1 Introduction

Motivated by the fact that current trends of energy use in US manufacturing are not consistent with predictions of traditional trade theory based on factor endowments, I examine the relationship

Conceptually, the energy tax is an useful proxy for domestic environmental policies that result in higher energy costs. Using this model I show that the effects of increasing imports from the South can be decomposed into two parts: a change in output caused by comparative advantage (positive effect) and changes in factor substitution caused by factor price equalization and an energy tax (negative effect). Without an energy tax, the output effect dominates and total energy use in the North increases due to trade with the South. However, this model predicts that the energy tax magnifies the negative effect on energy use caused by factor substitution between and within the US manufacturing industries. Therefore, even though the output effect is still positive in energy-intensive industries, the overall effect of increasing imports from China can be negative. Specifically, energy-intensive industries reduce energy use more than other sectors in response to the energy tax. On the other hand, increased output and welfare caused by trade are consistent even with energy tax. I test the model's predictions using a computable general equilibrium (CGE) approach calibrated to the US input-output table for the base year 2005 and simulate several scenarios related to increased imports from China and the energy tax. My simulation results are consistent with the predictions of the model. I find that the effect of trade with China is a small increase in energy use in the US manufacturing sector. On the other hand, the effect of an energy

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cause of air pollutants, namely national and international energy use. Based on the theoretical model of Antweiler et al. (2001), he empirically shows that trade liberalization is likely to increase per capita energy use for the mean country within the sample. His results also indicate that regulations and technological improvements are not keeping pace with the growth of GNP.

An extensive literature documents the effect of import penetration from low-wage countries on labor market outcomes, in particular employment and wages. These studies consistently find that increasing import penetration reduces employment and real wages [Revenga (1992), Hine and Wright (1998)]. Hine and Wright (1998) examine the relationship between trade with low wage economies and UK manufacturing. Their results suggest job loss and lower real wages as a result of increasing imports. Bernard et al. (2006) investigate the relationship between imports from low-wage countries and the reallocation of the US manufacturing sector within and across industries at the plant level. They find that plant survival and growth are negatively associated with industry exposure to imports from low-wage countries. Since energy is also an important input to manufacturing, it is surprising that the relationship between imports and energy use is rarely examined.

Unlike Cole (2006), this paper focuses on the effect of increasing imports from China on the US manufacturing sector, rather than the effect of general trade liberalization on national energy use. In addition, I investigate how policies to reduce national energy use may offset the effect of trade. Finally, I decompose the trade effect into two effects: a factor substitution effect and an output scale effect resulting from trade with China.

The rest of this paper is organized as follows. In Section 2, I describe the theoretical framework using a modified H-O model with energy tax. Section 3 calibrates the model using the US input-output table for the base year 2005. In Section 4, using US manufacturing panel data, I decompose the

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2.1 Description

There are two countries: the North and the South(*).

There are two production sectors: Manufacturing and Energy.

In the manufacturing sector, there are n industries. Manufacturing goods are produced by are perfectly transformable for producers. Therefore,

$$Y_i = C_i^D + EX_i \tag{3}$$

2.3 Production: Energy sector

domestically produced goods and imported goods of the sector.

$$C_i = ARM(C_i^D; C_i^M) = [\ {}_i C_i^D \ + (1 \quad {}_i) C_i^M \ ]^{\frac{1}{\ }} \tag{9}$$

The elasticity of substitution is $\ = \frac{1}{1\ }$. The domestically produced goods and imported goods can be derived as a function of total consumption of the sector.

$$C_i^D = \left(\frac{{}_i P_i^A}{P_i^d} \right)^{\frac{1}{1\ }} C_i$$

$$C_i^M = \left(\frac{(1 \quad {}_i) P_i^A}{(1+ \quad {}_i) P_i^m} \right)^{\frac{1}{1\ }}$$

components: the factor substitution effect and the output scale effect. The first term in equation (14) shows the substitution effect between factors caused by changing the factor-price ratio between energy and labor. According to the factor price equalization, imports from the South lower the relative wage in the North. Regardless of the characteristics of a sector such as factor intensity, a changed input-price ratio leads to an increased demand for labor and reduced use of energy. The second term in equation (14) shows the output scale effect caused by trade. Openness to the South will alter the output level of each sector in a manner that depends on the price ratio of domestic goods to imported goods. Total consumption of sector i is increased by the decreased price index of sector i, which causes the output level in sector i to increase. The output scale effect of energy demand dominates the factor substitution effect. Therefore, it causes that the

II and final consumption[5], FC_i^D. Utility is decided by aggregating all final consumption of outputs from all sectors. Additionally, consumers are also demanding the imported goods of each sector. Taxes are excluded in this part.

Figure 3(b) shows the structure of the production side in more detail. The output of sector i is produced by energy, intermediate inputs and composite factor. Labor (L_i), capital (K_i) and service intermediate inputs (SR_i) are aggregated into the composite factor. This composite factor is combined with intermediate inputs from other sectors (II_i) and energy (E_i) to produce the final output. There are two types of energy and intermediates inputs: domestic and imported.

3.1.2 The Functional Forms of CGE Model

To calibrate the model using the IO table, I construct all specific functional forms of each sector. Calibrated forms of the functions of each sector are shown below.

Production The production functions for all sectors are assumed to be CES with multiple levels of nesting. This application is typical in the representation of energy demand in production[6].

$$C_i = SR_i^{\alpha_{sr}} L_i^{\alpha_l} K_i^{\alpha_k} \qquad \text{where} \quad \alpha_{sr} + \alpha_l + \alpha_k = 1 \tag{15}$$

$$II_i = min[II_{ji}] \tag{16}$$

At the first level, primary factors such as labor (L) and capital (K), and other service sectors (SR) are used for the composite factor (C) in the Cobb-Douglas form with the constant returns to scale[7]. All intermediate inputs to a sector i from a sector j are aggregated in Leontief form by assumption. This form does not allow substitution between intermediate inputs, but significantly reduces the complexity of the model[8]. The composite factor and intermediate inputs (II) are combined in the constant elasticity substitution (CES) form.

[5] In the original IO table, the final consumption is also divided into private consumption, government consumption and investment. However, in this model, I assume that the consumer demand all these types of consumption, so I do not introduce the government and investment. Therefore, the consumer also collects all tax revenue later.

[6] There are many studies using the nested production function in energy demand. See Manne and Richels (1990).

[7] That is, $a_{sr} + a_l + a_k = 1$.

[8] Hosoe et al. (2010).

$Y_i = A_i \quad E_i$

These Armington elasticities for energy and intermediate inputs are equally assumed as 0.2 for the calibration, but this is changed in sensitivity analysis later. The final consumption of a sector *i* is also an Armington composition of domestic and imported goods.

$$FC_i = \quad {}_i \; \frac{FC_i^D}{FC_i^D} \quad + (1 \quad {}_i) \; \frac{FC_i^M}{FC_i^M} \qquad ^{\frac{1}{}} \tag{21}$$

Again, I fix the elasticity of substitution between domestically produced and imported final consumption to be 0.2.

Output of each sector is assumed to transform into domestic use and export with constant elasticity of transformation (CET). The elasticity of transformation is $= \frac{1}{1+}$.

$$Y_i = \quad {}_i DU_i^{\;i} + (1 \quad {}_i) EX_i^{\;i} \qquad ^{\frac{1}{}}$$

I assume that the domestic use and export are perfectly substitutable each other, so I can rewrite the CET function above as a linear function.

$$Y_i = DU_i + EX_i \tag{22}$$

3.1.3 Calibration of the CGE Model

The parameters in the functions are decided by the reference quantity from the IO table. In fact, all reported information from the IO table is values of price quantity. However, by setting all the prices at unity, then values in the IO table can be considered as quantity figures. Through the calibration, we can get the parameters in the CGE model. These parameters are fixed after the calibration. All parameters decided by the calibration are listed in Table 2. In equations (17) to (21), the parameters with a bar in the functional forms refer to the initial values from the data. Now, I can obtain the changed value of prices and quantity caused by simulations of changes in the exogenous variables using the specified functions.

For simplicity, I assume that this economy is small enough that it does not have a significant impact on the rest of the world. The point of the small economy assumption is that the export and import prices are exogenously given for this economy. To isolate and estimate the effect of

Chinese import penetration on the US energy use in the manufacturing sector by counter-factual simulations, all other factors are held constant.

3.1.4 General Equilibrium

A general equilibrium model considers the competitive behavior of each agent in the economy. Consumers earn income from wages and returns to capital and maximize their utility by demanding final goods. Producers use inputs and supply goods in the market. Production inputs are from consumers or other producers. Each sector producer is aiming to maximize profit.

