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What Can Industry Trade Orientation Tell Us About Trade-Related Employment Dynamics?

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Abstract

We explore whether imports and exports affect industry employment differently based on the industry's trade orientation. Effects of trade are examined for both production and non-production employment using data for 384 6-digit manufacturing industries, classified by the North American Industrial Classification System (NAICS), and 116 trading partners that span the years 1972 to 2001. Additionally, we consider potential employment effects stemming from shifts in import sources from high- to low-income nations. The findings confirm theory and provide a more detailed portrait of trade-related employment dynamics. As the United States further liberalizes trade, net job loss may be expected in more labor-intensive industries that run trade deficits and possess lower than average levels of technology. Export-oriented industries characterized by more capital-intensive production and possession of above-average levels of technology are expected to see net job creation.

Keywords: Import Penetration, Manufacturing, Net Employment Change
Trade Balance, Value Share Competition

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INTRODUCTION

Between 1972 and 2001, US manufacturing employment as a share of total employment decreased from 24.3 to 14.7 percent while trade as a share of Gross Domestic Product (GDP) increased from 11.3 to 18.5 percent [US Census, 2002; 1976]. Protectionists cite such statistics to argue that imports lead to domestic job loss and to justify the maintenance or expansion of trade barriers. Supporters of free trade claim that increasing exports creates jobs and that a declining manufacturing sector is understandable as US output has shifted toward the provision of services. The empirical literature finds both sides of the debate to be correct: exports have created jobs, while imports have destroyed jobs. We extend the literature by examining trade-related employment dynamics, placing particular focus on employment effects across industries that have been classified according to relative export and import intensity.

Theory predicts that trade with labor-abundant nations reallocates US production from labor-intensive to capital-intensive goods. Prior research has found the employment effects of imports to be minor when compared to domestic demand shifts and business cycle fluctuations [Sachs and Shatz, 1994; Revenga, 1992]. However, a strong positive relationship between imports and job loss is found for industries exposed to high levels of import competition [Kletzer, 2000 and 1998]. Additionally, Bernard and Jensen [1995] report higher employment growth at exporting firms as compared to non-exporters. Kletzer [2002], Blanchflower [2000], Belman and Lee [1996], Baldwin [1995] and Dickens [1988] provide excellent surveys of the associated literature.

We consider employment effects for both production and non-production workers. Additionally, we examine potential employment effects stemming from shifts in import sources from high- to low-income nations. The underlying rationale is that lower labor costs in low-income countries may confer an advantage to foreign producers. To complete the analysis, we employ data for 384 6-digit industries, classified using the North American Industrial Classification System (NAICS), and 116 trading partners that span the years 1972 to 2001. Following Kletzer [2002], we use a modified Grubel-Lloyd Index [1975] to classify industries as unbalanced importers, balanced importers, balanced exports and unbalanced exporters. The index, $\hat{GLI} = 1 - \frac{X - M}{X + M}$, identifies industries as unbalanced importers (exporters) if the index exceeds 1.5 (is below 0.5) and as balanced importers (exporters) if the index lies between 1 and 1.5 (0.5).

Generally speaking, the findings support the predictions of standard trade theory. Increased import competition contributes to job loss and increased exports generate jobs; however, we report significant variation in trade-related employment effects across industry classifications. We conclude that, as trade liberalization progresses, job loss may be expected in labor-intensive, less technologically-advanced net importing industries. Employment gains are expected in capital-intensive, more technologically-advanced export-oriented industries. The paper proceeds as follows. Section 2 presents the theoretical framework and estimation equation. Section 3 introduces the data, while Section 4 details the empirical results. Section 5 concludes.

THEORETICAL FRAMEWORK

Extending Freeman and Katz [1991], which modifies and extends the work of Mann [1988], factor markets are assumed competitive and equation (1) represents labor demand.

$$d\ln L_{jt} = -\eta d\ln W_{jt} + d\ln Z_{jt} + d\ln V_{jt} \qquad (1)$$

L_{jt} represents industry employment, η is the elasticity of labor demand and W_{jt} is the industry wage rate. Z_{jt} is a vector of factors that may exogenously shift product demand and, thus, may shift the labor demand curve, while V_{jt} is a vector of industry-specific variables. d is the difference operator, ln denotes the natural logarithm, and j and t are industry and time subscripts, respectively.

