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Import Source Reallocation and US Manufacturing Employment, 1972-2001

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Abstract Examining the US manufacturing sector, we focus on the potential employment effects of shifts in import sources from relatively high- to low-income nations. Data for 384 6-digit NAICS US manufacturing industries that span the years 1972–2001 are utilized. Increased import penetration is found to reduce both production and non-production employment; however, such job loss is countered by export-led job creation. Extending the literature, we report that reallocation of import sources from high- to low-income nations reduces manufacturing employment, and when shifts in import sources coincide with rising import penetration the result is an acceleration of job loss.

Keywords Employment · Exports · Import penetration · Manufacturing · Value Share competition

JEL Classification F14 · F16 · J63

1 Introduction

Trade-related employment dynamics are examined using annual data for 384 US manufacturing industries that span the years 1972–2001. Although trade in services has increased as a share of total trade, as recently as 2001 trade in goods accounted for nearly 84% of US imports and over 70% of exports (US Bureau of Economic Analysis (BEA) 2007). Thus, the manufacturing sector may be considered a bellwether for trade-related employment effects. Between 1972 and 2001, manufacturing employment declined from 26.4 to 13.3% of total employment while total imports increased from 6 to 13.8% of GDP (BEA 2007). An increase in the share of total imports sourced from low-income nations coincided with the overall rise in imports and the employment decline. Protectionists claim that such reallocation increases domestic-foreign wage differentials and leads to domestic job loss. Proponents of liberalization argue that expansion of exports from 5.7% of

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GDP in 1972 to 10.2% in 2001 counter the job destroying effects of imports (BEA 2007).

We examine the effects of imports and exports on both industry-level production employment and non-production employment. Extending the literature, we focus on the potential employment effects of import source reallocation from relatively high- to low-income nations. That the trade liberalization debate centers, in large part, on expected domestic labor market effects underscores the importance of understanding the trade-employment relationship. The findings presented here provide for such an understanding and confer valuable information to the debate.

2 Theoretical framework

To examine the influences of trade on employment, we extend Mann (1988), Freeman and Katz (1991) and Kletzer (2002) who relate changes in industry employment ($\Delta \ln L_{jt}$) to changes in industry sales ($\Delta \ln S_{jt}$); specifically, $\Delta \ln L_{jt} = \Phi \Delta \ln S_{jt}$, where the parameter Φ is given as $\left\{\frac{\frac{\lambda}{\lambda+\eta}}{1+(1-\psi)\varpi\left(\frac{1}{\lambda+\eta}\right)}\right\}$. λ and η represent labor supply and demand elasticities, respectively, ψ is the product demand elasticity, ϖ is labor's cost share, Δ is the difference operator, ln denotes natural logarithms, and j and t are industry and time subscripts. Freeman and Katz (1991) define industry sales such that $S_{jt} = D_{jt} + X_{jt} - M_{jt}$. Domestic and foreign demand for industry j products during year t are given by D_{jt} and X_{jt} while M_{jt} denotes imports. Thus, the import-employment relationship is assumed to not vary across source nations.

We modify the industry sales definition such that $S_{jt} = D_{jt} + X_{jt} - M^{\gamma}_{jt} - M^{\delta}_{jt}$. Imports from nations classified as "low-income" relative to the US are represented by M^{γ}_{jt}. Imports from all other nations are identified by M^{δ}_{jt}. In the analysis to follow, three separate "low-income" classifications are used. First, we classify a nation as low-income if its average per capita GDP value, over the years 1972–2001, is less than 10% of the average US level. Second, as 1987 is the midpoint of our data sample, we classify nations that are listed in that year at medium or low levels of human development as low-income (United Nations Development Programme (UN) 1990). Third, we classify nations as low-income if, in a given year, they are not members of the OECD. We admit the limitations of each classification, yet posit that using several measures-reflective of average income and relative development-may ameliorate shortcomings of individual measures, provide a degree of sensitivity testing, and test the robustness of results. The appendix lists the 116 nations in the data set and identifies the nations in each "low-income" classification. Building on Mann (1988), Freeman and Katz (1991) and Kletzer (2002), we control for additional factors that may influence industry employment to arrive at the estimation equation.