The general equilibrium is defined by three conditions derived from solving the model: zero profit, market clearing and income balance. Zero profit conditions state that cost of production and output tax equals value of output. For my model, the zero profit conditions should be satisfied for all production sectors, final consumption sector and trade sector. These conditions are associated with the level of each activity. The market clearing condition is that output equals intermediate use and final demands. In the model, all demanded final goods are equal to supplied goods, and the sum of supplied factor should be equal to factor demand in the market. Income balance condition states that the level of expenditure equals the value of the income of the consumer. Under these equilibrium conditions, the model is solved as a mixed complementarity problem (MCP) using the GAMS/MPSGE system described in Rutherford (1995).

3.2 Numerical Results

The purpose of this analysis is to try to isolate and estimate the effect of Chinese import penetration by counter-factual simulations. I introduce tax on energy use in US manufacturing in order to help understand the magnitude of the energy use response to increasing imports from China: What level of energy tax would offset this effect?

In Table 1, the selected values of elasticities of substitution for the basic simulation are reported. Table 4 shows the simulation scenarios related to increased imports from China and energy tax in the US. The `benchmark' columns in Tables 5 and 6 show the benchmark quantity from the IO table. Industry 7, `Refined petroleum products and nuclear fuel' is not reported in the results because this industry is considered as an energy sector, not a manufacturing sector.

For the first basic scenario, I consider the isolated effect of increasing imports from China due

a close relationship with what is occurring in the US economy, which cannot be explained by traditional H-O theory. But even without an offsetting energy tax, the effect of an increase in Chinese import penetration on energy use in the manufacturing sector is estimated to be very small as just noted.

3.3 Sensitivity Checks

Figure 4 shows the changes of energy consumption and output due to increased imports from China depending on the tax rate. Benchmark means without either Chinese imports shock or energy tax. 0% shows the results only of an increased imports from China as shown in the `Basic I' columns in Tables 5 and 6. The remaining part of the graph shows how the energy tax offsets the increased energy consumption and output caused by Chinese import penetration. With specified functional forms, about 1% of the energy tax is fully offsetting the increased energy and keeping the increased output level. However, with the higher tax rate of about 5% in this figure, the output the magnitude is not large. Using the US manufacturing industry-level panel data from 1997 to 2005, I examine whether increasing imports from China significantly affect energy use and how the effects are different depending on energy sources. In addition, I decompose the effect of increasing imports from China on energy use in US manufacturing into an output scale effect and a factor substitution effect based on the theoretical framework.

4.1 Data

I construct a panel dataset by merging several datasets related to the US manufacturing industries for the period of 1997 to 2005. My base datasets are the Annual Survey of Manufacturers (ASM) collected by the Census Bureau and the NBER's collection described in Schott (2010). The industry classification of the dataset is based on 1997 North American Industry classification (NAICS) codes with 6 digits.

The first dataset, ASM, includes all characteristic variables on the manufacturing sector, divided into 473 industries by the NACIS 6-digit classification[10]. This data provides variables about energy use, such as the total cost of purchased fuels and the quantity of purchased electricity, as well as industrial characteristics such as output[11], employment and capital expenditure. Additionally, I merge the data from the Statistics of US Businesses (SUSB), including the numbers of firms or establishments in each industry of manufacturing, to the previous dataset. This data is also tabulated by industry classification based on NAICS codes with 6 digits[12]. It is difficult to examine exactly how existing firms change their decision about energy use based only on the data at the industrial level. Therefore, it is necessary to control for exit or entry effects caused by increasing competition by imports for each industry. The variable, the number of firms in each industry, can solve the problem caused by data limitation. This means that an increase in the number of firms implies entry must have occurred, and a decrease in the number of firms implies an exit of firms from the industry.

The trade data for the US manufacturing sector comes from the NBER's collection described

[10] This survey had also collected in previous periods. However, this survey was classified by SIC 4-digit classification instead of NAICS 6-digit classification before 1997. This prevents having a longer panel data from earlier years.

[11] I use the value of shipment as a variable on output.

[12]

variables of energy use are mainly utilized as dependent variables in the empirical analysis.

4.1.2 UN Comtrade Data

I also use the UN Comtrade database[15] to construct an instrumental variable because Chinese import penetration is potentially endogenous. UN Comtrade is an international database of 6-digit HS commodity level information on all bilateral imports and exports between any given pairs of countries. I extract the bilateral exports from China to the world for the period and aggregate from the 6-digit HS commodity level to the 6-digit NAICS industry level using the concordance of Pierce and Schott (2009). I will explain instrumental variable in detail later.

4.1.3 Descriptive Statistics

The descriptive statistics of the merged and conducted dataset is shown in Table 7. In the regression sample, I drop 36 industries which have negative or greater than 1 import penetration [16]. This gives me a sample of 3,465 trade observations among 4,257 industry observations in US manufacturing for the period from 1997 to 2005.

The main independent variable, Chinese import penetration to the US manufacturing sector varies depending on industries. Traditional labor-intensive sectors such as textile and apparel have absolutely high penetration from China and the rate of their increase is also relatively high. Interestingly, Chinese import penetration of some sectors such as printing, chemical, and machinery, rapidly increased during the period. The rate of increase of imports is even higher than traditional labor-intensive sectors. However, the absolute size of Chinese imports in these sectors is still very low[17].

Changes in energy use in US manufacturing is interesting. Table B.2 shows how energy use of the manufacturing sector has changed depending on energy types. In the case of fuel, as imports from China have increased, the fuel consumption by those industries has decreased. Generally, these two variables move in opposite directions as theoretically predicted. However, in the case of electricity, those who have faced high import penetration from China also use more electricity. For similar to what is shown in the IO table[18]. Consum [redacted] d fuel are very di erent across manufacturing industries. Fuels ar [redacted] tries, which are commonly considered to be energy-intensive ind [redacted] enly distributed across all industries. These two points related t [redacted] facturing suggest that electricity and fuel may be dealt with di [redacted] duction factor.

4.2 Empirical Strategy

To examine how the determinants of e [redacted] g sector respond to increasing imports from China, the empiric [redacted] 9.

$$E_{i;t} = {}_0 + {}_1 IP^{China}_{i;t} + {}_2 LK_{i;t} + \text{[redacted]} {}_5 LK_{i;t} V{:}ship_{i;t} +$$
$${}_6 IP^{China}_{i;t} LK_{i;t} + {}_7 IP^{China}_{i;t} V{:}ship \text{[redacted]} P^{China}_{i;t} (V{:}ship)^2_{i;t} + {}_{i;t} \quad (25)$$

The dependent variables ($E_{i;t}$) are varia [redacted] at time t. $IP^{China}_{i;t}$ is the

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endogeneity problem, I construct an instrumental variable, the Chinese trade share of world trade, which is not correlated with unobserved shocks. The overall increase in Chinese exports is driven fundamentally by the country's opening to the global economy because of ongoing liberalization by policy makers. Therefore, it is arguably exogenous. The industries in which China has a comparative advantage are the ones that supply most of Chinese exports. The US, one of the biggest trading partners with China, faces a disadvantage in her manufacturing industries due to increasing imports from China. Therefore, Chinese trade share of world trade could be used as an instrumental variable for import penetration from China into the US[20]. The Chinese trade share is the value of exports originating from China as a share of total world exports at the industry level.

As predicted in the simulation model, the marginal effect of increased imports from China is expected to be positive because the structure of the US manufacturing sector would move toward more energy-intensive industries with comparative advantage compared to Chinese manufacturing. Through the decomposition of the trade effect, the factor substitution effect is expected to be negative because factor mobility through this trade with China causes more demand of labor in US manufacturing, and the relative price of energy increses. More labor-intensive industries with high imports from China lead the industries to use less energy. The output scale effect is positive because more output requires more energy consumption as a production factor.

4.3 Empirical Results

The first three columns of Table 8 show the results of basic specifications with the pooled OLS. All specifications include year and industry fixed effects to control for industry-specific macro shocks and time-invariant unobserved variables. The quantity of purchased energy is used as the dependent variable. Because of the interaction terms, the coefficient of Chinese import penetration (`penCHN') itself does not explain the trade effect. To examine the trade effect, I calculate the marginal effect at the sample mean. The marginal effect of increasing imports from China is positive at all specifications, but these are statistically insignificant in the pooled OLS estimation. These results without the interaction terms are shown in Table B.3. The results also show that the trade effect is positive, but statistically insignificant. Unlike the theoretical prediction of the factor substitution effect, the results indicate that such industries facing higher import penetration from

[20] This follows the \value share" approach outlined by Bernard et al. (2006).