Labor supply is expressed by equation (2), where λ is the elasticity of labor supply and R_{jt} is a vector of factors underlying potential labor supply shifts.

$$d\ln L_{jt} = \lambda d\ln W_{jt} + d\ln R_{jt} \qquad (2)$$

In equilibrium, labor market clearing dictates that equations (1) and (2) are equal. Solving for $d\ln W_{jt}$ yields

$$d\ln W_{jt} = \left(\frac{1}{\lambda+\eta}\right)\left[d\ln Z_{jt} + d\ln V_{jt} - d\ln R_{jt}\right]. \qquad (3)$$

Substitution of equation (3) into equation (2) and solving for the change in industry employment results in equation (4).

$$d\ln L_{jt} = \left(\frac{\lambda}{\lambda+\eta}\right)\left[d\ln Z_{jt} + d\ln V_{jt}\right] - \left(\frac{\lambda}{\lambda+\eta} - 1\right) d\ln R_{jt} \qquad (4)$$

Due to potential simultaneity caused by wage and employment pressures on prices and, thus, on shipments, estimating equation (4) to examine the effects of shifts in labor supply and product demand on industry employment would be a mistake. Following Freeman and Katz [1991], we assume output prices depend solely on production costs, resulting in the relation between wages and sales being expressed by equation (5)

$$d\ln Q_{jt} = -\psi d\ln P_{jt} + d\ln Z_{jt} \qquad (5)$$

where Q_{jt} is industry output, P_{jt} is the industry price level, and ψ is the price elasticity of product demand. Z_{jt} is a vector of exogenous product demand shifters.

Assuming P_{jt} depends solely on production costs and, for simplicity, that labor is the only factor input, P_{jt} is determined solely by wages. Equation (6) illustrates.

$$d\ln P_{jt} = \phi d\ln W_{jt} + \varepsilon_{jt} \tag{6}$$

ϕ represents labor's share of total costs and ε_{jt} is a normally distributed, stochastic error term with an expected mean of zero and constant variance. Setting $d\ln R_{jt}$ and $d\ln V_{jt}$ equal to zero, for now, permits equations (3) and (4) to be written as follows.

$$d\ln W_{jt} = \theta d\ln Z_{jt} \tag{7}$$

$$d\ln L_{jt} = \Omega d\ln Z_{jt} \tag{8}$$

In equations (7) and (8), $\theta = \frac{1}{\lambda + \eta}$ and $\Omega = \frac{\lambda}{\lambda + \eta}$. These equations illustrate that wages and employment change in response to exogenous shifts in product demand. Substituting equation (6) into (5) and assuming that ε_{jt} is equal to 0 yields

$$d\ln Q_{jt} = -\psi\phi d\ln W_{jt} + d\ln Z_{jt}. \tag{9}$$

Using the identity that $d\ln S_{jt} = d\ln P_{jt} + d\ln Q_{jt}$ (where S_{jt} is industry sales) and substituting equation (9) into this identity yields equation (10).

$$d\ln S_{jt} = -\psi\phi d\ln W_{jt} + d\ln Z_{jt} + d\ln P_{jt} \tag{10}$$

Further substituting equation (6) into equation (10), again assuming that ε_{jt} is equal to 0, and solving the resulting equation for $d\ln Z_{jt}$ yields equation (11).

$$d\ln Z_{jt} = d\ln S_{jt} - (1-\psi)\phi d\ln W_{jt} \tag{11}$$

Substitution of equation (7) into equation (11) for $d\ln W_{jt}$ results in equation (12).

$$d\ln Z_{jt} = \left(\frac{1}{(1 + (1-\psi)\phi\theta)} \right) d\ln S_{jt} \tag{12}$$

Finally, substitution of equation (12) into equation (8) yields an expression relating changes in sales to changes in employment. Defining $\Lambda = \left(\frac{\Omega}{(1 + (1-\psi)\phi\theta)} \right)$ we can write the change in employment as

$$d\ln L_{jt} = \Lambda d\ln S_{jt}. \tag{13}$$

We decompose sales into component parts: domestic sales, exports, and imports; however, we alter the definition of sales such that $S_{jt} = D_{jt} + X_{jt} - M^{\alpha}_{jkt} - M^{1-\alpha}_{jkt}$. M^{α}_{jkt} ($M^{1-\alpha}_{jkt}$) represent imports from countries, denoted by k, with per capita GDP less (greater) than α percent of the US level. We approximate for percent changes by taking log-differences. Subscripts are dropped for now.

