\Delta Tariffs_{1989-1979,j}$	- 0.031** (0.015)	-	- 0.014 (0.009)
$ImpPenChina_{1979,j}$	-	10.116*** (1.164)	1.769 (6.914)
$\Delta Tariffs_{1989-1979,j} * ImpPenChina_{1979,j}$	-	-	- 14.251 (12.632)
Constant	- 0.005 (0.004)	0.002** (0.001)	- 0.001 (0.002)
R^2	0.12	0.30	0.33
F(1, 67)	4.06	75.57	223.88
N	67	67	67

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

Table 4. Reduced-form individual-level regressions using the 1980 and 1990 Census of Population data.

Variable	$\log(w_{ijt})$		
	(1)	(2)	(3)
$\Delta Tariffs_{1989-1979,j} * \tau_{1989}$	- 0.02 (0.07)	-	-
$\Delta Tariffs_{1989-1979,j} * College_{ijt}$	- 0.19** (0.08)	-	-
$\Delta Tariffs_{1989-1979,j} * College_{ijt} * \tau_{1989}$	- 0.11** (0.05)	-	-
$ImpPenChina_{1979,j} * \tau_{1989}$	-	- 14.12*** (4.61)	-
$ImpPenChina_{1979,j} * College_{ijt}$	-	71.54*** (10.98)	-
$ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$	-	17.38** (7.44)	-
$\Delta ImpPenChina_{1989-1979,j} * \tau_{1989}$	-	-	- 0.52 (0.39)
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt}$	-	-	2.48*** (1.03)
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$	-	-	0.90 (0.64)
N	570,595	570,595	570,595
Weighted Count	11,281,191	11,281,191	11,281,191
R^2	0.45	0.45	0.45

Note: Census of Population data on manufacturing workers age 25 to 60. All regressions include a vector of personal covariates, state, industry, and occupation fixed effects. Robust standard errors clustered by industry are in parenthesis. *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 5. Instrumental variables individual-level regressions using the 1980 and 1990 Census of Population data.

Variable (Instruments)	$\log(w_{ijt})$		
	(1)	(2)	(3)
$\Delta ImpPenChina_{1989-1979,j} * \tau_{1989}$ ($\Delta Tariffs_{1989-1979,j} * \tau_{1989}$)	0.95 (2.56)	-	-
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt}$ ($\Delta Tariffs_{1989-1979,j} * College_{ijt}$)	6.96 ^{***} (2.56)	-	-
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$ ($\Delta Tariffs_{1989-1979,j} * College_{ijt} * \tau_{1989}$)	3.52 (2.41)	-	-
$\Delta ImpPenChina_{1989-1979,j} * \tau_{1989}$ ($ImpPenChina_{1979,j} * \tau_{1989}$)	-	- 1.40 ^{***} (0.41)	-
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt}$ ($ImpPenChina_{1979,j} * College_{ijt}$)	-	7.38 ^{***} (1.21)	-
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$ ($ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$)	-	1.58 ^{**} (0.69)	-
$\Delta ImpPenChina_{1989-1979,j} * \tau_{1989}$ ($\Delta Tariffs_{1989-1979,j} * \tau_{1989}$ and $ImpPenChina_{1979,j} * \tau_{1989}$)	-	-	- 0.99 (0.71)
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt}$ ($\Delta Tariffs_{1989-1979,j} * College_{ijt}$ and $ImpPenChina_{1979,j} * College_{ijt}$)	-	-	7.20 ^{***} (1.12)
$\Delta ImpPenChina_{1989-1979,j} * College_{ijt} * \tau_{1989}$ ($\Delta Tariffs_{1989-1979,j} * College_{ijt} * \tau_{1989}$ and $ImpPenChina_{1979,j} * College_{ijt} * \tau_{1989}$)	-	-	2.21 ^{***} (0.74)
N	570,595	570,595	570,595
Weighted Count	11,281,191	11,281,191	11,281,191
R^2	0.45	0.45	0.45

Note: Census of Population data on manufacturing workers age 25 to 60. All regressions include a vector of personal covariates, state, industry, and occupation fixed effects. Robust standard errors clustered by industry are in parenthesis. *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 6. Industry-level regressions with 1980 and 1990 Census of Population Data.

Variable	$\Delta \log(C/HS)_{1989-1979,j}$		
	(1)	(2)	(3)
$\Delta Tariffs_{1989-1979,j}$	0.04 (0.15)	-	-
$ImpPenChina_{1979,j}$	-	- 88.54 (53.69)	-
$\Delta ImpPenChina_{1989-1979,j}$	-	-	- 0.07 (2.09)
Constant	0.22*** (0.06)	0.23*** (0.04)	0.21*** (0.04)
R^2	0.01	0.06	0.01
F(1, 67)	0.06	2.72	0.01
N	67	67	67

Note: All regressions are weighted by industry employment. *** Denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

Table 7. Industry-level regressions using the Annual Survey of Manufactures and the Census of Manufactures data.