China use more energy. However, the marginal effects of factor substitution and output scale effect are both insignificant.

direction of the factor substitution effect is opposite of the theoretical prediction. These results mean that labor-intensive industries having high Chinese import penetration, causing them to use more electricity. This is the opposite of the result of fuel consumption. The IV estimates are shown in the last three columns in Table 10, in which all results are more significant than the pooled OLS estimates. The coefficient is about 0.03 for all specifications. This suggests that electricity could have the potential to easily replace labor. Therefore, labor-intensive industries use more electricity, thus reducing labor. Further research could investigate the substitutability of non-energy inputs such as labor and capital, with each energy type: fuel and electricity.

4.4.2 Exit and Entry

Increasing imports from China possibly causes domestic firms to face higher competition. It is possible that this causes the domestic firms to exit from the market. Therefore, it is necessary to control for this effect. Because of the limitation of industry level data, how each firm responds to this increase in competition is not observable. Instead, I control for the number of firms in each industry. The IV regression results from adding the number of firms are reported in Table B.6 for fuel and B.8 for electricity. Since the coefficient of the number of firms on fuel is significantly positive, this means that the industries in which entry of firms occurs use energy more. As a result of controlling for the number of firms, the calculated marginal effect of Chinese import penetration is slightly larger. The magnitude of the factor substitution effect of fuel also increases to -0.048. However, for electricity, the number of firms does not significantly affect the electricity demand.

5 Discussion

I investigate the determinants of energy use in the US manufacturing sector in response to increasing imports from China. The modified Heckscher-Ohlin model, by adding energy tax, indicates that energy tax can offset the raised energy use of producers in the North caused by increased imports from the South. The energy tax magnifies the factor substitution effect which has a negative effect on energy use. Therefore, energy use in the North can be reduced while the output is raised.

The simulation results show that increasing imports cause all manufacturing industries to use more energy, proportionally increasing the output of each industry. However, the magnitude of the effect of trade with China is very small. A 10% fall in the price of Chinese imports causes the total energy consumption in US manufacturing to increase by only 0.5%. On the other side, manufacturers respond sensitively to the energy tax such that a 1% rise in energy tax results in a 1% fall in energy consumption and 0.13% decrease in output, with all other prices holding constant. Each industry changes its energy use differently depending on the industry's factor intensity. Higher energy-intensive industries reduce energy use more than other industries. Combining these two scenarios of increasing imports from China and an energy tax can produce an outcome consistent with the data, decreasing energy consumption yet increasing output. Interestingly, total energy use in the manufacturing sector can fall at the same time as US welfare increases due to improved terms of trade.

As reported in the simulation model, my empirical results of IV estimation also show the overall positive trade effect of increasing imports from China on consumption of fuels and electricity. The marginal effect of Chinese import penetration is small, at about 0.08%, but is statistically very significant. However, the direction of factor substitution effects on fuel and electricity are opposite. Increasing imports from China decrease the ratio of labor over fuel, but increase that of labor over electricity.

6 Conclusions

Although imports from China continue to rise, total energy use in US manufacturing continues to decline. This trend is inconsistent with the traditional factor endowment trade theory prediction. To find the determinants of energy consumption in US manufacturing, I modify the Hechscher-Ohline model by adding energy tax in the North as a domestic regulation on energy use. The energy tax reveals the preference of lowering energy use, and causes increasing imports from the South to be different from the traditional H-O model prediction. Without the energy tax, the North has a comparative advantage on energy-intensive industries and increases energy use as imports from the South increase. However, the energy tax can lead the North to use less energy because there will be a substitution both away from energy-intensive industries and from energy use within industries. Increased imports from the South combined with the energy tax can bring the result that the North uses less energy than before and increases welfare due to its improved terms of trade.

I conduct the CGE model of the US economy using the US input-output table for the base year 2005. I simulate several types of scenarios related to a Chinese import shock (due to a price shock) with or without an offsetting energy tax. The numerical results show that increased imports from China cause all manufacturing industries in the US to use more energy even though the magnitude of the effect is very small. However, the energy-decreasing effect of an energy tax dominates the energy-increasing effect of imports from China with a low rate of tax, while the positive welfare effect of trade still holds. However, even without an offsetting energy tax, the effect of an increase in Chinese import penetration on energy use in US manufacturing is estimated to be very small.

Using the US manufacturing industry-level panel data, the effect of increasing imports from China is decomposed into an effect on factor use and an effect on output. Since import penetration is potentially endogenous, I instrument using the Chinese trade share of world trade for Chinese import penetration to US manufacturing. Consistent with the simulation results, the magnitude of the effect is small, but it is positive and statistically significant. The interesting findings from the decomposition of the trade effect is that the factor substitution effect and output scale effect have the opposite effect on consumption of fuels and electricity. In the case of fuel, the factor substitution effect is negative and the output scale effect is positive. This means that increasing imports from China decrease the ratio of labor over fuel within industries, and as output increases due to increased Chinese import penetration, the industries use more fuels. This result is exactly consistent with the prediction of traditional trade theory. However, the opposite results are shown in the case of electricity. The factor substitution effect on electricity is positive which means that electricity is considered to be substitutable with labor rather than fuels. Once the effect of Chinese import penetration is decomposed, I find opposite effects depending on energy types: while the factor substitution effect on fuel is positive, the factor substitution effect on electricity is negative even though the effect of Chinese import penetration on fuel and electricity are both significantly positive.

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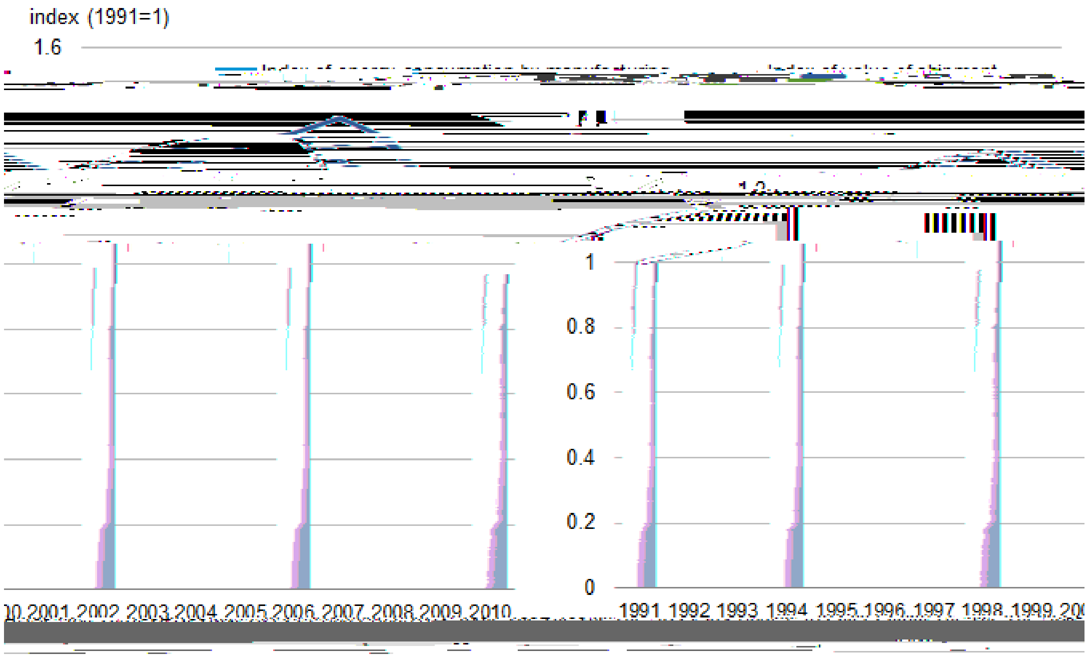
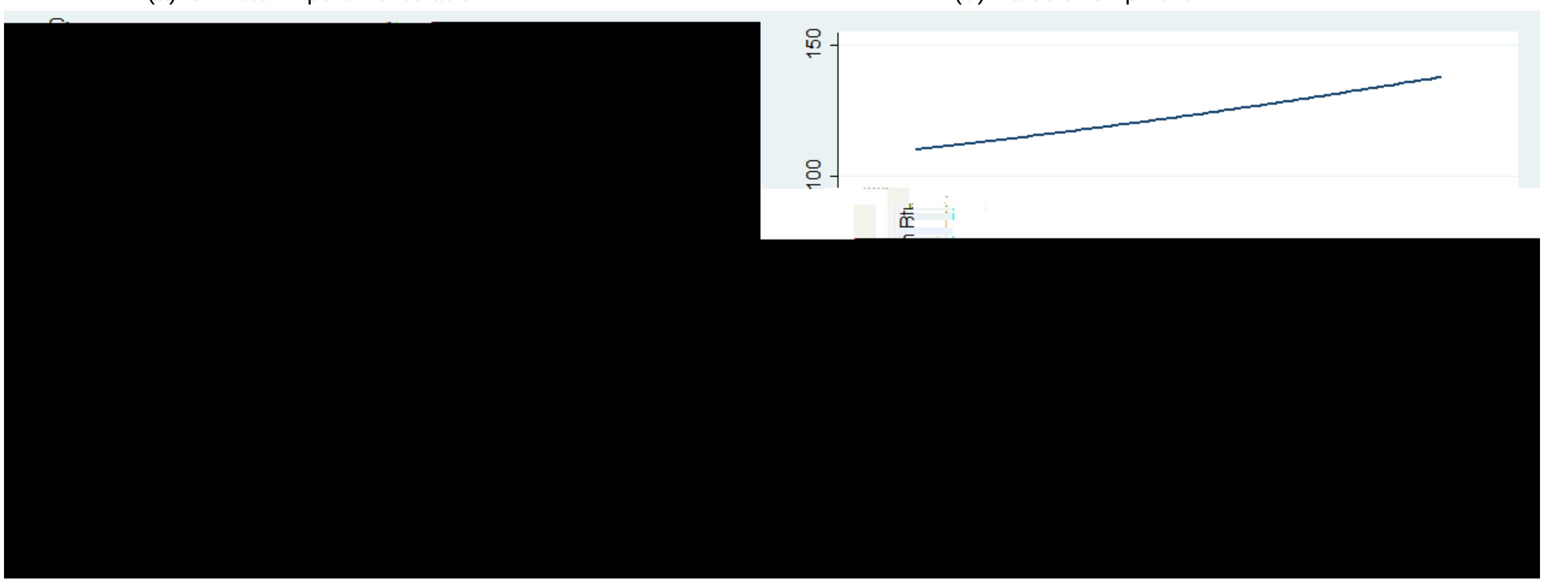