$$\frac{dS}{S} = \left(\frac{D}{S}\right)\frac{dD}{D} + \left(\frac{X}{S}\right)\frac{dX}{X} - \left(\frac{M^{\alpha}}{S}\right)\frac{dM^{\alpha}}{M^{\alpha}} - \left(\frac{M^{1-\alpha}}{S}\right)\frac{dM^{1-\alpha}}{M^{1-\alpha}} \tag{14}$$

If we permit $\frac{dS}{S} = \hat{S}$, $\frac{dD}{D} = \hat{D}$, $\frac{dX}{X} = \hat{X}$, $\frac{dM^{\alpha}}{M^{\alpha}} = \hat{M}^{\alpha}$ and $\frac{dM^{1-\alpha}}{M^{1-\alpha}} = \hat{M}^{1-\alpha}$, then equation (14) can be written as

$$\hat{S} = \left(\frac{D}{S}\right)\hat{D} + \left(\frac{X}{S}\right)\hat{X} - \left(\frac{M^{\alpha}}{S}\right)\hat{M}^{\alpha} - \left(\frac{M^{1-\alpha}}{S}\right)\hat{M}^{1-\alpha}. \tag{15}$$

Allowing $\hat{\eta} = \frac{D}{S} = \hat{D} - \hat{S}$, $\hat{\kappa} = \frac{X}{S} = \hat{X} - \hat{S}$, $\hat{\rho} = \frac{M^{\alpha}}{S} = \hat{M}^{\alpha} - \hat{S}$ and $\hat{\tau} = \frac{M^{1-\alpha}}{S} = \hat{M}^{1-\alpha} - \hat{S}$ implies that $\hat{D} = \hat{\eta} + \hat{S}$, $\hat{X} = \hat{\kappa} + \hat{S}$, $\hat{M}^{\alpha} = \hat{\rho} + \hat{S}$ and $\hat{M}^{1-\alpha} = \hat{\tau} + \hat{S}$. Substituting these identities into equation (15), recognizing that $\hat{\eta} = \frac{D}{S}$, $\hat{\kappa} = \frac{X}{S}$, $\hat{\rho} = \frac{M}{S}$, and $\hat{\tau} = \frac{M^{1-\alpha}}{S}$ and reintroducing subscripts yields equation (16)

$$\hat{S}_{jt} = \frac{\hat{\eta}}{\vartheta}\left(\frac{D}{S}\right)_{jt} + \frac{\hat{\kappa}}{\vartheta}\left(\frac{X}{S}\right)_{jt} - \frac{\hat{\rho}}{\vartheta}\left(\frac{M^{\alpha}}{S}\right)_{jt} - \frac{\hat{\tau}}{\vartheta}\left(\frac{M^{1-\alpha}}{S}\right)_{jt} \tag{16}$$

where $\vartheta = 1 - \hat{\eta} - \hat{\kappa} + \hat{\rho} + \hat{\tau}$. Substituting equation (16) into equation (13) yields equation (17).

$$d\ln L_{jt} = \beta_1 d\ln\left(\frac{D}{S}\right)_{jt} + \beta_2 d\ln\left(\frac{X}{S}\right)_{jt} - \beta_3 d\ln\left(\frac{M^{\alpha}}{S}\right)_{jt} - \beta_4 d\ln\left(\frac{M^{1-\alpha}}{S}\right)_{jt} \tag{17}$$

where $\beta_1 = \Lambda\left(\frac{\hat{\eta}}{\vartheta}\right)$, $\beta_2 = \Lambda\left(\frac{\hat{\kappa}}{\vartheta}\right)$, $\beta_3 = \Lambda\left(\frac{\hat{\rho}}{\vartheta}\right)$ and $\beta_4 = \Lambda\left(\frac{\hat{\eta}}{\vartheta}\right)$.

