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Lost protection and wages: Some time series evidence for the US

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Abstract

This short note examines some time series evidence relating prices of exports and imports to the aggregate US wage over 34 years of falling tariffs starting in the mid 1960s. The cointegrated unit root series lead to error correction and vector autoregression models. The lost protection and changing traded prices lowered the US wage very slightly, by less than 1%.

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Free trade agreements and lagging wages motivate the continuing debate over protection and wages in developed countries. [Stolper and Samuelson \(1941\)](#) develop the factor intensity link between product prices and factor prices in competitive general equilibrium with a falling real wage due to falling prices of labor intensive imports. Theoretical results beyond the two dimensional competitive model are ambiguous although there remains a presumption that a falling relative price of imports lowers the wage in labor scarce countries. [Leamer and Levinsohn \(1995\)](#) and [Cline \(1997\)](#) note that the empirical issue of the effect traded prices on wages has not been directly investigated.

The present note takes a direct approach to provide some time series evidence on the relationship between traded prices and the wage. [Leamer \(1994\)](#) points out that direct estimation of the price wage relationship is difficult due to collinearity of traded prices and wages and the present time series techniques address this issue directly.

The literature generally examines the wage effects of trade quantities, only indirectly related to the Stolper–Samuelson theorem. [Borjas, Freeman, and Katz \(1992\)](#) and [Wood \(1995\)](#) conclude that the quantities of imports and exports have had a negative impact on the US wage, while [Lawrence, Slaughter, Hall, Davis, and Topel \(1993\)](#) and [Krugman and Lawrence \(1994\)](#) find little evidence that trade quantities have lowered the wage. [Gaston and Trefler \(1994\)](#) conclude that US tariffs lower the wage.

The present paper presents some time series evidence on the effect of prices of exports and imports on the wage during a period of falling US protection, 1964 to 1997. The average tariff fell from about 10% to about 3% over these years before leveling off. There are long-term cointegrated relationships between the variables and the paper reports

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Table 1
Cointegrating equation

$\ln p^x_{t-1}$	1.000
$\ln p^m_{t-1}$	-0.589** (-27.52)
$\ln w_{t-1}$	-0.616** (-4.75)
trend (1964:2 to 1997:4)	-0.002** (-7.68)
Constant	-0.194
log likelihood ratio 1352.634	t-statistics **0.01 *0.05

error correction and vector autoregressive models. Time series analysis reveals that traded prices had a significant but very small negative impact on the wage.

1. Traded prices and the wage

The simple factor proportions model relates exogenous price changes to factor prices in a competitive model with two products, two factors of production, cost minimization, and full employment. Lost protection in a labor scarce country would lower the relative price of the labor intensive product and lead to a lower wage. The magnification effect of Jones (1965) shows that the wage falls more in percentage terms than the price of labor intensive imports. Beyond the 2x2 model, simply defining factor intensity presents theoretical difficulties with the directions of factor price adjustments depending on factor and industry shares as well as substitution. Nevertheless, there is a presumption that the intensity wage price link holds as discussed by Thompson (2005) motivating the search for an empirical link.

Quarterly data for the real wage and traded price indices during a period of falling tariffs from 1964 to 1997 are from the Bureau of Labor Statistics. The wage increases over the period, decelerating after the mid 1980s. The two price series rise less dramatically, meandering but following each other with little change in the terms of trade.

According to the intensity price link, the endogenous wage depends on the exogenous prices of traded products. A dynamic relationship between the wage and prices of exports and imports in reduced form is specified as

$$\ln w_t = a_0 + \sum_i a_{xi} \ln p^x_{t-i} + \sum_i a_{mi} \ln p^m_{t-i} + e_t, \tag{1}$$

where w_t is the real wage, p^x_t is the export price index, p^m_t is import price index, and $t-i$ represents time period t with i lags. Prices of exports and imports p^x_t and p^m_t have an impact on the wage w_t through the production structure with outputs adjusting in the general equilibrium. Estimated coefficients a_x and a_m are price elasticities of the wage, $\delta \ln w / \delta \ln p^x$ and $\delta \ln w / \delta \ln p^m$. The assumption is that factor endowments and technology are constant.

Estimating a reduced form equation such as (1) requires stationary variables. The series are not stationary in levels but augmented Dickey–Fuller (ADF) tests reveal unit root relationships for each. In particular, there are $I(1)$ autoregressive processes with 2 lags. Optimal lags are derived with Ljung-Box Q statistics.

