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Tariff Elimination and the Wage Gap in an Industrial Specific Factors Model*

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Abstract

A specific factors model of 458 US manufacturing industries simulates the effects of eliminating manufacturing tariffs on unskilled and skilled wages. The model assumes constant elasticity substitution, industry-specific capital inputs, and mobile unskilled and skilled labor. Tariff elimination slightly lowers both unskilled and skilled wages, and increases the skilled wage gap. Industry outputs and capital returns absorb the negative impact of the falling tariffs with losses concentrated in more highly protected industries and most industries enjoying small positive outcomes.

1. Introduction

The effect of falling tariffs on wages and the skilled wage gap in developed countries remains a topic of interest. The Stolper–Samuelson (1941) theorem predicts lost protection would lower wages in labor-scarce countries and income redistribution would be required to raise all real factor incomes. The present paper examines the potential impact on the skilled wage gap of a hypothetical trade liberalization event, the complete elimination of all US manufacturing tariffs. The paper specifies a specific factors model with 458 manufacturing industries, mobile unskilled and skilled labor, and specific industrial capital.

There is evidence of a decline in the middle of the US income distribution coincidental with declining tariffs over recent decades. The wage of US high school relative to college graduates fell by 19% between 1973 and 2003 as pointed out by Autor et al. (2005). Feenstra and Hanson (1995) estimate increased trade volumes account for a third of the decline in US production relative to nonproduction wages during the 1980s. Wood (1994), Slaughter (1998), Feenstra and Hanson (1999), Baldwin and Cain (2000), and Leamer (2000) also uncover large wage effects due to increased trade volumes. Dasgupta and Osang (2007) uncover an empirical link between US manufacturing prices and the wage gap over the years 1958 to 1996, closer to the theory based on price changes.

Technology rather than trade is seen as the predominant cause of the increased wage gap by Lawrence and Slaughter (1993), Sachs and Shatz (1994), Berman et al. (1998), Haskel and Slaughter (2002, 2003), and Tokarick (2005). Dasgupta and Osang (2007) also separate a technology effect on the wage gap and separate effects of changing capital and labor endowments, consistent with theory.

There seems to be some consensus that falling US tariffs have accounted for some of the increased wage gap but the weight of the impact remains an issue. The policy issue

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is critical as the US moves forward in various free-trade agreements. For example, Batra (1992, 1994) and Batra and Slotje (1993) believe discriminatory tariffs against high-technology imports from Japan during the 1980s would have supported the US wage, while Marjit (1994) and Rassekh (1994) disagree.

Trade liberalization events may provide evidence on the wage effects of free trade. NAFTA has been the largest single event but has had little impact on the US labor market. Hinojosa-Ojeda et al. (2000) estimate that between 1990 and 1997 there were 37,000 jobs lost per month in the US due to NAFTA but meanwhile the economy created over five times that many jobs. Burfisher et al. (2001) conclude the small effects of NAFTA should be no surprise since US trade with Mexico is relatively small and prices of traded products in the US have not changed.

In the present applied specific factors model, hypothetical price changes due to the trade liberalization event of eliminated manufacturing tariffs lead to comparative static adjustments in the unskilled wage and skilled wage. Adjustments in industrial outputs and capital returns are also derived. The industrial data separate two types of labor, production (unskilled), and non-production (mostly skilled), and both types of labor are assumed mobile between industries. Immobile capital is specific to its industry and the specific factors model is often characterized as the short run. The present model is much more disaggregated than other specifications in the literature such as Thompson (1994, 1996) or Thompson and Toledo (2001).

Tariff elimination slightly lowers both the wage and the skilled wage, and increases the relative skilled wage. Mobility of the two types of labor is the key to the small wage effects. In contrast, there are substantial adjustments in industrial capital return in highly protected industries. Most industries enjoy small gains, absorbing both types of labor from the industries that lose protection. Long-run adjustments due to altered investment incentives would be larger and are projected, and wage effects of the actual tariff decline between 1974 and 1996 are calculated.

2. The Industrial Specific Factors Model

Neoclassical production in each of the N industries requires inputs of mobile unskilled and skilled labor along with that particular industry-specific capital. Behavioral assumptions of the model are full employment and competitive pricing. Full employment of each of the $N+2$ factors is written

$$v_i = \sum_j a_{ij} x_j, \tag{1}$$

where v_i is the endowment of factor i, a_{ij} the cost-minimizing amount of factor i used to produce a unit of good j, and x_j the output of industry j.