We combine the import penetration rates in equation (17) such that the ratio of imports from low- to high-income nations, $\frac{M^{\alpha}}{M^{1-\alpha}}$, results. While changes in import penetration rates represent "level" changes, changes in the ratio of imports from low- to high-income nations represent "share" changes. To capture "level" effects, we reintroduce an import penetration rate to equation (17). The value share measure of import competition represents "share" changes. Bernard, Jensen and Schott [2006], Schott [2002] and Bernard and Jensen [2002] construct value share measures as average annual values of the share of US imports from nations with per capita GDP less than 5 percent of the US level for the five preceding years. We set α equal to 10 percent to capture imports from nations such as China, India, Brazil, Indonesia, the Philippines, Thailand and many Latin and South American and African nations.[2] We complete the set of control variables with an interaction term constructed using import penetration and value share competition measures.

To control for additional influences on employment, we reintroduce the vectors $d\ln V_{jt}$ and $d\ln R_{jt}$, which include industry-level changes in technology, constructed as Solow [1957] residuals, and capital-labor ratios. Industry capital-labor ratios are given as the value of plant and equipment divided by production employment. To control for business cycle fluctuations, the annual change in the manufacturing sector capacity utilization rate is included.

To avoid possible multicollinearity problems, we modify the estimation equation such that measures of the domestic market and exports are included. Finally, a vector of year dummies, Ω_t, controls for unobservable variation due to policy changes. In the estimations to follow, we utilize a least squares regression procedure, allowing for industry fixed effects. Thus, α_j is a vector of industry-specific intercept terms and ε_{jt} is an assumed i.i.d error term. Equation (18) presents the resulting estimation equation.

$$\begin{aligned}\Delta\ln EMPLOYMENT_{jt} &= \alpha_j + \beta_1\Delta\ln DOMESTIC_{jt} + \beta_2\Delta\ln EXPORTS_{jt} \\ &+ \beta_3\Delta\ln IMPORT\ PENETRATION_{jt} + \beta_4\Delta\ln VALUE\ SHARE \\ &COMPETITION_{jt} + \beta_5(\Delta\ln IMPORT\ PENETRATION_{jt} \times \\ &\Delta\ln VALUE\ SHARE\ COMPETITION)_{jt} + \beta_6\Delta\ln CAPACITY \\ &UTILIZATION\ RATE_{jt} + \beta_7\Delta\ln CAPITAL - LABOR\ RATIO_{jt} \\ &+ \beta_8\Delta\ln TECHNOLOGY_{jt} + \beta_{\Omega}\Omega_t + \varepsilon_{jt}\end{aligned} \tag{18}$$

The vector $EMPLOYMENT_{jt}$ includes industry production and non-production employment. $DOMESTIC_{jt}$, representing domestic demand, is equal to industry shipments less exports plus imports. Foreign demand is given by $EXPORTS_{jt}$, while *IMPORT*

[2] A list of countries included in the data set is provided in the Appendix.

PENETRATION$_{jt}$, *VALUE SHARE COMPETITION*$_{jt}$ and the associated interaction term represent import competition.

DATA SOURCES

We have drawn upon several data sources to facilitate the estimation of employment effects. Trade data for the years 1972-1994 are from the National Bureau of Economic Research (NBER) Trade Database [Feenstra, 1996; 1997]. Data for 1995-1996 are from Feenstra, Romalis, and Schott [2002] and, for 1997-2001, are from the US International Trade Commission. Industry employment, output, capital stock, payroll and capital investment data for 1972-1996 are from the NBER–US Census Bureau Center for Economic Studies Manufacturing Industry Database [Bartelsman and Gray, 1996]. Corresponding data, for the years 1997-2001, are from the Annual Survey of Manufacturers [US Department of Commerce, 2003]. Values are inflation-adjusted using the US Consumer Price Index. Manufacturing sector capacity utilization rates are from the Federal Reserve Bank of St. Louis [2004].

A change in industry classification systems coinciding with implementation of the North American Free Trade Agreement results in post-1996 data being classified by the North American Industrial Classification System (NAICS) while pre-1997 data are classified according to a variety of systems. The change in classification systems necessitates merging the data into a single common classification. Trade data for the years 1972-1994, classified at the 4-digit 1972 Standard Industrial Classification (SIC) level, were mapped to the 4-digit 1987 SIC level to match the 1995-1996 trade and industry data [Bartelsman and Gray, 1996]. An additional concordance, developed by Bayard and Klimek [2003], was employed to map the 1972-1996 4-digit 1987 SIC level trade data to the 6-digit 1997 NAICS level. The resulting data segments the manufacturing sector into 384 6-digit 1997 NAICS industries. Collectively, these industries account for 98.7 and 91.9 percent of US manufacturing imports and exports, respectively, during the period.

