Import Penetration and Output Change in Japanese Manufacturing Industries

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Abstract

This paper examines the effect of import penetration in Japanese manufacturing market on the change of productivities of Japanese industries from 1988 to 2003. As for the route through which the import of manufacturing products affects the productivities of Japanese industry, TFP effect and industry competition effect are examined. Our result shows that the change of manufacturing imports has little, statistically insignificant effect on the productivities of Japanese industries.

1 Introduction

This paper examines the effect of manufactruing trade on the change of productivities of Japanese industries from 1988 to 2003. As for the route through which the import of manufacturing products affects the productivities of Japanese industry, TFP effect and industry competition effect are examined.

The relationship among trade, productivity, and wage attracts our attention, regardless of economic situation. In Japan, where the economy is on the upturn after a decade of stubborn recession, some member of the Policy Board of the Bank of Japan propose the opinion that the strengthening "globalization" and the business "competiton" with foreign countries are the reasons why the real wage of Japanese workers doesn't increase despote the current economic upturn, repeatedly on Monetary Policy Meetings and various speeches and town meetings. This research sheds light on this topic by analyzing the effect of trade on wage through industries' productivity.

2 Production Function

Assume industry i's production function as Cobb-Douglas form with constant return to scale. Output of industry i, Y, is produced using labor L, capital K, and intermediate input M,

$$Y = A\left[F\left(L,K\right)\right]^{1-\gamma} M^{\gamma}, \qquad 0<\gamma<1$$

where A is a measure of Hicks-neutral technological progress. Totally differentiate this, and letting $\widehat{z} = dz/z$ denote the percentage change in any variable, we see that

$$\widehat{Y} = \widehat{A} + \left(1-\gamma\right)\frac{F_L L}{F}\widehat{L} + \left(1-\gamma\right)\frac{F_K K}{F}\widehat{K} + \gamma\widehat{M}$$

A net revenue of this industry at any point of time is

$$P\left(Y\right)Y\left(L,K,M\right) - wL - vI - mM$$

where $P(Y)$ is the price of the output, w is the wage, I is the investment, v is the price of investment good, and m is the price of intermediate input. The gross investment of this industry i has two components: net investment $K' \equiv dK/dt$ and replacement investment δK, where δ is the depreciation rate of K. Therefore, the net revenue of this industry can be written as

$$P\left(Y\right)Y\left(L,K,M\right) - wL - v\left(K' + \delta K\right) - mM$$

Applying the discount factor $e^{-\rho t}$, where ρ is a discount rate and t represents time, to this expression and summing over time, we can express the present-value net worth N of the industry as

$$N(L,K,M) = \int_0^{\infty}\left[P\left(Y\right)Y\left(L,K,M\right) - wL - v\left(K' + \delta K\right) - mM\right]e^{-\rho t}dt$$

In applying Euler equations, we have these optimal conditions:

$$\left(1-\gamma\right)\frac{F_L L}{F} = \left(\frac{\eta}{\eta-1}\right)\frac{wL}{PY} = \left(\frac{\eta}{\eta-1}\right)\theta_L$$

$$\gamma = \left(\frac{\eta}{\eta-1}\right)\frac{mM}{PY} = \left(\frac{\eta}{\eta-1}\right)\theta_M$$

$$\left(1-\gamma\right)\frac{F_K K}{F} = \left(\frac{\eta}{\eta-1}\right)\frac{vK\left(\delta+\rho\right)}{PY} = \left(\frac{\eta}{\eta-1}\right)\theta_K$$

where $\eta = -\frac{\partial Y}{\partial P}\frac{P}{Y}$ is the (positive) elasticity of demand. Submitting these conditions into $\widehat{Y}$ equation, and using the notation $\widehat{input} = \theta_L\widehat{L} + \theta_K\widehat{K} + \theta_M\widehat{M}$,

$$\widehat{Y} = \widehat{A} + \left(\frac{\eta}{\eta-1}\right)\left(\theta_L\widehat{L} + \theta_K\widehat{K} + \theta_M\widehat{M}\right)\widehat{input}$$

Output of this industry Y is sold to domestic market by the amount Y^D and to foreign market by the amount Y^F, and each market has different elasticity of demand, η^D and η^F. Also, we assume that import of goods strengthens domestic market's competition. In addition, to measure the possibility that A might be affected by import of this industry, we assume $\widehat{A} = \alpha_1 \frac{\widehat{M}}{Y} + \alpha_2 \frac{\widehat{E}}{Y}$. Then, we have

$$\widehat{Y} = \alpha_1 \frac{\widehat{M}}{Y} + \alpha_2 \frac{\widehat{E}}{Y} + \left[\left(\frac{\overline{\eta^D}}{\overline{\eta^D} - 1} - \gamma \frac{M}{Y} \right) \left(\frac{Y^D}{Y} \right) + \left(\frac{\overline{\eta^F}}{\overline{\eta^F} - 1} \right) \left(\frac{Y^F}{Y} \right) \right] \widehat{input}$$

This is the basic equation to estimate.

3 Estimation Resutls

3.1 Main Data Sources and Classification

Japanese manufacturing data: Houjin Kigyou Toukei Chousa (the Business Survey of Incorporated Enterprises), the Ministry of Finance, http://www.mof.go.jp/1c002.htm (Japanese). There are 22 manufactruing industries surveyed: Agriculture, Forestry, Fishery, Mining, Food, Textile, Clothes, Wood Products, Paper and Paper Pulp, Publishing, Chemical, Petroleum Products, Ceramics, Steel, Nonferrous Metal, Metal Goods, General Machinery, Electric Machinery, Transport Equipment, Precision Machinery, Vessels, Other Manufacturing. Each industry has four groups of firms in respect of capital: companies capitalized below 50 million yen, between 50 to 100 million yen, between 100 to 1,000 million yen, and more thatn 1,000 million yen.

Japanese trade data: Zaimusyou Boueki Toukei (Trade Statistics of Japan), http://www.customs.go.jp/toukei/index.htm (Japanese). Import and export items are classified into 22 manufacturing categories above.

Period: 1988-2003.

3.2 Results

Estimation results, OLS, with industry, year, and capital group dummies. (Estimated coefficient of each dummies are not reported).

$$\widehat{Y} = -.023 \frac{\widehat{M}}{Y} + .045 \frac{\widehat{E}}{Y} + \left[\left(1.033 - .009 \frac{M}{Y} \right) \frac{Y^D}{Y} + 1.088 \frac{Y^F}{Y} \right] \widehat{input}$$

$$(.028) \qquad (.048) \qquad\qquad (.006) \qquad (.016) \qquad\qquad (.027)$$

Number of Obs = 1300, adjusted R-squared = .987, standard errors are in parentheses.

Estimeted coefficient of $\frac{Y^D}{Y}\widehat{input}$ and $\frac{Y^F}{Y}\widehat{input}$ are both statistically significant and close to one, which means that Japanese manufactuirng industries are facing fairly competitive markets. The coefficient of $\frac{M}{Y}\frac{Y^D}{Y}\widehat{input}$ represents the competitive effect of import, and it is statistically insignificant. The coefficients of $\frac{\widehat{M}}{Y}$ and $\frac{\widehat{E}}{Y}$, the TFP effect of import and export, are also not statistically different from zero. From these results, we can conclude that the change of manufacturing trade has little, statistically insignificant effect on the productivities of Japanese industries in the period 1988-2003. The effect of trade on real wage through productivities are not observed.