Competitive pricing implies

$$p_j = \sum_i a_{ij} w_i, \tag{2}$$

where p_j is the price of good j, and w_i is the price of factor i. Each industry is assumed a price taker in its international market, difficult to verify at the present level of aggregation (Broadwoven Fabrics, Luggage, Blowers and Fans, Fabricated Pipe, etc.) but Thompson (2004) shows that the basic results of the model are not much affected by parametric relaxation of competitive pricing or full employment.

Totally differentiate (1) and introduce substitution elasticities to find

$$\hat{v}_i = \sum_j \lambda_{ij}\hat{x}_j + \sum_k \sigma_{ik}\hat{w}_k, \tag{3}$$

where the circumflex ("^") represents percentage change, λ_{ij} is the industry j share of factor i employment, and σ_{ij} the elasticity of demand for factor i with respect to the price of factor k.

Totally differentiate (2) and use the cost-minimizing envelope result to find

$$\hat{p}_j = \sum_j \theta_{ij}\hat{w}_i, \tag{4}$$

where θ_{ij} is the share of factor i in the revenue of good j. Output price changes in (4) are a weighted average of factor price changes in the Jones (1965) magnification effect.

Equations (3) and (4) are combined into

$$\begin{pmatrix} \sigma & \lambda \\ \theta' & 0 \end{pmatrix}\begin{pmatrix} \hat{w} \\ \hat{x} \end{pmatrix} = \begin{pmatrix} \hat{v} \\ \hat{p} \end{pmatrix}, \tag{5}$$

where $\hat{x}$ is the $N = 458$ vector of output changes, $\hat{w}$ is the $M = N + 2 = 460$ vector of factor price changes, $\hat{v} = 0$ is the M vector of zero endowment changes, $\hat{p}$ is the N vector of output price changes, σ is the $M \times M$ matrix of factor substitution elasticities, λ is the $M \times N$ matrix of industry shares, θ' is the $N \times M$ matrix of factor shares, and 0 is an $N \times N$ null matrix.

The comparative static $\hat{w}/\hat{p}$ elasticities of interest are derived inverting (5). A vector $\hat{p}$ of price changes from tariff elimination is multiplied by this derived $\hat{w}/\hat{p}$ matrix to find the endogenous $\hat{w}$ vector of factor price adjustments.

International manufacturing prices are held constant with the assumption that the US is a price taker in international markets. A number of the highly protected industries are in apparel, making this assumption reasonable. For industries with tariffs close to the average of 2.9% (Blowers and Fans, Hardware, etc.) tariff elimination might raise world prices but the effect would seem to be small.

3. Factor Shares and Industry Shares in the Industrial Specific Factors Model

The system matrix on the left-hand side of (5) is constructed from the Manufacturing Industry Productivity Database of the National Bureau of Economic Research (NBER). The dataset provides production data by industry SIC code, most recently for 1996. Asbestos Products SIC 3292 has no value-added and is dropped from the sample leaving 458 industries.

The present model focuses on manufacturing, not services or agriculture where there is no similar breakdown of labor. The dataset provides total payments to production and total labor with production labor a proxy for unskilled labor. The nonproduction (skilled) labor bill is derived as the residual from the total labor bill. Professionals and technical workers are the predominant groups in this residual category. The numbers of workers are similarly separated and average wages for the two groups are derived.

The capital payment is the residual of value-added after the total labor bill. The mean of the capital share is 0.64 and its standard deviation 0.11, and it ranges from 0.95 to 0.15. Some part of this large variation is due to energy inputs, implicitly included in residual capital. The mean energy share in more aggregated manufacturing data is 0.12 and the standard deviation about the same size. The present simulations effectively assume capital and energy are perfect complements. The wage effects of tariff elimination would be somewhat smaller with perfectly mobile energy input between industries.

The mean wage of production labor across industries is \$26,200 with a standard deviation of \$8200 due at least in part to cost-of-living differences. The wage distribution across industries is near normal with a low kurtosis of 0.67 and slight right skew of 0.78.

The mean skilled wage is two-thirds higher at \$43,700. Its standard deviation of \$8600 is much smaller relative to its mean. There is clustering around the mean with a kurtosis of 1.21 and a negligible skew of –0.13. The suggestion is that skilled labor is more mobile across industries.

The θ matrix of factor shares is the factor payment relative to industry value-added. The working assumption is that mobility of unskilled labor implies equal unskilled wages across industries, and the same assumption holds for skilled labor. Competitive product markets and constant returns imply factor shares sum to one for each product.