During the 1972-2001 period, the 116 nations in the data set comprised 85.9 percent of the non-US world population, 96.2 percent of non-US global output and 96.7 (96.1) percent of non-US global exports (imports) [World Bank, 2003]. Additionally, import source countries shifted from high income nations towards relatively low income countries. In 1972, 3.8 percent of US imports were from low-income nations; however, this value increased to 19.4 percent by 2001. On average, over the years 1972-2001, imports comprised 14.2 percent of domestic sales for the typical industry with low-income nations supplying 2.15 percent of the total. Descriptive statistics are presented in Table 1.

Average import penetration rises steadily as we compare across industry classifications: from 6 percent for unbalanced exporting industries to 21 percent for unbalanced importers. Average exports are significantly below-average for unbalanced importers, yet above-average for all other industry classifications. The typical unbalanced importing industry has an above-average level of value share competition (18.6 percent), while all other industry classifications have below-average value share measures. Unbalanced importing industries are also the only classification to have an average technology level below the overall mean. Net exporting industries tend to be, on average, more capital intensive than net importing industries. Lower average levels of technology and capital-intensity create *a priori* expectations of unbalanced importers as candidates for trade-related job loss while unbalanced exporters, being capital-intensive and above-average in terms of technology, may gain jobs.

Table 1: Descriptive Statistics

		Industry Trade Balance			
Variable	All Industries	Unbalanced Exporters	Balanced Exporters	Balanced Importers	Unbalanced Importers
Import Penetration Rate	0.1415	0.0598**	0.1169**	0.1605**	0.2097**
	(0.2848)	(0.4152)	(0.1529)	(0.2073)	(0.2008)
Value Share Competition	0.1518	0.1251**	0.0928**	0.1128**	0.1858**
	(0.3629)	(0.2503)	(0.1943)	(0.2203)	(0.2959)
Exports ($1,000s)	594,339	714,636**	829,434*	835,553*	285,590**
	(1,765,600)	(2,019,030)	(2,044,480)	(2,209,810)	(968,128)
Imports ($1,000s)	749,666	215,224**	666,762**	1,069,180**	1,075,570**
	(2,230,900)	(680,540)	(1,712,080)	(2,700,680)	(2,850,630)
Production Employment	26,142	25,384	27,816	29,124	24,683
	(34,359.4)	(32,142)	(40,541.3)	(38,764)	(30,676.6)
Non-Production Employment	10,213	12,247**	11,540**	11,643**	7,353**
	(16,382.6)	(19,102.3)	(17,465)	(19,340.6)	(10,726.5)
Domestic Market ($1,000s)	5,205,680	4,406,820**	5,098,970**	6,352,360**	5,391,420**
	(10,731,000)	(6,442,440)	(7,763,140)	(10,786,700)	(14,052,600)
Capital-Labor Ratio	14,508.44	14,243.57	20,144.87	12,027.25	13,258.41
	(47,904)	(37,197)	(91,062)	(24,029)	(32,372)
Technology	16.1793	16.5525**	16.6375**	16.2965*	15.6213**
	(3.3158)	(3.4082)	(3.3051)	(2.7156)	(3.4058)
N	11,520	3,390	1,950	1,890	4,290

Mean values are presented with standard deviations in parentheses. T-tests have been employed to determine statistical significance of mean values for stratified samples from mean values of the full sample. "**", "*", and "#" denote significance at the 1%, 5%, and 10% levels, respectively.

ECONOMETRIC ANALYSIS

We decompose the sample by relative trade orientation to allow examination of potential variation in trade effects across industries. Results of estimating equation (18) for net exporting industries are reported in Table 2. Results for net importing industries are presented in Table 3. While unbalanced exporters appear unaffected by rising import penetration, a hypothetical 1 percent increase in the import penetration rate decreases balanced exporters' production and non-production employment by 0.024 and 0.063 percent, respectively. Similar hypothetical increases in exports increase production employment by 0.049 and 0.019 percent in unbalanced and balanced exporting industries, respectively, and increase unbalanced exporter non-production employment by 0.034

percent. Rising value share competition significantly decreases unbalanced exporter production employment; however, the corresponding coefficient (-0.0009) is quite weak in magnitude.