Figure 1: Total energy consumption and value of shipments by U.S. manufacturing

Note: Value of shipment is based on monetary value of shipment collected from the Census Bureau.
Source: US Energy Information Administration

[redacted]

(a) Chinese Import Penetration (b) Value of Shipment



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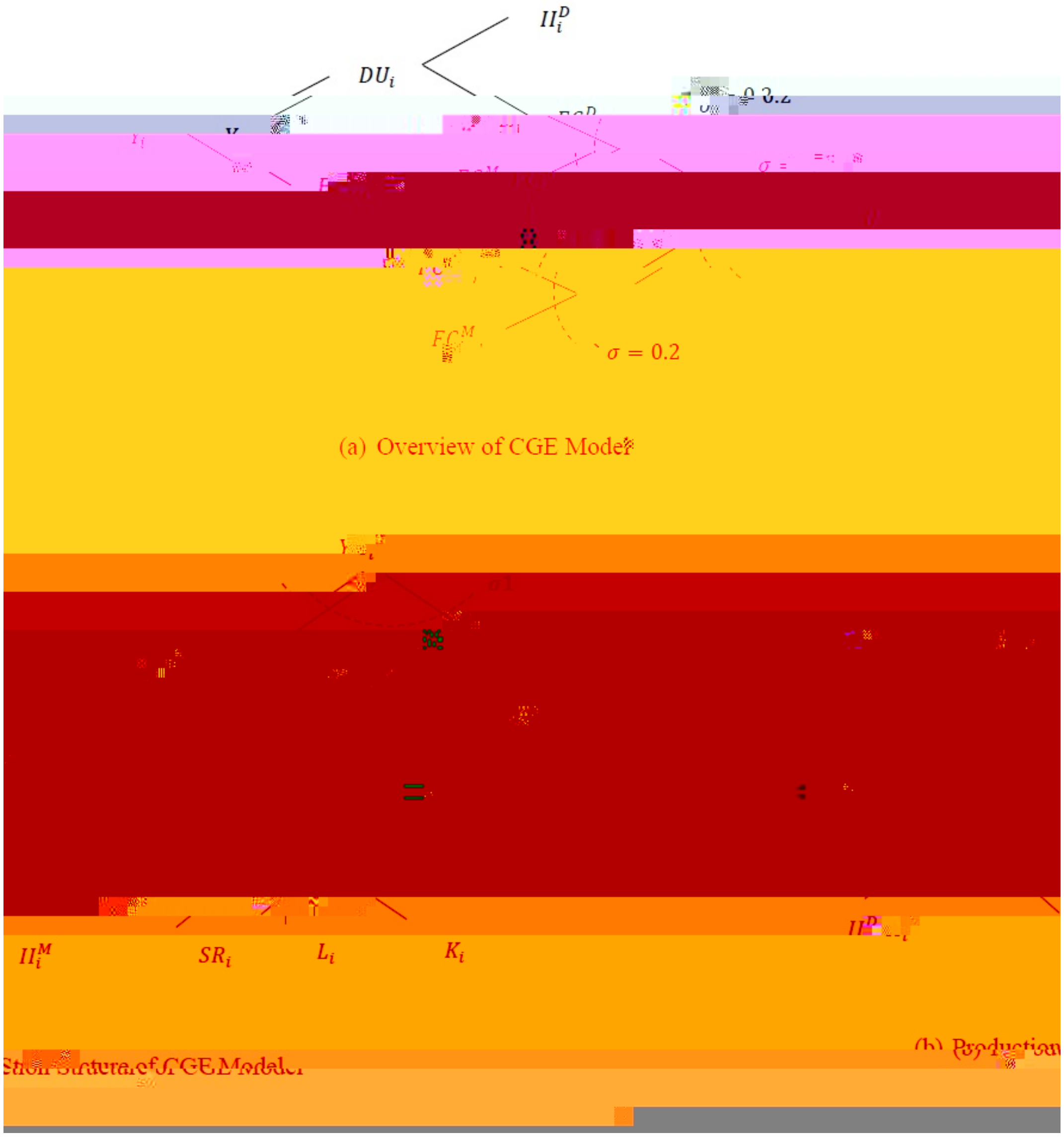
(c) Energy intensity (d) Quantity of Energy Use

Figure 2: US Manufacturing from 1997 to 2005



Y_i	Domestic output of a sector i
DU_i	Output domestically consumed
EX_i	Exports
FC_i^D	Final consumption of domestic output
FC_i^M	Final consumption of imported goods
E_i^D	Domestic energy intermediate inputs
E_i^M	Imported energy intermediate inputs
II_i^D	Domestic intermediate inputs of manufacturing
II_i^M	Imported intermediate inputs of manufacturing
L_i	Labor
K_i	Capital
SR_i	Service intermediate inputs
	Elasticity of substitution

Figure 3: Structure of CGE Model

Table 1: Selected Elasticities

Elasticity of substitution	Meaning	Selected Value
1	Between composite factor and intermediate inputs	0.5
2	Between energy and other inputs	0.5
E	Armington elasticities for energy	0.2
II	Armington elasticities for intermediate inputs	0.2

Table 2: Fixed Parameters after Calibration

Parameter	Meaning
	Cost share of composition factor($_{sr}$, $_{l}$ and $_{k}$)
	Distribution between intermediate inputs and composite factor
	Distribution between energy and other inputs
	Expenditure share of consumption
	Distribution between domestic and imported energy inputs
	Distribution between domestic and imported intermediate inputs
	Distribution between domestic and imported nal consumption

Table 3: Production sectors in the US IO table

		Proportion of energy use (%)			cost share(%)		
	Sectors	1	2	7	1	2	7
	Energy						
1	Mining and quarrying	10.5	1.4	3.5	13.64	0.03	2.80
2	Electricity, gas and water supply	23.0	1.7	1.8	28.10	0.00	1.40
	Manufacturing						
3	Food products, beverages and Fo((ev)28346(1.7)-1596(1.s5 Tf 14)-1346(010)-13460010)-1346000903 240 (						

Table 4: Scenarios related to increased imports from China and energy tax

	Description
a. Basic Scenario I	Increasing imports from China by price shock (10%)
b. Basic Scenario II	Energy tax in manufacturing (1%)
c. Combined Scenario	Increasing imports from China and energy use tax in manufacturing

Table 5: Changes in intermediate energy input by US manufacturing

Sectors	Benchmark	Basic I		Basic II		Combined	
		M	%	M	%	M	%
3	11447.898	11474.436	(0.232)	11335.586	(-0.981)	11361.842	(-0.752)
4	2134.940	2144.179	(0.433)	2106.009	(-1.355)	2115.150	(-0.927)
5	1471.028	1476.351	(0.362)	1454.615	(-1.116)	1459.886	(-0.757)
6	9709.872	9728.504	(0.192)	9626.411	(-0.860)	9644.856	(-0.670)
8	49800.213	50075.040	(0.552)	49429.389	(-0.745)	49701.310	(-0.199)
9	5840.354	5870.705	(0.520)	5776.091	(-1.100)	5806.114	(-0.586)
10	11145.230	11176.058	(0.277)	11021.067	(-1.114)	11051.481	(-0.841)
11	15472.037	15653.767	(1.175)	15249.678	(-1.437)	15428.744	(-0.280)
12	4929.398	4944.529	(0.307)	4871.063	(-1.183)	4886.053	(-0.879)
13	3305.038	3323.561	(0.560)	3264.258	(-1.234)	3282.587	(-0.679)
14	3615.331	3655.203	(1.103)	3575.238	(-1.109)	3614.691	(-0.018)
15	5513.878	5589.704	(1.375)	5419.935	(-1.704)	5494.610	(-0.349)
16	1814.079	1821.898	(0.431)	1789.766	(-1.340)	1797.510	(-0.913)
17	2318.413	2326.054	(0.330)	2294.107	(-1.048)	2301.678	(-0.722)
Total	128517.708	129259.990	(0.578)	127213.214	(-1.015)	127946.513	(-0.444)