$$\begin{aligned}\Delta \ln L_{jt} =& \alpha_j + \beta_1 \Delta \ln D_{jt} + \beta_2 \Delta \ln X_{jt} + \beta_3 \Delta \ln \left(\frac{M}{D}\right)_{jt} + \beta_4 \Delta \ln \left(\frac{M^{\gamma}}{M}\right)_{jt} \\ &+ \beta_5 \left[\Delta \ln \left(\frac{M}{D}\right)_{jt} \times \Delta \ln \left(\frac{M^{\gamma}}{M}\right)_{jt}\right] + \beta_6 \Delta \ln A_{jt} + \beta_7 \Delta \ln \left(\frac{K}{L}\right)_{jt} \\ &+ \beta_8 \Delta \ln CAPUT_t + \beta_{\Omega} \Omega_t + \varepsilon_{jt}\end{aligned} \tag{1}$$

Equation 1 is estimated using industry-level production and non-production employment, separately, as dependent variables. Non-production employment includes "supervisors above the line-supervisor level, clerical, sales, office, professional, and technical workers" while production employment consists of all other workers (Bartelsman and Gray 1996). Domestic market demand (D) is equal to industry shipments less exports plus imports. Exports (X) represent foreign demand. Collectively, the import penetration rate $\left(\frac{M}{D}\right)$, the share of total imports sourced from low-income nations $\left(\frac{M^r}{M}\right)$ and the associated interaction term measure import competition. While changes in import penetration rates represent "level" changes in import competition, the change in total imports sourced from low-income nations represent "share" changes. This is analogous to the Value Share import competition measure introduced by Schott (2002) and employed by Bernard and Jensen (2002) and Bernard et al. (2006). As technological change and capital-deepening may affect employment, measures of industry-level technology (A) are constructed as Solow (1957) residuals and industry-level capital-labor ratios $\left(\frac{K}{L}\right)$, given as the ratio of capital stock to production employment, are included. The annual change in the manufacturing sector capacity utilization rate ($CAPUT$) controls for macroeconomic fluctuations. A vector of year dummies (Ω) controls for unobservable employment variation due to policy changes.

3 Data

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 et al. (2002) and, for 1997–2001, are from the US International Trade Commission Database. Import values are c.i.f. (cost, insurance and freight) and export values are f.o.b. (free on board). Industry data for production and non-production employment, output, capital stock, payroll and capital investment for the years 1972–1996 are from the NBER-US Census Bureau Center for Economic Studies Manufacturing Industry Database (Bartelsman and Gray 1996) and, for 1997–2001, are from the Annual Survey of Manufacturers (ASM) (US Department of Commerce, Economics and Statistics Administration 2003). Values have been inflation-adjusted using the US Consumer Price Index. Capacity utilization rates for the manufacturing sector are from the Federal Reserve Bank of St. Louis (2005).

An overhaul of industry classification systems coinciding with NAFTA resulted in post-1996 data classified by the North American Industrial Classification System (NAICS) while pre-1997 data are classified by various other systems. This necessitated merging the data to a common classification. Trade data for 1972–1994 were mapped, using a concordance developed by Bartelsman and Gray (1996), from the 4-digit 1972 Standard Industrial Classification (SIC) level to the 4-digit 1987 SIC level to match the 1995–1996 trade and industry data. As the 1997–2001 ASM data are at the 6-digit 1997 NAICS level, a separate concordance (Bayard and Klimek 2003) was used to convert the 1972–1996 SIC-coded data to the 6-digit 1997 NAICS level. The result is a data set comprised of 384 6-digit 1997 NAICS manufacturing industries. These industries account for 98.7% of US imports from and 91.9% of exports to the 116 nations included in the data set. Collectively, the

116 nations comprise 85.9% of the non-US world population. Similarly, these nations generate 96.2% of non-US global output and 96.7 (96.1)% of non-US global exports (imports). Table 1 presents descriptive statistics.

4 Econometric analysis

Table 2 presents estimation results. Given the double-log functional form of the estimation equation, coefficients are interpreted as elasticities. Focusing first on the results in columns (a) through (c), where the annual change in industry-level production employment is the dependent variable, we see similarity in coefficients on the variables representing annual changes in import penetration. An assumed 10% increase in import penetration decreases production employment by 0.123–0.143%. As anticipated, increased exports counter the job destroying effects of imports. Production employment is estimated to rise by 0.402–0.44% in response to a hypothetical 10% increase in annual exports. As with import penetration, little variation is found in the