Table 1 shows rows of the θ matrix for a select 30 industries that include 20 industries with the highest tariffs, five industries with tariffs closest to the average, and a selection of five of the 22 industries with no tariffs. Table 1 also contains the corresponding industry-specific residual capital shares.

Table 2 shows the industry share matrix, each element λ_{ij} calculated dividing the employment of factor i in industry j by the total quantity of the factor. As an example, skilled labor employment in Broadwoven Fabrics SIC 2231 is 1700 and its skilled labor industry share is $0.0003 = 1700 \div 5{,}159{,}700$, the total skilled labor employment in all 458 industries. Table 2 shows rows of the λ matrix for the selected industries. Each specific capital industry share equals one.

4. Factor Substitution in the Industrial Specific Factors Model

The partial cross-price elasticity of the input of factor i with respect to the price of factor k in industry j is

$$E_{ik}^{j} = \hat{a}_{ij} / \hat{w}_k. \tag{6}$$

Given the first-order envelope theorem of cost minimization, Sato and Koizumi (1973) show that

$$E_{ik}^{j} = \hat{a}_{ij} / \hat{w}_k = \theta_{kj} S_{ik}^{j}, \tag{7}$$

where S_{ik}^{j} is the Allen partial elasticity of substitution. With Cobb–Douglas production implies $S_{ik}^{j} = 1$ and constant elasticity of substitution (CES) production makes S_{ik}^{j} a positive constant. Estimated cross-price elasticities S_{ik}^{j} in the applied production literature are typically between 0.5 and 1, and the present simulations examine this sensitivity.

Each element σ_{ik} of the factor substitution matrix is the weighted elasticity of factor i input with respect to the price of factor k in the economy:

$$\sigma_{ik} = \sum_{j} \lambda_{kj} E_{ik}^{j} = \sum_{j} \lambda_{ij} \theta_{kj} S_{ik}^{j}, \tag{8}$$

as developed by Jones and Scheinkman (1977). Cobb–Douglas production implies the substitution elasticity is a sum of industry and factor shares:

$$\sigma_{ik} = \sum_{j} \lambda_{ij} \theta_{kj}. \tag{9}$$

Table 1. Factor Shares θ_{ij}

	Skilled labor	*Labor*	*K_j share*
High protection			
Broadwoven Fabrics Mills, Woven	0.099	0.345	0.557
Fabrics Dress & Work Gloves	0.065	0.221	0.714
Men's & Boys' Shirts	0.082	0.326	0.592
Ice Cream & Frozen Desserts	0.067	0.142	0.791
Ceramic Wall & Floor Tile	0.101	0.273	0.627
Men's & Boys' Suits & Coats	0.135	0.281	0.584
Women's & Misses' Blouses & Shirts	0.131	0.257	0.613
Knit Outerwear Mills	0.064	0.222	0.714
Men's & Boys' Work Clothing	0.080	0.209	0.711
Girls' & Children's Outerwear	0.077	0.197	0.726
Girls' Dresses & Blouses	0.101	0.142	0.757
Luggage	0.090	0.119	0.798
Women's & Misses' Suits & Coats	0.164	0.248	0.589
Leather Gloves & Mittens	0.138	0.701	0.153
House Slippers	0.112	0.315	0.575
Women's Handbags & Purses	0.057	0.252	0.690
Men's & Boys' Clothing	0.089	0.285	0.626
Rubber & Plastics Footwear	0.120	0.253	0.627
Women's & Misses' Dresses	0.126	0.297	0.577
Weft Knit Fabric Mills	0.127	0.335	0.538
Average protection			
Blowers & Fans	0.181	0.225	0.593
Wet Corn Milling	0.051	0.089	0.859
Crowns & Closures	0.124	0.256	0.619
Photographic Equipment & Supplies	0.106	0.093	0.801
Hardware	0.137	0.246	0.616
No protection			
Dog & Cat Food	0.044	0.094	0.861
Paperboard Mills	0.078	0.191	0.731
Periodicals	0.231	0.028	0.741
Ready-Mixed Concrete	0.111	0.290	0.599
Fabricated Pipe and Fittings	0.157	0.282	0.562

Homogeneity of the production function implies $\Sigma_k E^j_{ik} = 0$ and own-substitution elasticities are derived as the negative of the sum of derived cross-price elasticities. Scaling of the CES production function implies uniform scaling of the substitution elasticities σ_{ik}.