Table 2: Effects of Trade on Industry Employment, Net Exporting Industries

	Unbalanced Exporters		*Balanced Exporters*	
	(a)	(b)	(c)	(d)
Dependent Variable:	Production Employment	Non-Production Employment	Production Employment	Non-Production Employment
Δ ln Import Penetration Rate	-0.0003	-0.0042	-0.024**	-0.0634**
	(0.0031)	(0.0038)	(0.0063)	(0.0115)
Δ ln Value Share Competition	-0.0009*	-0.0003	-0.0007	0.0003
	(0.0004)	(0.0005)	(0.0008)	(0.0011)
Δ ln Import Penetration Rate x Δ ln Value Share Competition	0.0001	0.0001	0.0023	-0.0068#
	(0.0003)	(0.0004)	(0.0029)	(0.0038)
Δ ln Exports	0.0491**	0.0342**	0.0185#	-0.001
	(0.0051)	(0.0061)	(0.0097)	(0.0128)
Δ ln Domestic Market	0.171**	0.1404**	0.5042**	0.5414**
	(0.0077)	(0.0094)	(0.0162)	(0.0213)
Δ ln Capacity Utilization Rate	0.2706**	-0.0767	0.413**	0.114
	(0.0847)	(0.1029)	(0.1166)	(0.1531)
Δ ln Capital-Labor Ratio	-0.0431**	-0.0125*	-0.0316**	-0.0047
	(0.0046)	(0.0056)	(0.0043)	(0.0057)
Δ ln Technology	-0.0013	0.0006	-0.0022*	-0.0015
	(0.0011)	(0.0014)	(0.0009)	(0.0012)
Adjusted R^2	0.31	0.13	0.53	0.36
N	3,390	3,390	1,950	1,950

Fixed effects estimations with robust standard errors in parentheses. Industry fixed effects and coefficients on year dummy variables not shown. Statistical significance is denoted as follows: "**", "*", and "#" indicate significance from zero at the 1%, 5%, and 10% levels, respectively.

For both net importer classifications, we see that import competition is positively associated with job loss. A 1 percent increases in import penetration reduces balanced importers' production and non-production employment by 0.064 and 0.078 percent, respectively. Similarly, in response to a like proportional increase in import penetration, production and non-production employment in unbalanced importing industries decrease by 0.087 and 0.082 percent, respectively. Increases in the value share competition variable reduce production employment, but do not appear to contribute to non-production job loss. Exports are found to generate jobs, with production employment in balanced importers increasing by 0.047 percent in response to a 1 percent increase in foreign demand. A similar increase in exports leads to 0.012 and 0.031 percent increases in production and non-production employment, respectively, for unbalanced importers.

Table 3: Effects of Trade on Industry Employment, Net Importing Industries

	Balanced Importers		*Unbalanced Importers*	
	(a)	(b)	(c)	(d)
Dependent Variable:	Production Employment	Non-Production Employment	Production Employment	Non-Production Employment
Δ ln Import Penetration Rate	-0.0644**	-0.0783**	-0.0866**	-0.0818**
	(0.0083)	(0.0124)	(0.0067)	(0.0091)
Δ ln Value Share Competition	-0.0012**	0.0011	-0.0021**	0.002
	(0.0008)	(0.0019)	(0.0009)	(0.0016)
Δ ln Import Penetration Rate x Δ ln Value Share Competition	-0.0035	-0.0102*	-0.0011**	0.0004
	(0.0032)	(0.0048)	(0.0004)	(0.0011)
Δ ln Exports	0.0466**	0.0205	0.0121*	0.0309**
	(0.0093)	(0.0138)	(0.0055)	(0.0075)
Δ ln Domestic Market	0.55**	0.5757**	0.6267**	0.4898**
	(0.0142)	(0.0211)	(0.0123)	(0.0166)
Δ ln Capacity Utilization Rate	0.4165**	-0.2426	0.3558**	0.1778
	(0.1383)	(0.206)	(0.1166)	(0.1577)
Δ ln Capital-Labor Ratio	-0.0419**	-0.0139	-0.0562**	-0.0103#
	(0.0061)	(0.0091)	(0.004)	(0.0054)
Δ ln Technology	-0.0098**	-0.0071**	-0.0109**	-0.0024
	(0.0015)	(0.0022)	(0.0014)	(0.0018)
Adjusted R^2	0.63	0.42	0.51	0.25
N	1,890	1,890	4,290	4,290

See Table 2 notes.