Table 6: Changes in output by US manufacturing

Sectors	Benchmark	Basic I		Basic II		Combined	
		M	%	M	%	M	%
3	662198.908	663734.028	(0.232)	662259.323	(0.009)	663793.286	(0.241)
4	108567.065	109036.886	(0.433)	108166.815	(-0.369)	108636.304	(0.064)
5	111587.472	111991.221	(0.362)	111445.816	(-0.127)	111849.654	(0.235)
6	531117.804	532137.006	(0.192)	531818.168	(0.132)	532837.204	(0.324)
8	593141.040	596414.307	(0.552)	594611.589	(0.248)	597882.665	(0.799)
9	195858.452	196876.303	(0.520)	195640.433	(-0.111)	196657.306	(0.408)
10	113815.360	114130.301	(0.277)	113673.002	(-0.125)	113986.700	(0.151)
11	203253.382	205640.747	(1.175)	202335.621	(-0.452)	204711.511	(0.717)
12	284670.354	285544.164	(0.307)	284114.591	(-0.195)	284988.910	(0.112)
13	315536.828	317305.237	(0.560)	314759.894	(-0.246)	316527.339	(0.314)
14	452781.503	457774.986	(1.103)	452237.787	(-0.120)	457228.303	(0.982)
15	494721.674	501524.959	(1.375)	491155.709	(-0.721)	497922.714	(0.647)
16	189990.403	190809.368	(0.431)				

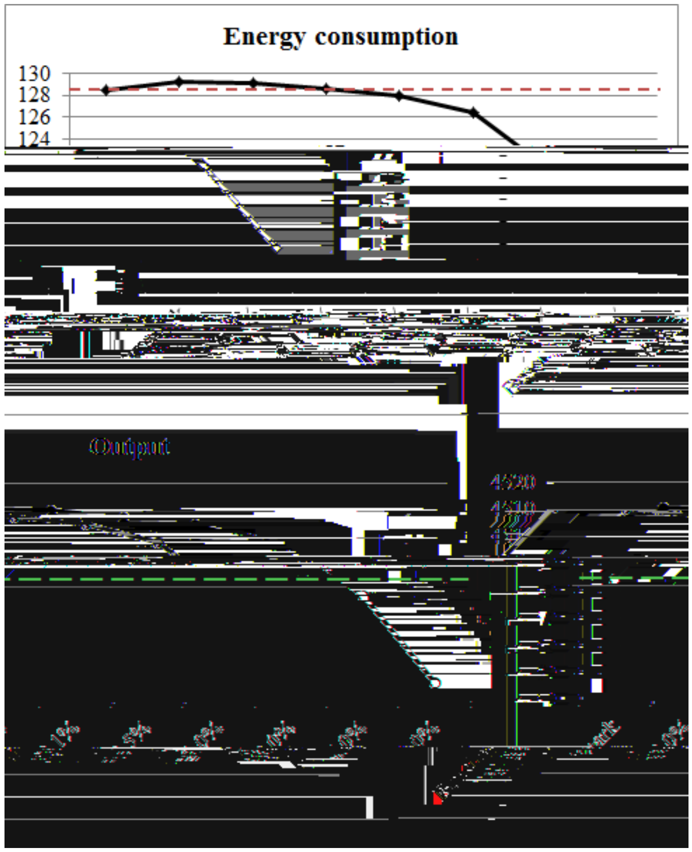


Figure 4: Changes depending on tax rate

Note: Except the benchmark, all results of taxes are based on increasing imports from China.

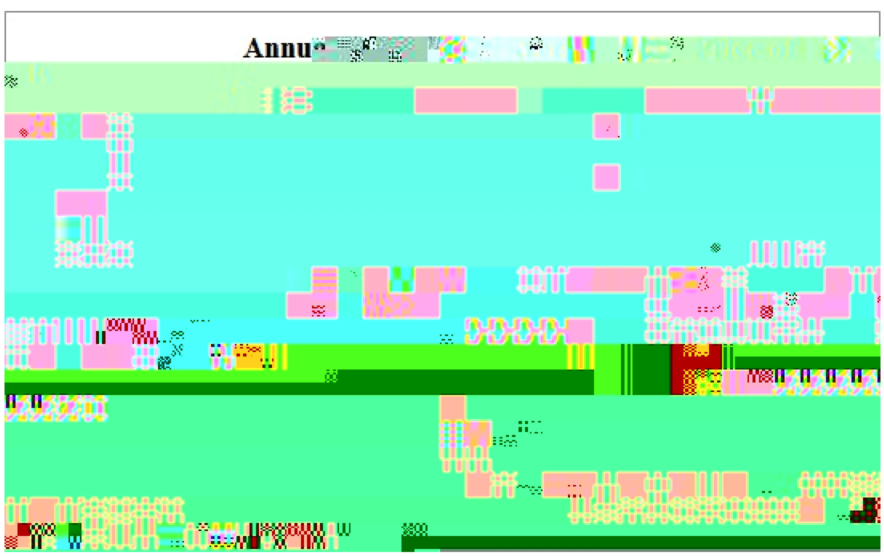


Figure 5: Comparison of energy price for all industries and energy price index for US manufacturing

Note: The dash line shows the annual average price of fuels for all industrial sectors including construction, agriculture

Table 7: Summary statistics of US manufacturing

Variable	Mean	Std. Dev.	Min.	Max.
Industrial Characteristics (N=4257)				
Value of shipment	8669.4	17143.7	98	445910
Employment	32.4	44.0	0.8	554.9
Payment	1235.0	1741.1	19.9	16162.9
Material Cost	4561.6	11678.0	34.8	345883.1
Value added	4122.4	7072.2	51.7	104711.5
Capital Expenditure	288.8	669.2	1.1	14583.6
Number of rms	670.4	1593.6	3	23787
Industrial Trade (N=3465)				
Imports	2646.9	7145.7	0	126324.8
Exports	1730	4102.0	0	60005.5
Imports from low-wage countries	407.5	1145.0	0	19380.7
Imports from China	320.2	1035.3	0	18961.4
Tari	0.021	0.034	0	0.517
Variables related to Industrial Energy Use				
Total energy cost	158.9	482.4	0	11246.1
Total electric cost	86.4	188.1	0	2626.8
Total fuels cost	74.0	323.2	0	8619.4
Quantity of electricity (1000 Kwh)	1782.2	4570.6	0	60552.5
Energy Price	8.654	3.1	2.4	16.1
Quantity of energy purchased (million Btu)	28.3	107.1	0.07	1760.7
Quantity of electric purchased (million Btu)	6.1	15.6	0	206.6
Quantity of fuels purchased (million Btu)	22.3	94.6	0.01	1607.4

Table 8: Estimation on the quantity of energy

	Fixed effects			IV Fixed effects		
MODEL VARIABLES	A	B	C	A	B	C
penCHN	0.0234	-0.188***	-0.808***	0.108***	-0.00247	-0.136
	(0.0155)	(0.0512)	(0.210)	(0.0209)	(0.0739)	(0.233)
L/K	-0.107	-0.309	-0.405*	-0.200	-0.296*	-0.317*
	(0.251)	(0.257)	(0.241)	(0.161)	(0.168)	(0.167)
vship	1.456***	1.492***	2.261***	1.469***	1.484***	1.635***
	(0.285)	(0.275)	(0.313)	(0.158)	(0.158)	(0.255)
sqvship	-0.0551***	-0.0495***	-0.0968***	-0.0538***	-0.0511***	-0.0602***
	(0.0157)	(0.0154)	(0.0176)	(0.00859)	(0.00857)	(0.0147)
LKvship	0.0312	0.0512*	0.0623**	0.0427**	0.0522***	0.0547***
	(0.0300)	(0.0309)	(0.0286)	(0.0180)	(0.0189)	(0.0191)
penCHNLK	0.0125	0.00333	0.000784	0.0125	0.00801	0.00760
	(0.00795)	(0.00790)	(0.00787)	(0.00856)	(0.00851)	(0.00834)
penCHNvship		0.0238***	0.173***		0.0117	0.0424
		(0.00591)	(0.0475)		(0.00720)	(0.0496)
penCHNsqvship			-0.00885***			-0.00177
			(0.00264)			(0.00274)
Observations	3,313	3,313	3,313	3,204	3,204	3,204
R-squared	0.405	0.416	0.425	0.353	0.371	0.377
Number of NAICS	380	380	380	363	363	363
Marginal Effects						
penCHN	0.0108	0.0089	0.0055	0.0956***	0.0876***	0.0854***
	(0.0099)	(0.0101)	(0.0010)	(0.0190)	(0.0204)	(0.0211)
penCHNLK	0.0125	0.0033	0.0008	0.0125	0.0080	0.0076
	(0.0076)	(0.0079)	(0.0079)	(0.0086)	(0.0085)	(0.0083)
penCHNvship		0.0238	0.0984		0.0117	0.0275
		(0.0059)	(0.0256)		(0.0072)	(0.0270)