Table 3 reports Cobb–Douglas substitution elasticities. An increase of 1% in the unskilled wage would increase skilled labor input by 0.191% and average industrial capital input by 0.224%, and lower its own input by –0.758%. The skilled wage has slightly smaller cross-effects due to its smaller factor share. An increase of 1% in the skilled wage would increase unskilled labor input by 0.138% and average industrial capital input by 0.137%, and reduce its own input by –0.832%. Elasticities with respect to capital input prices are somewhat larger. For instance, an increase of 1% in the price of capital input in Broadwoven Fabric in the third column would increase unskilled labor input by 0.345% and skilled labor input by 0.099%, and reduce capital input by –0.443%.

Table 2. Industry Shares λ_{ij}

	Skilled labor	*Labor*
High protection		
Broadwoven Fabrics Mills, Woven	0.0003	0.0010
Fabrics Dress & Work Gloves	0.0001	0.0002
Men's & Boys' Shirts	0.0012	0.0044
Ice Cream & Frozen Desserts	0.0011	0.0011
Ceramic Wall & Floor Tile	0.0003	0.0003
Men's & Boys' Suits & Coats	0.0009	0.0018
Women's & Misses' Blouses & Shirts	0.0014	0.0030
Knit Outerwear Mills	0.0010	0.0033
Men's & Boys' Work Clothing	0.0007	0.0016
Girls' & Children's Outerwear	0.0006	0.0015
Girls' Dresses & Blouses	0.0005	0.0007
Luggage	0.0003	0.0004
Women's & Misses' Suits & Coats	0.0012	0.0022
Leather Gloves & Mittens	0.0001	0.0002
House Slippers	0.0000	0.0001
Women's Handbags & Purses	0.0001	0.0002
Men's & Boys' Clothing	0.0008	0.0025
Rubber & Plastics Footwear	0.0003	0.0006
Women's & Misses' Dresses	0.0025	0.0066
Weft Knit Fabric Mills	0.0001	0.0007
Average protection		
Blowers & Fans	0.0020	0.0017
Wet Corn Milling	0.0005	0.0005
Crowns & Closures	0.0002	0.0003
Photographic Equipment & Supplies	0.0048	0.0029
Hardware	0.0034	0.0048
No protection		
Dog & Cat Food	0.0006	0.0008
Paperboard Mills	0.0025	0.0034
Periodicals	0.0202	0.0013
Ready-Mixed Concrete	0.0040	0.0061
Fabricated Pipe and Fittings	0.0016	0.0019

Both unskilled labor and skilled labor are very weak substitutes for industrial capital due to their small factor shares with average elasticities of 0.001 with respect to prices of industrial capital. In the capital substitutions of the first two columns, capital is a somewhat better substitute for unskilled labor than for skilled labor. Capital has an average own elasticity of –0.186 across industries, much less than the unskilled and skilled labor own elasticities due to larger cross-price elasticities with respect to the prices of capital.

All inputs are substitutes with CES production. Estimates of translog production functions in the applied literature typically uncover weak substitution. The largest capital input elasticity with respect to the skilled wage is 0.43 for Computer Terminals SIC 3575 (not in Table 3) and the largest elasticity with respect to the unskilled wage is 0.70 in Leather Gloves and Mittens SIC 3151. The assumption of 0.5 CES would imply substitution elasticities half as large as those in Table 3.