Table 1 Descriptive statistics

Variable	Mean Value	Variable	Mean Value
Import Penetration Rate	0.1415	Δ Import Penetration Rate	0.0622
	(0.2848)		(0.4253)
Value Share Competition (10%)	0.1002	Δ Value Share Competition (10%)	0.0054
	(0.1538)		(0.0422)
Non-OECD Value Share Competition	0.2226	Δ Non-OECD Value Share Competition	0.0103
	(0.2439)		(0.0185)
Low HDI Value Share Competition	0.0389	Δ Low HDI Value Share Competition	0.0018
	(0.0727)		(0.003)
Medium HDI Value Share Competition	0.1083	Δ Medium HDI Value Share Competition	0.0035
	(0.219)		(0.007)
Exports ($1,000s)	594,339	Δ Exports ($1,000s)	29,168.42
	(1,765,600)		(380,843)
Imports ($1,000s)	749,666	Δ Imports ($1,000s)	62,712.69
	(2,230,900)		(474,613)
Production Employment	26,142	Δ Production Employment	−115.298
	(34,359.4)		(3,830.47)
Non-Production Employment	10,213	Δ Non-Production Employment	50.840
	(16,382.6)		(2,128.38)
Domestic Market ($1,000s)	5,205,680	Δ Domestic Market ($1,000s)	80,931.64
	(10,731,000)		(2,252,531)
Capital-Labor Ratio	14,508.44	Δ Capital-Labor Ratio	2,602.88
	(47,904)		(1,548,964)
Capacity Utilization Rate	79.5872	Δ Capacity Utilization Rate	0.9999
	(4.6845)		(0.5578)
Technology	16.1793	Δ Technology	0.1231
	(3.3158)		(0.9788)
N	11,520	*N*	11,136

Standard deviations in parentheses. The sample size of 11,520 (left column) results from 384 industries being represented for each of the 30 years during the 1972–2001 period. Taking annual changes in variables results in a reduced sample size of 11,136 observations (right column)

influence of exports across estimations. Considering results presented in columns (d) through (f), where the annual change in industry-level non-production employment is the dependent variable, we see similar influences of rising import penetration and exports. Assuming, again, a 10% increase in import penetration, non-production

Table 2 Effects of trade on industry employment

Dependent Variable:	ln Production Employment$_{jt}$			ln Non-Production Employment$_{jt}$		
	(a)	(b)	(c)	(d)	(e)	(f)
Δ ln Import Penetration Rate$_{jt}$	−0.0123*	−0.0118**	−0.0143*	−0.0188*	−0.0135*	−0.012*
	(0.0026)	(0.0054)	(0.0036)	(0.0032)	(0.0046)	(0.0026)
Δ ln "Low-income" Import Share (GDP per capita measure)	−0.0009**			−0.0006		
	(0.0004)			(0.0005)		
Δ ln "Low-income" Import Share (non-OECD measure)		−0.0023***			−0.0015	
		(0.0013)			(0.0012)	
Δ ln "Low-income" Import Share (Low HDI measure)			−0.0012*			−0.001*
			(0.0003)			(0.0003)
Δ ln "Low-income" Import Share (Medium HDI measure)			−0.0013**			−0.0016
			(0.0005)			(0.0012)
Δ ln Import Penetration Rate$_{jt}$ × Δ ln "Low-income" Import Share (GDP per capita measure)	−0.0005***			−0.0004*		
	(0.0003)			(0.0002)		
Δ ln Import Penetration Rate$_{jt}$ × Δ ln "Low-income" Import Share (non-OECD measure)		−0.0005**			−0.0003*	
		(0.0002)			(0.0001)	
Δ ln Import Penetration Rate$_{jt}$ × Δ ln "Low-income" Import Share (Low HDI measure)			−0.0004*			−0.0004***
			(0.0001)			(0.0002)
Δ ln Import Penetration Rate$_{jt}$ × Δ ln "Low-income" Import Share (Medium HDI measure)			−0.0007*			−0.0006**
			(0.0002)			(0.0003)
Δ ln Export$_{jt}$	0.0413*	0.044*	0.0402*	0.0389*	0.0366**	0.0381*
	(0.0033)	(0.0067)	(0.0055)	(0.0041)	(0.0157)	(0.005)
Δ ln Domestic Market$_{jt}$	0.3542*	0.414*	0.3753*	0.3096*	0.343*	0.3312**
	(0.0059)	(0.01)	(0.0113)	(0.0074)	(0.0105)	(0.1323)
Δ ln Capacity Utilization Rate$_t$	0.249*	0.178*	0.213*	−0.0527	0.0199	−0.0264
	(0.0607)	(0.0328)	(0.064)	(0.0763)	(0.0155)	(0.025)
Δ ln Capital-Labor Ratio$_{jt}$	−0.0487*	−0.0423*	−0.0397**	−0.0121*	−0.0069*	−0.0092**
	(0.0025)	(0.0068)	(0.0187)	(0.0032)	(0.0015)	(0.0047)
Δ ln Technology$_{jt}$	−0.0049*	−0.0053**	−0.0037*	−0.0013	−0.0015**	−0.0016
	(0.0007)	(0.0022)	(0.0007)	(0.0008)	(0.0008)	(0.0011)
Adjusted R^2	0.38	0.36	0.41	0.29	0.24	0.26
N	11,136	11,136	11,136	11,136	11,136	11,136