Note: All model specifications use time-fixed effects. Elasticities are evaluated at sample means using the Delta method. *** < 0.01, ** < 0.05, * < 0.1

Table 9: Estimation on the quantity of fuel

	Fixed effects			IV Fixed effects		
MODEL VARIABLES	A	B	C	A	B	C
penCHN	0.00302	-0.226***	-1.054***	0.0571***	-0.0879	-0.478**
	(0.0162)	(0.0553)	(0.2270)	(0.0212)	(0.0754)	(0.2350)
L/K	0.0636	-0.16	-0.292	-0.118	-0.245	-0.308
	(0.3180)	(0.3260)	(0.2980)	(0.1920)	(0.2010)	(0.1990)
vship	1.526***	1.566***	2.594***	1.620***	1.640***	2.081***
	(0.2940)	(0.2890)	(0.3560)	(0.1740)	(0.1760)	(0.2830)
sqvship	-0.0593***	-0.0532***	-0.116***	-0.0621***	-0.0585***	-0.0850***
	(0.0163)	(0.0163)	(0.0213)	(0.0095)	(0.0095)	(0.0162)
LKvship	0.00158	0.0237	0.0392	0.0169	0.0296	0.0372*
	(0.0387)	(0.0398)	(0.0362)	(0.0211)	(0.0220)	(0.0218)
penCHNLK	-0.00408	-0.0140*	-0.0174**	-0.0154	-0.0211**	-0.0222**
	(0.0085)	(0.0082)	(0.0083)	(0.0096)	(0.0096)	(0.0096)
penCHNvship		0.0258***	0.225***		0.0153**	0.105**
		(0.0064)	(0.0522)		(0.0074)	(0.0498)
penCHNsqvship			-0.0118***			-0.00517*
			(0.0030)			(0.0027)
Observations	3,296	3,296	3,296	3,187	3,187	3,187
R-squared	0.425	0.435	0.447	0.396	0.412	0.425
Number of NAICS	380	380	380	363	363	363
Marginal Effects						
penCHN	0.0071	0.0052	0.0006	0.0727***	0.0621***	0.0557**
	(0.0105)	(0.0105)	(0.0104)	(0.0207)	(0.0220)	(0.0222)
penCHNLK	-0.0041	-0.0140*	-0.0174**	-0.0154	-0.0211**	-0.0222**
	(0.0085)	(0.0082)	(0.0083)	(0.0096)	(0.0096)	(0.0096)
penCHNvship		0.0258***	0.1254***		0.0153**	0.0616**
		(0.0064)	(0.0274)		(0.0074)	(0.0273)

Note: All model specifications use time-fixed effects. Elasticities are evaluated at sample means using the Delta method. *** < 0.01, ** < 0.05, * < 0.1

Table 10: Estimation on the quantity of electricity

	Fixed e ects			IV Fixed e ects		
MODEL VARIABLES	A	B	C	A	B	C
penCHN	0.0360**	-0.0866	-0.296	0.109***	0.121	0.488*
	(0.0167)	(0.0614)	(0.2660)	(0.0243)	(0.0882)	(0.2850)
L/K	-0.348	-0.467*	-0.501*	-0.371**	-0.360*	-0.301
	(0.2480)	(0.2560)	(0.2650)	(0.1820)	(0.1980)	(0.2080)
vship	1.512***	1.533***	1.793***	1.482***	1.480***	1.066***
	(0.2900)	(0.2830)	(0.3750)	(0.1600)	(0.1620)	(0.3260)
sqvship	-0.0590***	-0.0557***	-0.0717***	-0.0560***	-0.0563***	-0.0314*
	(0.0154)	(0.0153)	(0.0204)	(0.0084)	(0.0082)	(0.0185)
LKvship	0.0714***	0.0832***	0.0871***	0.0791***	0.0781***	0.0709***
	(0.0269)	(0.0276)	(0.0286)	(0.0196)	(0.0212)	(0.0226)
penCHNLK	0.0260***	0.0207**	0.0198**	0.0331***	0.0336***	0.0347***
	(0.0092)	(0.0095)	(0.0095)	(0.0097)	(0.0101)	(0.0103)
penCHNvship		0.0138**	0.0642		-0.00131	-0.0857
		(0.0070)	(0.0600)		(0.0082)	(0.0599)
penCHNsqvship			-0.00299			0.00486
			(0.0033)			(0.0033)
Observations	3,296	3,296	3,296	3,187	3,187	3,187
R-squared	0.339	0.342	0.343	0.316	0.314	0.303
Number of NAICS	380	380	380	363	363	363
Marginal E ects						
penCHN	0.0098	0.0088	0.0077	0.0751***	0.0760**	0.0821**
	(0.0111)	(0.0116)	(0.0115)	(0.0224)	(0.0250)	(0.0265)
penCHNLK	0.0260***	0.0207**	0.0198**	0.0331***	0.0336***	0.0347***
	(0.0092)	(0.0095)	(0.0095)	(0.0097)	(0.0101)	(0.0103)
penCHNvship		0.0138**	0.039		-0.0013	-0.0449
		(0.0070)	(0.0323)		(0.0082)	(0.0326)

Note: All model speci cations use time- xed e ects. Elasticities are evaluated at sample means using the Delta method. *** < 0.01, ** < 0.05, * < 0.1

Appendix

A Data: the US Input-Output Table

To analyze the model above, I use the US input-output (IO) table for the base year 2005. In this section, I overview the typical structure of IO tables and examine the speci c feature of the US economy, especially focusing on the energy use in manufacturing.

A.1 IO tables: An Overview

into three parts: energy, manufacturing and aggregated for all other industries. Energy sector includes two industries: 1) mining and quarrying, and 2) utility (electricity, gas and water supply). Manufacturing sector includes 15 detailed industries according to IO classi cation. Table 3 shows the list of industry classi cations used in the numerical analysis. All remaining sectors are aggregated into the sector, `other industries' which includes agriculture, construction, and services.

I focus on energy use in the manufacturing sector. Among manufacturing industries, the industry, `coke, re ned petroleum products and nuclear fuel' also should be considered as an energy sector. Therefore, I examine how three energy uses including re ned petroleum of manufacturing sectors are a ected by increasing imports from China with energy tax. Table 3 shows how energy use is distributed across industrial sectors. Mining and quarrying is mostly used by energy sectors. Re ned petroleum industry is the biggest consumer for mining and quarrying. About electricity and re ned petroleum, manufacturing sector demands relatively about 21.6% and 26.8% of total energy use by the industrial sectors. It shows that energy is one of the important intermediate inputs for producing manufacturing goods. The columns of energy cost share in Table 3 show the ratio of energy cost related to total production cost. These columns are rather interesting in that electricity cost share is quite similar across industries, while fuel cost share of chemical, rubber, plastic products is much higher than other industries. These industries are traditionally considered as energy intensive industries. On the other hand, food and textile industries has high electricity cost share. Through these di erences in energy cost share, electricity and fuel are predicted to be di erently considered as a product factor even though both are types of energy.

In order to examine how US energy use in manufacturing responds to increased imports from China, the import column in the IO table should be divided into two parts: imports from China and imports from the rest of world. To construct, I use the bilateral trade database from OECD[24]. This data provides bilateral trade value by industry and end-use. I assume the tari of each sector is consistent regardless trading partners. If examined closely, the imports from China takes a very signi cant portion in each industry. Specially, the industry of textile and related products are imported from China more than 50% out of total imports in the sector. Interestingly, the industry of machinery and equipment is also imported a lot from China. The pattern of imports from China can be divided into two parts: labor intensive industries which are traditionally predicted by trade

[24] The STAN Bilateral Trade Database from www.oecd.org/sti/btd

theory and which are relatively close to energy intensive industries such as metal and machinery.