Table 3. Substitution Elasticities σ_{ik}

	$\hat{w}_S$	$\hat{w}_U$	$\hat{w}_K$
Skilled Labor	–0.832	0.191	0.001 mean
Labor	0.138	–0.758	0.001 mean
High protection			
Broadwoven Fabrics Mills, Woven	0.099	0.345	–0.443
Fabrics Dress & Work Gloves	0.065	0.220	–0.286
Men's & Boys' Shirts	0.082	0.326	–0.408
Ice Cream & Frozen Desserts	0.066	0.142	–0.209
Ceramic Wall & Floor Tile	0.101	0.273	–0.373
Men's & Boys' Suits & Coats	0.135	0.281	–0.417
Women's & Misses' Blouses & Shirts	0.131	0.257	–0.388
Knit Outerwear Mills	0.064	0.222	–0.360
Men's & Boys' Work Clothing	0.080	0.209	–0.289
Girls' & Children's Outerwear	0.077	0.197	–0.274
Girls' Dresses & Blouses	0.101	0.142	–0.243
Luggage	0.090	0.112	–0.202
Women's & Misses' Suits & Coats	0.164	0.248	–0.412
Leather Gloves & Mittens	0.137	0.710	–0.842
House Slippers	0.111	0.315	–0.425
Women's Handbags & Purses	0.057	0.253	–0.310
Men's & Boys' Clothing	0.089	0.285	–0.374
Rubber & Plastics Footwear	0.119	0.253	–0.373
Women's & Misses' Dresses	0.126	0.297	–0.423
Weft Knit Fabric Mills	0.127	0.335	–0.462
Average protection			
Blowers & Fans	0.181	0.225	–0.406
Wet Corn Milling	0.051	0.089	–0.141
Crowns & Closures	0.124	0.258	–0.382
Photographic Equipment & Supplies	0.106	0.093	–0.199
Hardware	0.137	0.246	–0.383
No protection			
Dog & Cat Food	0.044	0.095	–0.139
Paperboard Mills	0.078	0.191	–0.269
Periodicals	0.231	0.028	–0.259
Ready-Mixed Concrete	0.111	0.290	–0.401
Fabricated Pipe and Fittings	0.157	0.282	–0.439
Industrial means	0.137	0.224	–0.186

Matrices of substitution, factor shares, and industry shares are combined to construct the 918 × 918 system matrix on the left-hand side of (5). Matrix dimensions are $\sigma_{460\times460}$, $\lambda_{460\times458}$, $\theta'_{458\times460}$, and $0_{458\times458}$.

5. Tariff Elimination and Price Changes in the Industrial Specific Factors Model

Tariff elimination would decrease prices in the vector $\hat{p}$ in (5) to world levels with larger industrial tariffs implying larger price declines. Data on tariff levels by SIC code from Feenstra et al. (2002) include derived duties and customs value, and the present tariff rates are derived as total customs duties divided by declared customs value.

Table 4. Tariff Rates and Projected Price Changes

	% Tariff	$\hat{p}$
High protection		
Broadwoven Fabrics Mills, Woven	19.3	–16.2
Fabrics Dress & Work Gloves	17.9	–15.2
Men's & Boys' Shirts	17.5	–14.9
Ice Cream & Frozen Desserts	17.5	–14.9
Ceramic Wall & Floor Tile	16.9	–14.1
Men's & Boys' Suits & Coats	15.6	–13.5
Women's & Misses' Blouses & Shirts	15.6	–13.4
Knit Outerwear Mills	15.5	–13.4
Men's & Boys' Work Clothing	14.9	–13.0
Girls' & Children's Outerwear	14.8	–12.9
Girls' Dresses & Blouses	14.5	–12.6
Luggage	14.3	–12.5
Women's & Misses' Suits & Coats	14.3	–12.5
Leather Gloves & Mittens	13.4	–11.8
House Slippers	12.9	–11.4
Women's Handbags & Purses	12.9	–11.4
Men's & Boys' Clothing	12.8	–11.3
Rubber & Plastics Footwear	12.4	–11.0
Women's & Misses' Dresses	12.3	–11.0
Weft Knit Fabric Mills	11.9	–10.6

Data are constructed from harmonized tariff codes but there is no unique one-to-one mapping between tariff and SIC codes. Some tariff products map to alternate categories. For instance, SIC 2013 is listed as having no trade data because it is included in SIC 2011. For 64 of these "missing" industries there is a unique alternate SIC code. The same tariff rates would apply to both industries and then is assigned to the missing industry. Some other industries map to more than a single SIC category and a weighted average of the appropriate duties is calculated. A few remaining categories do not map to any alternate SIC and these industries are assumed to have no trade and zero tariffs.

Table 4 reports the highest calculated tariff rates and percentage price declines due to tariff elimination. Price declines are derived as percentage changes assuming a unit world price $\hat{p} = -t/(1 + t)$. For instance, the tariff in Broadwoven Fabrics SIC 2231 is 0.193 and the derived price decline is $-0.162 = -0.193/1.193$. It is reasonable to assume effects on world markets would be minimal if not zero. Pricing to market by foreign exporters would diminish price decreases in Table 4. The present assumptions provide a benchmark for the general-equilibrium effects of total tariff elimination rather than detailed industrial analyses.

The simple average tariff for all industries in Figure 1 is 2.9% with many industries clustered close to the mean as indicated by the 5.3 kurtosis. The high standard deviation 3.4% is due to a long low tail of industries with high tariffs ranging up to 19%. There is a strong right skew of 2.2 and the median tariff 1.7% is well below the mean.

