International Trade, Technology and Wage Inequalities in the US Manufacturing Sector: Evidence from Granger Causality Tests

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Abstract

One of the most widely-discussed public policy issues in the U.S. has been the decline in real wages of less-skilled workers during the 1980s and 1990s. From 1979 to 1995, the real wages of full-time workers with less than 12 years of education fell by 20.2% and those with 12 years of education fell by 13.4%. During the same time period, the real wages of full-time workers with 16 or more years of schooling rose by 3.4%. As a result, the wage gap between less-skilled and more-skilled workers has increased sharply in the U.S. and elsewhere.[1]

Economists have conducted a battery of tests to see which of the two suspects - international competition from low-wage countries or skill-based technological change - lies behind the increase in wage inequalities. Based upon the Stolper-Samuelson theorem, the first set of tests examines the relationship of import and export prices and the movement in wages (see Lawrence and Slaughter, 1993; Lawrence, 1994 and Leamer, 1998 for examples). In reviewing the relative-price change literature, Slaughter (2000) finds conflicting evidence on whether international trade raised the relative prices of skill-intensive industries and thereby contributed to the increase in wage inequality. The second set of tests decomposes the shifts in the relative employment of less-skilled workers into those occurring *within* industries and those occurring *between* industries. Again, there is conflicting evidence on which suspect is mostly likely with Berman et al. (1994) finding support for technological change and Bernard and Jensen (1997) finding support for international trade.

In this paper, we propose an alternative approach to see which of the two suspects lies behind the increase in wage inequalities. We conduct a multivariate Granger causality test on the causal relationship between trade, technology and wage inequalities. We

[1] Freeman and Katz (1994) and Katz and Autor (1999) document the same decline in the relative wages of less-educated workers in Australia, Canada, Japan, Sweden and the United Kingdom.

choose a vector error-correction representation of Granger (1986) and Engle and Granger (1987). With cointegration, the error-correction approach provides a formal framework for testing for and estimating long-run relationship between trade, technology and wage inequalities.

We conduct our analysis on the relationship between trade, technology and wage inequality in three steps. The first step applies unit root tests to test for the order of integration of the variables. The variables need to have the same order of integration in order for the cointegration tests to be valid. The second step uses the Engle-Granger method to test for cointegration. It is now well known that many macroeconomic time-series are nonstationary, and that in such cases the means and variances may not be well defined. The third step applies a vector error correction model to address the causality between trade, technology and wage inequalities in the manufacturing sector. Engle and Granger (1987) show that with cointegration, there always exists a corresponding error-correction representation that implies that changes in the dependent variable are a function of the level of disequilibrium in the cointegrating relationship, captured by the error-correction term as well as changes in other explanatory variables. Applying an F-test on the joint significance of the sum of the lags of each explanatory variable and a t-test on the lagged error-correction term implies statistically the Granger exogenity or endogeneity of the dependent variable.

Our data set covers the period 1960-1996. The end-dates are constrained due to the switch in 1997 from Standard Industrial Classification (SIC) codes to the North American Industrial Classification (NAIC), which renders comparison between the pre-1997 data and the post-1997 data incompatible at the two-digit industry level. This study uses data for net imports (as a percentage of total production), the wage gap and technology for 20 manufacturing industries, SIC 20-39. The export and import data are obtained from the Bureau of Census publication, *U.S. Commodity Exports and Imports as Related to Output.* For the production data for each industry we use the value of shipments data from the *Annual Survey of Manufactures*. The wage gap and technology data are constructed using data from the NBER-CES data set (Bartelsman and Gray, 1996). To estimate the wage gap, we follow the methodology of Sachs and Shatz (1994) and use the category "nonproduction workers" to proxy for skilled workers in manufacturing, and the category "production workers" to proxy for unskilled workers. We estimate a five-input model for each industry to arrive at our measure of total factor productivity or technology.

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