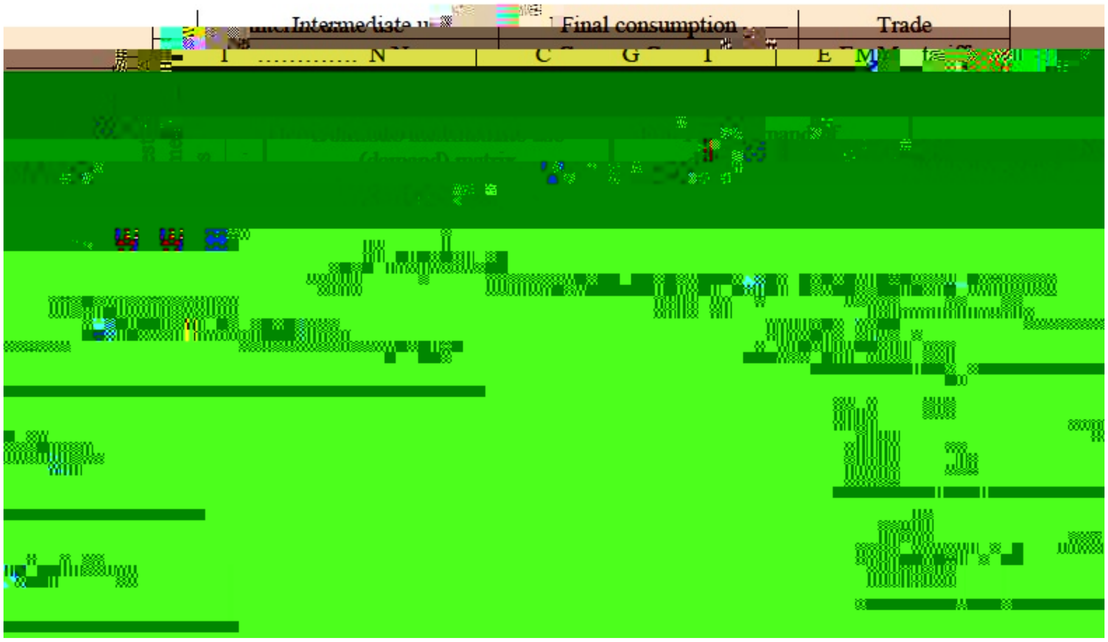


Figure A.1: Structure of IO table

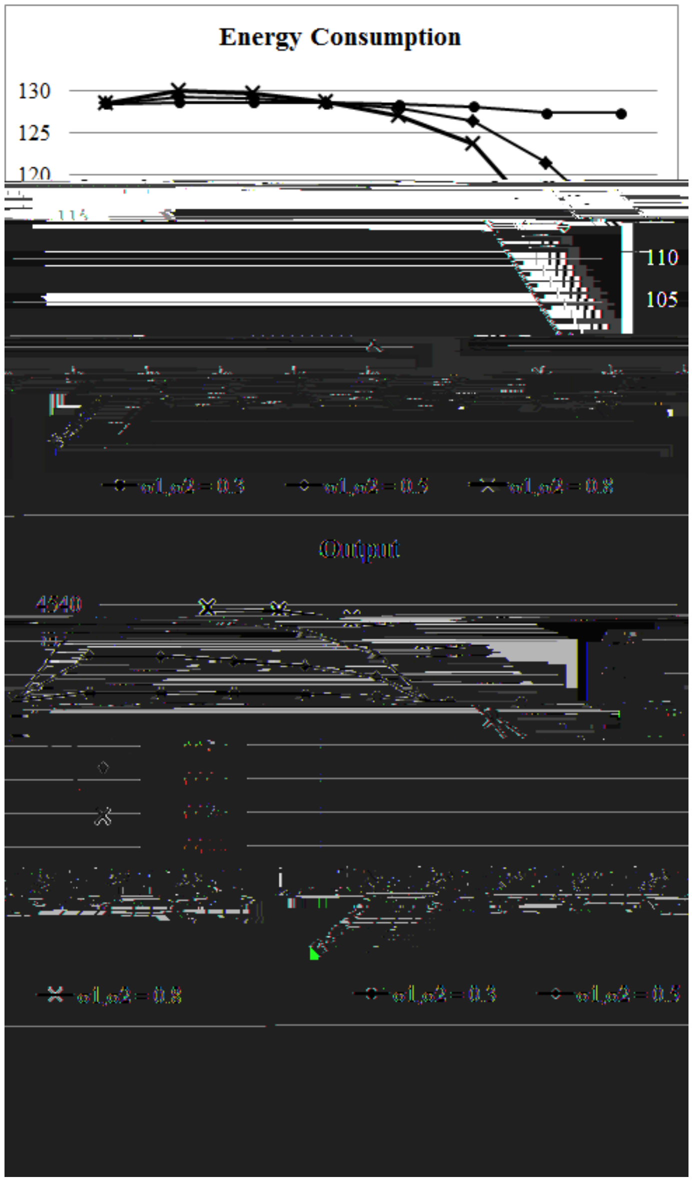


Figure A.2: Sensitivity Checks

B Empirical Analysis

Table B.1: Import Penetration from China into US manufacturing, 1997-2005

		Chinese Import Penetration			
	NAICS			Changes	
Sectoral Description	code	1997	2005	2005-1997	%
Food	311	0.002	0.006	0.004	1.90
Beverage and Tobacco Product	312	0.000	0.000	0.000	0.62
Textile Mills	313	0.006	0.075	0.070	12.11
Textile Product Mills	314	0.027	0.123	0.096	3.61
Apparel	315	0.115	0.286	0.171	1.48
Leather and Allied Product	316	0.306	0.511	0.205	0.67
Wood Product	321	0.007	0.027	0.019	2.68
Paper	322	0.019	0.039	0.020	1.03
Printing and Related Support Activities	323	0.023	0.117	0.094	4.13
Petroleum and Coal Products	324	0.000	0.000	0.000	0.63
Chemical	325	0.004	0.018	0.014	3.54
Plastics and Rubber Products	326	0.006	0.023	0.017	2.98
Nonmetalic Mineral Product	327	0.017	0.048	0.031	1.89
Primary Metal	331	0.006	0.021	0.015	2.37
Fabricated Metal Product	332	0.011	0.051	0.039	3.52
Machinery	333	0.013	0.062	0.049	3.78
Computer and Electronic Product	334	0.029	0.124	0.094	3.25
Electrical Equipment, Appliance, and Component	335	0.048	0.129	0.081	1.67
Transportation Equipment	336	0.004	0.013	0.009	2.33
Furniture and Related Product	337	0.030	0.128	0.097	3.22
Miscellaneous	339	0.100	0.194	0.094	0.94
All sectors		0.030	0.082	0.052	1.70

Table B.2: Changes in Energy Use in US Manufacturing, by sectors 1997-2005

	Quantity of Purchased Fuels				Quantity of Purchased Electricity			
			Changes				Changes	
NAICS	1997	2005	2005-1997	%	1997	2005	2005-1997	%
311	16.581	18.926	2.345	0.14	4.115	5.722	1.607	0.39
312	9.587	9.987	0.400	0.04	2.900	3.550	0.650	0.22
313	14.061	9.144	-4.917	-0.35	8.109	6.172	-1.938	-0.24
314	4.438	3.864	-0.574	-0.13	2.031	2.825	0.794	0.39
315	1.802	0.497	-1.305	-0.72	1.003	0.495	-0.508	-0.51
316	0.694	0.385	-0.309	-0.45	0.320	0.325	0.005	0.01
321	9.748	10.189	0.440	0.05	5.328	6.817	1.489	0.28
322	66.552	62.218	-4.334	-0.07	11.951	12.862	0.911	0.08
323	3.703	3.173	-0.531	-0.14	4.062	5.166	1.103	0.27
324	227.241	350.000	122.759	0.54	27.287	33.552	6.265	0.23
325	70.779	92.387	21.608	0.31	15.764	15.116	-0.648	-0.04
326	8.834	9.206	0.372	0.04	10.010	13.173	3.162	0.32
327	35.806	40.099	4.293	0.12	5.349	6.595	1.246	0.23
331	56.510	79.591	23.081	0.41	17.402	17.923	0.522	0.03
332	5.873	4.871	-1.002	-0.17	3.294	4.201	0.907	0.28
333	2.302	1.782	-0.520	-0.23	1.876	2.115	0.238	0.13
334	2.899	2.206	-0.693	-0.24	4.300	3.936	-0.363	-0.08
335	18.743	16.417	-2.326	-0.12	2.549	2.494	-0.055	-0.02
336	9.380	7.910	-1.470	-0.16	6.050	6.592	0.542	0.09
337	2.528	1.920	-0.608	-0.24	2.207	2.601	0.393	0.18
339	1.762	1.511	-0.251	-0.14	1.401	1.874	0.473	0.34
All	20.936	24.692	3.757	0.18	5.938	6.552	0.614	0.10