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

employment is estimated to decrease by 0.12–0.188%. A like increase in exports is estimated to increase non-production employment by 0.366–0.389%. The observed job destruction/creation effects are consistent with earlier research.

Extending the literature, we find production employment declines as import sources shift from high-to low-income nations. Coefficients are low in magnitude, yet remain significant across "low-income" classifications. An assumed 10% annual increase in the share of total imports sourced from nations with average GDP per capita less than 10% of the US level decreases production employment by 0.009%. A like increase in the share of total imports sourced from non-OECD member nations reduces production employment by 0.023%. Finally, a hypothetical 10% annual increase in the share of total imports that are from low HDI nations and medium HDI nations decreases production employment by 0.012 and 0.013%, respectively. While a negative relationship is reported between annual changes in production employment and import source reallocation, in appears that the pace of reallocation contributes to coefficients being small in magnitude. This is taken as emblematic of a significant albeit slowly-evolving process. Coefficients generated when non-production employment is the dependent variable, are negative yet generally insignificant from zero. If reallocation occurred over shorter time horizons or had annual average reallocation been greater, more pronounced effects would be expected for production employment and, perhaps, significant effects would be witnessed for non-production employment.

Coefficients on the interaction terms indicate that industries facing rising import penetration coupled with a reallocation of import sources from high-to low-income source nations realize additional job loss. Significant effects are reported for both production and non-production employment, with slight variation found across estimations. The implication is that industries facing rising import competition realize associated job loss; however, industries which face rising import competition and for which the source of imports shifts from high-to low-income nations appear to experience additional employment decline. Effectively, the reallocation of import sources accelerates import-related job destruction.

The remaining coefficients provide additional interesting information. Rising domestic demand increases employment of both production and non-production workers. Business cycle upturns also increase production employment; however, non-production employment appears less sensitive to business cycle fluctuations. Similarly, technological advancements reduce production employment, but are generally unrelated to non-production employment. Lastly, capital-deepening reduces both production and non-production employment; however, production employment appears affected to a greater degree. That results do not vary substantially when different "low-income" classifications are utilized is taken as an indication of the robustness of results.

5 Conclusion

Utilizing data for US manufacturing industries, we examine the relationships between annual changes in imports and exports and changes in production and non-production employment. Confirming prior research, we report that rising import penetration reduces both production and non-production employment. However, this job loss is

countered by export-led job creation. Extending the literature, we examine whether shifts in the sources of US imports from high-to low-income nations influence employment. We find that such reallocation reduces production employment and, when witnessed in conjunction with rising import competition accelerate job loss. The findings provide a more detailed portrait of trade-related employment dynamics. However, it is important to note that the net employment effect of trade depends on the relative magnitudes of export-led job creation and import-induced job destruction. Further, as the results presented here are restricted to the US manufacturing sector, there is no accounting for trade-related employment change in other sectors and conclusions cannot be generalized to the remaining sectors. As more precise estimation of trade-related employment effects will contribute to a more fruitful debate of the issue, there remains room for additional research into this topic.

Appendix

COUNTRY LISTING ([a] Average GDP per capita, over 1972-2001 period, less than 10 percent of the level of US GDP per capita; [b] non-OECD nation; [c] Medium HDI nation; [d] Low HDI nation)