Variable	$ImpPenChina_{jt}$		$\log(w^{NP}/w^P)_{jt}$		$\log(NP/P)_{jt}$		$\log(I/Q)_{jt}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Time_t * I_{Year \geq 1980}$	0.0003 (0.0003)	0.0003 (0.0003)	- 0.0833*** (0.0295)	- 0.0838*** (0.0309)	0.2384*** (0.0599)	0.2398*** (0.0620)	0.0216*** (0.0069)	0.0227*** (0.0073)
$Time_t * \Delta Tariffs_{1989-1979,j}$	- 0.0001 (0.0001)	-	0.0064*** (0.0021)	-	- 0.0065 (0.0058)	-	0.0011** (0.0005)	-
$\Delta Tariffs_{1989-1979,j} * I_{Year \geq 1980}$	0.0078 (0.0054)	0.0075 (0.0057)	0.1321* (0.0737)	0.1269 (0.0791)	- 0.1827 (0.1771)	- 0.1669 (0.1973)	0.0190** (0.0088)	0.0216** (0.0095)
$Time_t * \Delta Tariffs_{1989-1979,j} * I_{Year \geq 1980}$	- 0.0004* (0.0003)	- 0.0004* (0.0003)	- 0.0068** (0.0034)	- 0.0065* (0.0037)	0.0080 (0.0080)	0.0073 (0.0089)	- 0.0009** (0.0004)	- 0.0010** (0.0004)
Industry Specific Time Trend	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.48	0.87	0.91	0.93	0.98	0.99	0.77	0.84
N	5,138	5,138	5,138	5,138	5,138	5,138	5,138	5,138

Note: Data from 1974 to 1987. All regressions are weighted by industry employment and include industry and year dummies. Robust standard errors clustered by industry are in parenthesis. All coefficients are scaled up by 100. *** Denotes significance at 1 percent, ** at 5 percent, and * at 10 percent.

FIGURES

Figure 1. Imports by partner groups.

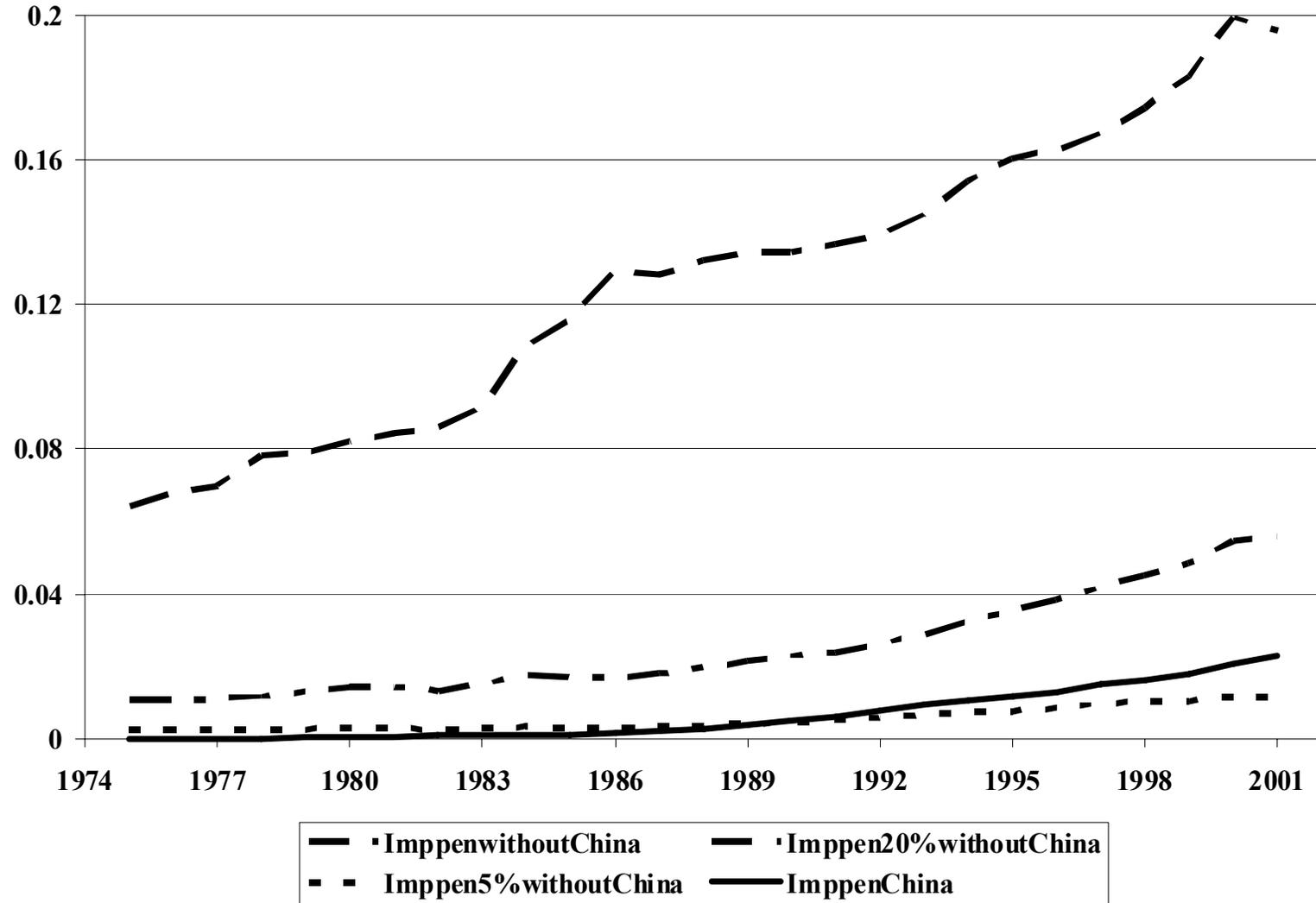


Figure 2. Imports by partner groups.