Figure 2 shows the tariff distribution by SIC category, and major categories are listed in Table 5. There are clusters of high protection in the 2200–2300 range of Textile and Apparel as well as the 3100–3200 range of Leather, Stone, and Glass. The mean of the tariff without these industries falls from 2.9% to 2.1%.

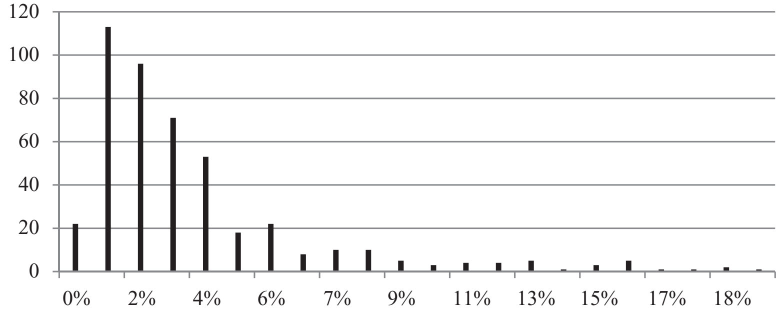

Figure 1. Tariff Frequency

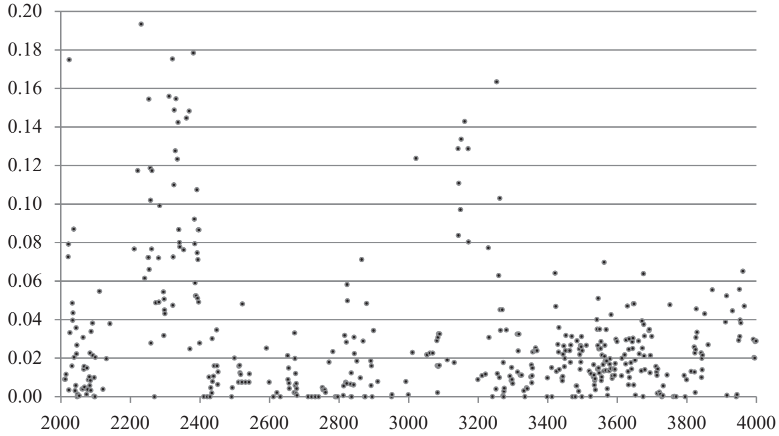

Figure 2. Tariff Distribution by SIC

Table 5. SIC Categories

SIC	*Category*
2000	Food
2100	Tobacco
2200	Textiles
2300	Apparel
2400	Lumber
2500	Furniture
2600	Paper
2700	Chemicals
2800	Printing
2900	Petroleum
3000	Rubber/Plastic
3100	Leather
3200	Stone/Glass
3300	Primary Metals
3400	Fabricated Metals
3500	Machinery
3600	Electrical/Electronic
3700	Transport
3800	Instruments
3900	Miscellaneous

6. Adjustments in Factor Prices and Outputs to Tariff Elimination

To find the vector $\hat{w}$ of factor price changes due to tariff elimination, multiply the comparative static $\hat{w}/\hat{p}$ matrix from the inverted system (5) by the vector $\hat{p}$ of price changes. The output adjustment vector $\hat{x}$ is found multiplying $\hat{x}/\hat{p}$ from (5) by the predicted $\hat{p}$.

Table 6 reports the predicted factor price and output changes. The same factor price changes would occur for any degree of CES, a property first noted by Thompson and Toledo (2001). With a lower degree of CES, for instance, output adjustments along the

Table 6. Percentage Factor Price and Output Adjustments

Skilled Labor	–1.6	
Labor	–2.6	
Industry capital returns		*Outputs*
High protection		
Broadwoven Fabrics Mills, Woven	–27.2	–11.0
Fabrics Dress & Work Gloves	–20.3	–5.1
Men's & Boys' Shirts	–23.9	–8.7
Ice Cream & Frozen Desserts	–18.2	–3.3
Ceramic Wall & Floor Tile	–21.1	–7.0
Men's & Boys' Suits & Coats	–21.5	–8.0
Women's & Misses' Blouses & Shirts	–20.5	–7.1
Knit Outerwear Mills	–17.8	–4.4
Men's & Boys' Work Clothing	–17.3	–4.3
Girls' & Children's Outerwear	–16.9	–4.0
Girls' Dresses & Blouses	–16.0	–3.4
Luggage	–15.1	–2.6
Women's & Misses' Suits & Coats	–19.7	–7.2
Leather Gloves & Mittens	–63.9	–52.1
House Slippers	–18.1	–6.7
Women's Handbags & Purses	–15.5	–4.1
Men's & Boys' Clothing	–16.7	–5.4
Rubber & Plastics Footwear	–16.2	–5.2
Women's & Misses' Dresses	–17.4	–6.4
Weft Knit Fabric Mills	–17.7	–7.1
Average protection		
Blowers & Fans	–2.9	–0.3
Wet Corn Milling	–2.7	–0.1
Crowns & Closures	–2.8	–0.2
Photographic Equipment & Supplies	–2.8	–0.1
Hardware	–2.9	–0.3
No protection		
Dog & Cat Food	0.4	0.4
Paperboard Mills	0.5	0.8
Periodicals	0.6	0.6
Ready-Mixed Concrete	1.5	1.5
Fabricated Pipe and Fittings	1.7	1.7