Cointegrated models are built from stationary integrated linear combinations of nonstationary variables, leading to the error correction model (ECM) that captures short run adjustment toward the long run equilibrium. The cointegrating model is reported in Table 1 and the ECM in Table 2.

The wage is cointegrated with export and import price indices suggesting a long-term empirical relationship. The wage does not move independently from these traded prices, a result that favors not rejecting the null hypothesis of an intensity price link. The direction (labor intensity) and size (magnification effect) of the relationship depend on the parameter estimates in Eq. (1).

Table 2
Error correction model

Cointegrating residual	-0.06** (-4.17)
$d \ln p^x_{t-1}$	-0.142** (-3.44)
$d \ln p^m_{t-1}$	-0.058* (-1.95)
$d \ln w_{t-1}$	0.226** (2.50)
Constant	0.002** (3.83)
R^2 0.42, log likelihood ratio 532.39	t-statistics **0.01 *0.05

Table 3
VAR wage forecast

dp^x_{t-1}	-0.124** (-2.65)	dp^m_{t-1}	-0.012 (-0.42)	dw_{t-1}	0.321** (3.49)
dp^x_{t-2}	-0.084* (-1.69)	dp^m_{t-2}	0.026 (0.82)	dw_{t-2}	-0.066 (-0.72)
dp^x_{t-3}	-0.000 (-0.00)	dp^m_{t-3}	0.008 (0.25)	dw_{t-3}	0.364** (3.97)
dp^x_{t-4}	0.016 (0.34)	dp^m_{t-4}	0.057* (1.94)	dw_{t-4}	0.099 (1.10)
Constant	0.0008 (1.60)	R^2	0.47	log likelihood	526.93

The dependent variable in the ECM is the differenced log of the wage, $\ln w$. The log likelihood ratio supports the present model specification at the 1% level. The cointegrating equation is significant to the model and suggests inverse relationships between traded prices and the wage. The wage adjustment process converges 24% during 1 year.

The export price has a negative relationship with the wage with every 1% increase in the export price lowering the wage 0.142% as reported in Table 2. The import price has a smaller and less significant negative effect with every 1% decrease in the import price due to lost protection raising the wage 0.058%. The fall in the average tariff from 10% to 3% during the sample period amounts to a decrease of 6.3% in the import price, implying a negligible wage increase of 0.37%.

2. VAR analysis of traded prices and the wage

The series are adjusted for serial correlation to eliminate drift in the variance-covariance matrix. Griffiths, Hill, and Judge (1993) suggest a VAR for short run forecasting given such data. Vector autoregressive (VAR) analysis with the likelihood ratio test suggests 4 lags are optimal, and the VAR model is reported in Table 3.

There are negative effects of the export price on the wage after one and two quarters coinciding with the ECM results in Table 2. Every 1% increase in the export price lowers the wage -0.12% next quarter and then -0.08% the following quarter for a total impact of about -0.2%, somewhat larger than in the ECM.

The import price has a very small positive effect on the wage after four quarters. Every decrease of 1% in the import price lowers the wage after 1 year by -0.057%. The 6.3% decline in the import price due to lost protection lowers the wage by -0.36%. This positive link between the import price and the wage is consistent with labor intensive imports but the effect is minimal.

Given these parameters, an average tariff of 18% would be required to raise the wage 1%. Regarding the related adjustment in the real wage, the price index for labor is $p = (1 - \theta_m)p_x + \theta_m p_m$ where θ_m is the share of income spent on imports. Holding p_x constant, $p' = \theta_m p_m'$ where ' represents percentage change. The change in real wage $w'_R = w' - \theta_m p_m'$ would be negative unless θ_m happened to be less than $5.6\% = 1\%/18\%$. This lack of a magnified effect on the wage suggests models with multiple factors of production are more appropriate to model the effect of traded prices on the wage.

3. Conclusion

The effect of lost protection on the wage garners political and media attention but the effect of changing prices of imports and exports during a period of falling tariffs from 1964 to 1997 in the US was trivial. The present results suggest that the lost protection accounts for a wage decrease of less than 1%.

Applied time series analysis provides a novel approach to the trade and wage debate. Further analysis can provide evidence comparing factor proportions, specific factors, and industrial organization theories. Clark, Hofler, and Thompson (1988) show that labor should be separated into no fewer than eight skilled groups in US manufacturing, and stronger effects between traded prices and wages might be anticipated with less aggregated labor data.

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