Table B.3: Pooled OLS Estimation on the Quantity of Energy

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lgpenCHN	0.00955	0.00676	0.00705	0.0234	-0.188***	-0.194***	-0.808***	-1.029***	-0.799***	-0.764***

Table B.4: IV Estimation on the Quantity of Energy

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lgpenCHN	0.113***	0.0959***	0.0973***	0.108***	-0.00247	0.0517	-0.136	-0.103	-0.0807	-0.0334
	(0.0196)	(0.0194)	(0.0193)	(0.0209)	(0.0739)	(0.0780)	(0.233)	(0.238)	(0.238)	(0.234)
lgLK	0.0684	0.0866**	-0.318**	-0.200	-0.296*	0.0339	-0.317*	0.00334	0.0157	0.146
	(0.0461)	(0.0422)	(0.152)	(0.161)	(0.168)	(0.198)	(0.167)	(0.200)	(0.199)	(0.196)
lgvship	0.542***	1.308***	1.542***	1.469***	1.484***	1.159***	1.635***	1.339***	1.298***	1.080***
	(0.0322)	(0.122)	(0.146)	(0.158)	(0.158)	(0.171)	(0.255)	(0.284)	(0.284)	(0.278)
sqlgvship		-0.0469***	-0.0568***	-0.0538***	-0.0511***	-0.0354***	-0.0602***	-0.0461***	-0.0445***	-0.0353**
		(0.00718)	(0.00814)	(0.00859)	(0.00857)	(0.00906)	(0.0147)	(0.0160)	(0.0160)	(0.0155)
LKvship			0.0488***	0.0427**	0.0522***	0.0145	0.0547***	0.0182	0.0158	0.00689
			(0.0182)	(0.0180)	(0.0189)	(0.0232)	(0.0191)	(0.0238)	(0.0237)	(0.0229)
penCHNLK				0.0125	0.00801	-0.0189	0.00760	-0.0188	-0.0179	-0.00252
				(0.00856)	(0.00851)	(0.0121)	(0.00834)	(0.0121)	(0.0120)	(0.0120)
penCHNvship					0.0117	0.00503	0.0424	0.0405	0.0353	0.0305
					(0.00720)	(0.00773)	(0.0496)	(0.0499)	(0.0499)	(0.0487)
penCHNsqLK						-0.0113***		-0.0110***	-0.0104***	-0.00821**
						(0.00365)		(0.00368)	(0.00368)	(0.00343)
penCHNsqvship							-0.00177	-0.00204	-0.00177	-0.00170
							(0.00274)	(0.00272)	(0.00271)	(0.00262)

Table B.5: Pooled OLS Estimation on the Quantity of Fuel

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lgpenCHN	0.0116	0.00838	0.00838	0.00302	-0.226***	-0.194***	-1.054***	-1.029***	-1.024***	-1.002***
	(0.00975)	(0.00945)	(0.00947)	(0.0162)	(0.0553)	(10 ***				

Table B.7: Pooled OLS Estimation on the Quantity of Electricity

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lgpenCHN	0.00387	0.00120	0.00187	0.0360**	-0.0866	-0.113*	-0.296	-0.316	-0.316	-0.272
	(0.0106)	(0.0105)	(0.0104)	(0.0167)	(0.0614)	(0.0592)	(0.266)	(0.255)	(0.255)	(0.252)
lgLK	0.0840	0.101	-0.568**	-0.348	-0.467*	-0.694**	-0.501*	-0.724**	-0.717**	-0.623**
	(0.0866)	(0.0798)	(0.242)	(0.248)	(0.256)	(0.306)	(0.265)	(0.310)	(0.309)	(0.303)
lgvship	0.472***	1.272***	1.656***	1.512***	1.533***	1.764***	1.793***	2.014***	2.004***	1.718***
	(0.0601)	(0.223)	(0.259)	(0.290)	(0.283)	(0.290)	(0.375)	(0.360)	(0.359)	(0.348)
sqlgvship		-0.0487***	-0.0650***	-0.0590***	-0.0557***	-0.0671***	-0.0717***	-0.0826***	-0.0823***	-0.0688***
		(0.0126)	(0.0139)	(0.0154)	(0.0153)	(0.0157)	(0.0204)	(0.0197)	(0.0197)	(0.0187)
LKvship			0.0804***	0.0714***	0.0832***	0.109***	0.0871***	0.113***	0.112***	0.106***
			(0.0278)	(0.0269)	(0.0276)	(0.0377)	(0.0286)	(0.0379)	(0.0377)	(0.0361)
penCHNLK				0.0260***	0.0207**	0.0389*	0.0198**	0.0379*	0.0384*	0.0506***
				(0.00920)	(0.00952)	(0.0204)	(0.00948)	(0.0205)	(0.0206)	(0.0180)
penCHNvship					0.0138**	0.0173**	0.0642	0.0662	0.0662	0.0604
					(0.00696)	(0.00699)	(0.0600)	(0.0583)	(0.0582)	(0.0576)
penCHNsqLK						0.00764		0.00757	0.00773	0.0101*
						(0.00646)		(0.00648)	(0.00651)	(0.00567)
penCHNsqvship							-0.00299	-0.00290	-0.00291	-0.00270
							(0.00331)	(0.00327)	(0.00327)	(0.00323)
lgN rm									0.0192	0.00770
									(0.0664)	(0.0653)
lgtfp										0.330***
										(0.0908)
Constant	10.77***	7.545***	5.514***	6.464***	6.041***	4.909***	5.001***	3.910**	3.865**	5.406***
	(0.555)	(1.058)	(1.265)	(1.445)	(1.410)	(1.407)	(1.768)	(1.674)	(1.696)	(1.671)
Observations	3,296	3,296	3,296	3,296	3,296	3,296	3,296	3,296	3,296	3,296
R-squared	0.304	0.323	0.329	0.339	0.342	0.346	0.343	0.347	0.347	0.359
Number of NAICS	380	380	380	380	380	380	380	380	380	380

Table B.8: IV Estimation on the Quantity of Electricity

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lgpenCHN	0.0928***	0.0769***	0.0793***	0.109***	0.121	0.109	0.488*	0.481*	0.479*	0.545*
	(0.0230)	(0.0230)	(0.0229)	(0.0243)	(0.0882)	(0.0897)	(0.285)	(0.288)	(0.288)	(0.282)
lgLK	0.0878*	0.106**	-0.685***	-0.371**	-0.360*	-0.437*	-0.301	-0.361	-0.362	-0.165
	(0.0474)	(0.0443)	(0.171)	(0.182)	(0.198)	(0.228)	(0.208)	(0.244)	(0.245)	(0.236)
lgvship	0.494***	1.222***	1.677***	1.482***	1.480***	1.556***	1.066***	1.121***	1.126***	0.795**
	(0.0342)	(0.128)	(0.147)	(0.160)	(0.162)	(0.186)	(0.326)	(0.359)	(0.361)	(0.348)
sqlgvship		-0.0446***	-0.0638***	-0.0560***	-0.0563***	-0.0599***	-0.0314*	-0.0340*	-0.0342*	-0.0203
		(0.00743)	(0.00803)	(0.00844)	(0.00818)	(0.00924)	(0.0185)	(0.0200)	(0.0201)	(0.0191)
LKvship			0.0953***	0.0791***	0.0781***	0.0868***	0.0709***	0.0777***	0.0779***	0.0647**
			(0.0200)	(0.0196)	(0.0212)	(0.0258)	(0.0226)	(0.0281)	(0.0281)	(0.0267)
penCHNLK				0.0331***	0.0336***	0.0398***	0.0347***	0.0396***	0.0395***	0.0632***
				(0.00971)	(0.0101)	(0.0148)	(0.0103)	(0.0150)	(0.0151)	(0.0140)
penCHNvship					-0.00131	0.000230	-0.0857	-0.0854	-0.0847	-0.0910
					(0.00818)	(0.00849)	(0.0599)	(0.0600)	(0.0602)	(0.0581)
penCHNsqLK						0.00261		0.00206	0.00198	0.00533
						(0.00442)		(0.00449)	(0.00451)	(0.00399)
penCHNsqvship							0.00486	0.00491	0.00488	0.00492
							(0.00330)	(0.00328)	(0.00329)	(0.00314)
lgN rm									-0.00689	-0.0162
									(0.0340)	(0.0337)
lgtfp										0.359***
										(0.0604)
Observations	3,187	3,187	3,187	3,187	3,187	3,187	3,187	3,187	3,187	3,187
R-squared	0.252	0.286	0.292	0.316	0.314	0.317	0.303	0.305	0.305	0.316
Number of naics	363	363	363	363	363	363	363	363	363	363