production frontier diminish but factor price adjustments along the contract curve are identical. If CES = 0.5 factor price changes are identical and output changes half as large in absolute value as those in Table 6.

Tariff elimination lowers the unskilled wage by 2.6% and the skilled wage by 1.6%, resulting in an increase of 1% in the relative skilled wage. The average unskilled wage would fall from $26,200 to $25,519 and the skilled wage from $43,700 to $43,001, both about $700. The difference between skilled and unskilled wages falls slightly from $17,500 to $17,482. The modest adjustments in the unskilled and skilled wage are due to the moderating effects of mobility across industries.

The net increase in the demand for skilled relative to unskilled labor with tariff elimination is due to differences in factor intensity and substitution. More highly protected industries are slightly more intensive in unskilled relative to skilled labor. The mean ratio of unskilled to skilled labor L/S is 4.37 with a high standard deviation of 2.01 and a cluster of industries around the mean with a 7.13 kurtosis. The right skew of 1.85 indicates a long tail of highly unskilled labor-intensive industries similar to the tariff distribution. The correlation of tariffs with the L/S ratio is 0.382, as illustrated in Figure 3. There are more unskilled labor-intensive industries facing falling prices on average. There is a slightly weaker correlation of 0.209 between tariffs and unskilled labor factor shares, and there is a weak negative correlation of –0.133 between tariffs and skilled labor factor shares. Unskilled labor is more highly protected and suffers more with manufacturing tariff elimination than skilled labor.

Industrial outputs fall by an average of –0.5% ranging from a maximum of 3.1% to a minimum of –52.1% with a standard deviation of 3.2%. Figure 4 shows the distribution of output changes across SIC categories with one omitted outlier. Most industries cluster close to the mean with an extremely high kurtosis of 152 and a strong left skew of –10. Industries with no protection produce little more output with tariff elimination while outputs in highly protected industries decline considerably, as verified by the high correlation of 0.677 between price changes and output adjustments. The scale of output adjustments decreases with the degree of CES substitution.

Regarding industrial capital return adjustments, Thompson (1989) shows that with two shared inputs there is no guarantee a higher industry price leads to a higher specific capital return. The uniform weak substitution in the present model, however, leads to a 0.912 correlation between price changes and capital return adjustments. Figure 5