The remaining coefficients provide additional interesting results. While changes in domestic demand significantly affect employment in all industry classifications, unbalanced exporters' employment appears less affected as compared to the other classifications. More specifically, a 1 percent decline in domestic demand yields 0.171 and 0.14 percent decreases in unbalanced exporters' production and non-production employment, respectively. A like decline in domestic demand reduces production and non-production employment by 0.5 to 0.63 percent and 0.49 to 0.58 percent, respectively, in the remaining classifications. Non-production employment appears unaffected by business cycle fluctuations; however, production employment is found to be pro-cyclical across all industry classifications.

Capital-deepening is associated with declining production employment, with similar coefficients reported across classifications. Non-production employment in unbalanced exporting and importing industries is estimated to decrease in response to increased capital-labor ratios; however, balanced exporters and importers appear unaffected. While technological advances present minor employment effects in the cases of net importing industries, employment in net exporting industries is not significantly affected. Balanced importers are estimated to realize production and non-production employment declines of roughly 0.01 percent in response to a 1 percent increase in the level of technology. A similar response is estimated for production employment in unbalanced importing industries; however, non-production employment in such industries appears unaffected.

The results presented thus far confirm the anticipated positive relationship between exports and job creation. Similarly, we see that increased import competition contributes to job loss. Application of the estimated coefficients, presented in Tables 2 and 3, to the industry data permits estimation of employment effects for the entire manufacturing sector and each industry classification. Effects are estimated as the sum of the products of observed annual changes in all explanatory variables and corresponding coefficients, reported in Tables 2 and 3, multiplied by annual production or non-production employment values. Panel A of Table 4 presents associated effects for production employment, while Panel B details effects for non-production workers.

Table 4: Estimated Aggregate Employment Effects

Panel A: Production Employment	All Industries	Unbalanced Exporters	Balanced Exporters	Balanced Importers	Unbalanced Importers
Δ ln Import Penetration Rate	-912,790	-959	-76,380	-255,116	-580,335
Δ ln Value Share Competition	-45,978	-11,582	-3,880	-7,496	-23,014
Δ ln Import Penetration Rate x Δ ln Value Share Competition	-6,371	-1,554	-2,583	-1,167	-1,067
Δ ln Exports	470,472	246,644	46,374	139,113	38,392
Δ ln Domestic Market	924,076	23,807	228,073	398,394	273,956
Δ ln Capacity Utilization Rate	-440,792	-206,023	-192,904	24,709	-66,389
Δ ln Capital-Labor Ratio	-369,594	-123,311	-44,120	-22,079	-180,093
Δ ln Technology	-106,720	-9,086	-3,091	-7,806	-86,698
Total Estimated Change	-487,697	-82,064	-48,511	268,552	-625,248
Trade-related Employment Change	-494,667	232,549	-36,469	-124,666	-566,024

Panel B: Non-production Employment	All Industries	Unbalanced Exporters	Balanced Exporters	Balanced Importers	Unbalanced Importers
Δ ln Import Penetration Rate	-434,730	-5,370	-116,779	-115,627	-196,952
Δ ln Value Share Competition	-11,492	-1,752	-685	-2,794	-6,261
Δ ln Import Penetration Rate x Δ ln Value Share Competition	-6,088	-1,583	-2,363	-624	-1,517
Δ ln Exports	130,428	73,368	10,291	24,652	22,117
Δ ln Domestic Market	612,442	20,739	183,594	276,426	131,722
Δ ln Capacity Utilization Rate	-14,972	21,803	-16,987	-14,631	5,173
Δ ln Capital-Labor Ratio	-37,562	-19,400	-3,244	-9,595	-5,324
Δ ln Technology	-4,559	1,982	-2,014	-1,068	-3,465
Total Estimated Change	233,467	89,787	51,813	156,739	-54,507
Trade-related Employment Change	-321,882	64,663	-109,536	-94,393	-182,613