Algeria[a,b,c], Angola[a,b,d], Argentina[b], Australia, Austria, Bahamas[b], Bangladesh[a,b,d], Barbados[b], Belgium, Belize[a,b,c], Benin[a,b,d], Bolivia[a,b,c], Brazil[b,c], Burkina Faso[a,b,d], Burundi[a,b,d], Cameroon[a,b,d], Canada, Central African Republic[a,b,d], Chad[a,b,d], Chile[b], China[a,b,c], Colombia[a,b], Congo[a,b,d], Costa Rica[b], Cote d'Ivoire[a,b,d], Cyprus[b], Czech Republic[b (1972-95)], Denmark, Djibouti[a,b,d], Dominican Republic[a,b,c], Ecuador[a,b,c], Egypt[a,b,c], El Salvador[a,b,c], Fiji[a,b,c], Finland, France, Gabon[b,c], Gambia[a,b,d], Germany, Ghana[a,b,d], Greece, Guatemala[a,b,c], Guinea-Bissau[a,b,d], Guyana[a,b,c], Haiti[a,b,d], Honduras[a,b,c], Hong Kong[b], Hungary[b (1972-95)], Iceland, India[a,d], Indonesia[a,b,c], Iran[a,b,c], Ireland, Israel[b], Italy, Jamaica[a,b], Japan, Jordan[a,b,c], Kenya[a,b,d], Kiribati[a,b], Korea (Republic of)[b (1972-96),c], Kuwait[b], Liberia[a,b,d], Madagascar[a,b,d], Malawi[a,b,d], Malaysia[b], Mali[a,b,d], Malta[b], Mauritania[a,b,d], Mauritius[b,c], Mexico[b (1972-93)], Morocco[a,b,d], Nepal[a,b,d], Netherlands, New Caledonia[b], New Zealand[b (1972)], Nicaragua[a,b,c], Niger[a,b,d], Nigeria[a,b,d], Norway, Oman[b,c], Pakistan[a,b,d], Panama[b], Papua New Guinea[a,b,d], Paraguay[a,b,c], Peru[b,c], Philippines[a,b,c], Poland[b (1972-96)], Portugal, Romania[a,b], Rwanda[a,b,d], Saudi Arabia[b,c], Senegal[a,b,d], Seychelles[b,c], Sierra Leone[a,b,d], Singapore[b], South Africa[b,c], Spain, Sri Lanka[a,b,c], Sudan[a,b,d], Suriname[a,b,c], Sweden, Switzerland, Syria[a,b,c], Thailand[a,b,c], Togo[a,b,d], Trinidad and Tobago[b], Tunisia[a,b,c], Turkey[a,c], Uganda[a,b,d], United Arab Emirates[b,c], United Kingdom, Uruguay[b], Venezuela[b], Zambia[a,b,d], Zimbabwe[a,b,c].

References

Bartelsman EJ, Gray W (1996) The NBER manufacturing productivity database. NBER Technical Working Paper No. 205

Bayard KN, Klimek SD (2003) Creating a historical bridge for manufacturing between the standard industrial classification system and the North American industry classification system. Working paper

Bernard AB, Jensen JB (2002) The deaths of manufacturing plants. NBER Working Paper No. 9026

Bernard A, Jensen JB, Schott PK (2006) Survival of the best fit: Exposure to low-wage countries and the (Uneven) growth of U.S. manufacturing plants. Journal of International Economics 68:219–237
Blanchflower DG (2000) Globalization and the labor market, paper commissioned by the U.S. trade deficit review commission, Washington, DC
Feenstra RC, Romalis J, Schott PK (2002) U.S. imports, exports and tariff data, 1989–2001. NBER Working Paper No. 9387
Feenstra RC (1997) NBER Trade Database, Disk 3: U.S. Exports, 1972–1994, with State Exports and Other U.S. Data. NBER Working Paper No. 5990
Feenstra RC (1996) NBER trade database, disk 1: U.S. imports, 1972–1994: Data and concordances. NBER Working Paper No. 5515
Federal Reserve Bank of St. Louis (2005) Industrial production and capacity utilization. Federal reserve statistical monthly release: G.17
Freeman RB, Katz LF (1991) Industrial wage and employment determination in an open economy. In: Abowd JM, Freeman RB (eds) Immigration, trade, and the labor market. The University of Chicago Press, Chicago
Kletzer LG (2002) Imports, exports and jobs: What does trade mean for employment and job loss? Kalamazoo, MI: W.E. Upjohn Institute for Employment Research
Mann CL (1988) The Effect of foreign competition in prices and quantities on the employment in import-sensitive U.S. industries. The International Trade Journal II(Summer): 409–444
Schott PK (2002) Moving up and moving out: Product level exports and competition from low wage countries. Yale School of Management mimeo
Solow R (1957) Technical and the aggregate production function. Review of Economics and Statistics Vol 39:312–320
United Nations Development Programme (UN) (1990). Human Development Report 1990. New York, NY: United Nations Development Programme
US Bureau of Economic Analysis (BEA) (2007) Table 1.1.10. Percentage shares of gross domestic product (A) (Q). Online. Available at: http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=Y. Accessed February 16, 2007
US Department of Commerce, Economics and Statistics Administration (2003) Annual Survey of Manufacturers: 2001. Washington, DC