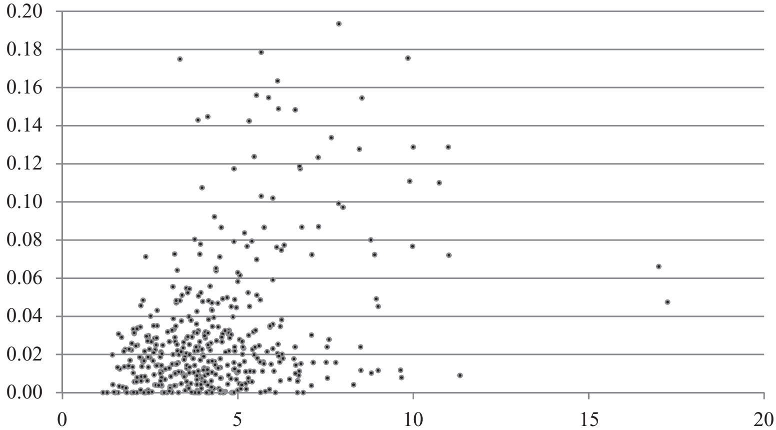

Figure 3. Tariff Rates and Unskilled/Skilled Labor Ratio

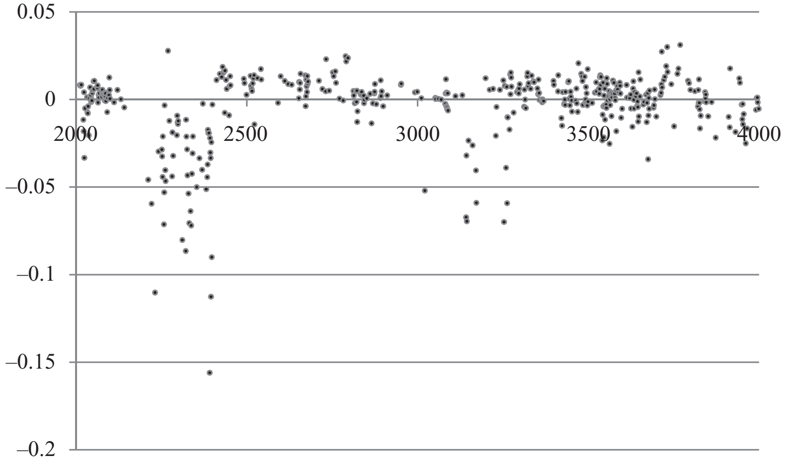

Figure 4. Output Adjustments by SIC

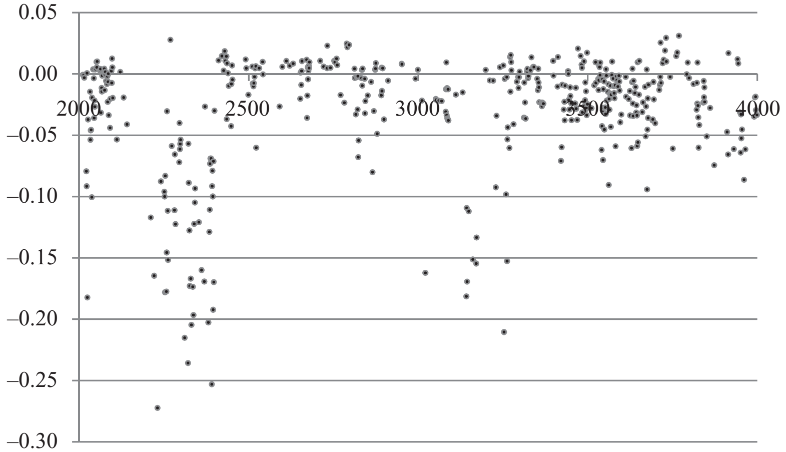

Figure 5. Capital Return Adjustments by SIC

shows the industrial distribution of capital returns short of the omitted –64% for Leather Gloves and Mittens SIC 3151. The largest increase is 3.1% in Space Vehicle Equipment SIC 3769. The mean adjustment in industrial capital returns is –3.2% with a high standard deviation of 5.7% and most industries clustered close to the mean with a high kurtosis of 29. The negative skew of –3.9 reflects losses for more highly protected industries.

The model also gauges effects of the historical reduction in industrial tariffs between 1974 and 1996. Weighting each industrial relative wage by its share of value-added in the NBER Productivity Database, the relative skilled wage rises from 1.53 to 1.69. The actual tariff changes from 1974 to 1996 generate price changes, and the present model predicts declines of 4% in the unskilled wage and 3% in the skilled wage. The model predicts the actual tariff reductions would have increased the skilled wage from 1.53 to 1.55, about 13% of the actual increase. Dasgupta and Osang (2007) estimate that actual changes in US manufacturing prices from 1958 to 1996 accounted for up to a quarter of the increase in the wage gap. Changing prices of traded products in fact played a larger role than suggested by simple tariff reductions, with prices of a range of manufactured imports falling due to imports from low-wage countries while prices of manufactured exports rose.

7. Conclusion

Eliminating US manufacturing tariffs in the present industrial specific factors model slightly lowers the unskilled wage and the skilled wage, and increases the relative skilled wage by 1%. The average industrial price decline due to tariff elimination outweighs the decline in the unskilled wage, suggesting neither type of labor would necessarily lose in real terms depending on consumption shares. The average decline in capital returns across the 458 industries is about –3% with losses highly skewed toward protected industries. Over a longer time horizon, declining capital returns would diminish investment and lead to noticeable output adjustments.

With a broader perspective on the move to free trade, the price of labor-intensive services in the US increases with exports and would support wages. Nevertheless, the real return to some factor of production must fall with free trade and the present model suggests it would be unskilled labor. The suggestion is that tax reform should be tackled along with trade policy reform.

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