Across all industries we estimate that 965,139 production jobs and 452,310 non-production jobs were lost due to import competition between 1972 and 2001. These estimated losses were partially offset by gains, attributable to rising exports, of 470,472 production jobs and 130,428 non-production jobs. Thus, the estimated net effect of trade on manufacturing employment is a loss of 816,549 jobs over the period. While unbalanced exporting industries appear to have gained, on net, 297,212 jobs due to trade, all other industry classifications are estimated to have realized net trade-related job losses. Given the relationships between imports and exports and employment, it is not surprising that estimated trade-related employment losses are greatest for unbalanced importing industries (a loss of 748,637 jobs) and smallest for balanced exporters (a loss of 146,005 jobs).

The effects of shifts in domestic demand are significantly greater (an estimated gain of 1,536,518 jobs) than the individual or combined effects of imports and exports. Business cycle fluctuations and capital deepening are estimated to have led to net job losses of 455,764 jobs and 407,156 jobs during the period, respectively. Technological improvements are estimated to have resulted in the net loss of 111,279 jobs. The cumulative employment effect of observed changes in explanatory variables is a loss of 254,230 jobs. That being said, similar to the effects of trade on employment, considerable variation is found across industry classifications.

CONCLUSION

In examining the relationship between employment and international trade, we have concentrated our focus on possible variation in effects across industries classified by trade balance. Rising import penetration is found to reduce employment, although effects vary by industry trade orientation. More specifically, employment in unbalanced exporting industries appears least affected by rising import penetration, while unbalanced importers are the most affected. Shifts in import sources, from relatively high- to low-income source nations, weakly decrease employment. Exports generate jobs, with production employment in net exporting industries most affected. The findings provide a more detailed picture of trade-related employment dynamics. Net job loss may be expected in more labor-intensive industries that run trade deficits and possess below-average levels of technology. Export-oriented industries characterized by more capital-intensive production and the possession of above-average technology levels are expected to see net job creation. As the US moves forward with further trade liberalization, the associated debate surrounding the employment effects of trade is expected to continue. The information presented here may allow for a more enlightened and fruitful debate.

COUNTRY LISTING ([a] US import share value increased from 1972 to 2001**)**

Countries with average GDP per capita <u>*less than*</u> *10 percent of US level:* Algeria[a], Angola[a], Bangladesh[a], Belize, Benin, Bolivia[a], Burkina Faso[a], Burundi, Cameroon[a], Central African Republic[a], Chad[a], China[a], Colombia[a], Congo[a], Cote d'Ivoire, Djibouti, Dominican Republic, Ecuador, Egypt[a], El Salvador[a], Fiji, Gambia[a], Ghana, Guatemala[a], Guinea-Bissau[a], Guyana, Haiti, Honduras[a], India[a], Indonesia[a], Iran, Jamaica, Jordan[a], Kenya, Kiribati[a], Liberia, Madagascar[a], Malawi[a], Mali[a], Mauritania, Morocco[a], Nepal[a], Nicaragua, Niger, Nigeria[a], Pakistan[a], Papua New Guinea[a], Paraguay, Philippines[a], Romania, Rwanda, Senegal[a], Sierra Leone, Sri Lanka[a], Sudan, Suriname, Syria[a], Thailand[a], Togo[a], Tunisia, Turkey[a], Uganda[a], Zambia, Zimbabwe.

Countries with average GDP per capita <u>*greater than*</u> *10 percent of US level:* Argentina, Australia, Austria, Bahamas, Barbados, Belgium, Brazil[a], Canada, Chile[a], Costa Rica[a], Cyprus[a], Czech Republic, Denmark, Finland, France, Gabon, Germany, Greece, Hong Kong, Hungary[a], Iceland, Ireland[a], Israel[a], Italy, Japan, Korea (Republic of)[a], Kuwait[a], Malaysia[a], Malta[a], Mauritius[a], Mexico[a], Netherlands, New Caledonia, New Zealand, Norway, Oman[a], Panama, Peru, Poland, Portugal, Saudi Arabia[a], Seychelles[a], Singapore[a], South Africa[a], Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates[a], United Kingdom, Uruguay[a], Venezuela.

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