The Impact of Import Competition on Japanese Manufacturing Employment

Eiichi Tomiura[*]

Research Institute for Economics and Business Administration, Kobe University,
2-1 Rokko-dai, Kobe City, 657-8501, Japan

E-mail: tomiura@rieb.kobe-u.ac.jp

Revised: November 3, 2001
January 15, 2001

[*] Correspondence: tomiura@rieb.kobe-u.ac.jp (e-mail), +81-78-803-7008 (phone), +81-78-803-7059 (fax). Valuable comments from two anonymous referees are appreciated. I thank participants at Kansai Labor Economics Seminar, especially Takenori Inoki, Jun-ichi Goto, Naoki Mitani, and Fumio Ohtake for helpful comments. The financial support by the Grant-in-Aid for Scientific Research C No.13630056 is acknowledged. All remaining errors are mine.

The Impact of Import Competition on Japanese Manufacturing Employment

Although previous studies of the effect of imports on Japanese employment relied on relatively aggregate data, the variability among industries is substantial within each two-digit sector. This paper exploits recently available longitudinal data of 390 manufacturing industries and controls for industry-specific factors at the four-digit level. This paper finds the significant impact of import price changes on Japanese employment. The estimates suggest that substantial share of average employment decline can be accounted for by the intensified import competition and that the employment sensitivity increases with industry import share, especially in the yen appreciating recession years.

Journal of Economic Literature Classification Numbers: F14, F41.

I. INTRODUCTION

The intensified import competition must have non-negligible impact on many decision variables of domestic firms in increasingly globalized economies. Among the variables of concern, employment is one of the most serious indicators for households and policy makers. Despite the attention to the possibility of deindustrialization in Japan, there has been very little formal research for the effect of foreign trade on Japanese employment. When we limit our scope to papers in international academic journals published during the last decade, Dekle (1998), Rebick (1999) and Tachibanaki et al. (1998) are almost the sole contribution to this issue.[1] On the other hand, various studies,

[1] Even if we expand our scope to earlier literature on this issue, we can think of no directly relevant papers other than Higuchi (1989) and Brunello (1990). Several authors are interested in the effect of foreign direct investment on employment or the effect of imports on wages in Japan. On the other hand, Burgess and Knetter (1998) accomplish

including Revenga (1992), since Branson and Love (1988), have accumulated for the U.S. case to meet the challenges posed by the appreciating dollar and high unemployment in the 1980s. One of the reasons for this lack of analyses of Japanese experience may have been the relative stability of employment once assured by the Japanese traditional long-term employment practice, but the unemployment has now become a serious economic problem in Japan. Hence, the direct investigation of impact of international competition on Japanese employment is required to respond to the needs both in academia and in policy circles.

Previous studies of Japanese employment and imports, however, have been limited to those using relatively aggregate data, although they succeeded in revealing important regularities. Dekle (1998) found, by estimating the labor demand function, that yen fluctuations have a sizable impact on Japanese employment. By decomposing Japanese demand into components, Rebick (1999) detected that employment changes of men are strongly related with export growth but import share changes have no noticeable effect on employment changes. Tachibanaki et al. (1998) reported, based on cross-section regressions of Japanese industries, that the relation between employment and imports has generally been weak while the imports from China could have a strong effect on wages. All these findings are very informative, carefully based on analytically elaborated methods and produced critical implications, but, at the same time, are unfortunately constrained by the limitation of Japanese import data concorded to a domestic industry basis. All previous empirical work on Japanese employment and trade, as far as the author knows, relied on broadly defined two-digit data.[2] This contrasts

---

an international comparison of G-7 countries, including Japan, on employment response to exchange rates.

[2] For example, Rebick (1999) uses observation of 18 two-digit industries with five-year intervals. Tachibanaki et al. (1998) depend on two-digit data of 22 industries. The data

with studies of the U.S. case since they have already extensively employed four-digit data.

The level of data aggregation is beyond an issue of mere curiosity. As will be explained in this paper, substantial variability is actually observed across four-digit industries within the same two-digit sector in terms of import penetration and of employment growth in the case of Japanese manufacturing. For example, the import share of industries ranges widely from one-hundredth percent up to 98 percent in 1995 if industries are disaggregated into the four-digit level, while the variation is at most around thirty percent among two-digit sectors. Therefore, since the two-digit classification is obviously too broad for our purpose, we need to control for various industry-specific factors at more disaggregated level.

To meet such a requirement, this paper exploits recently available four-digit longitudinal data of 390 Japanese industries, based on the data concordance between import statistics and Japan's *Annual Survey of Manufacturers* (Kogyou Tokei, in Japanese) established by Tomiura and Uchida (2001).[3] The number of industries whose data are available, 390, is much larger than typical numbers in previous studies; i.e. around twenty. The impact of import competition on employment is examined by estimating the labor demand function in the open economy, as in Dekle (1998).[4] The sample period in the data set, 1988-1995, is quite information rich, as it covers both the

---

set of Dekle (1998) consists of 12 two-digit industries.

[3] Tomiura and Uchida (2001) describe the data set in detail and apply it to the preliminary study of gross job creation and destruction. Since their gross job flow data are available only twice in five years, this paper is the first attempt to use this concorded data to the analysis of longitudinal data with sufficient observations along the time dimension.

[4] As will be explained, we cannot choose the approach by Rebick (1999) due to the data constraint on the export side. The econometric models in Tachibanaki et al. (1998) are not suited in our optimization framework. On the other hand, the reduced-form estimation, as in Revenga (1992), is vulnerable to misspecifications of labor supply

boom years with relatively stable exchange rate and the recession years after the burst of real estate and stock bubble with yen appreciation.[5] To examine the possible asymmetry in employment response during these years, this paper splits the whole sample period into two sub-periods.

To preview our results, this paper confirms that Japanese employment is significantly responsive to import price changes even if industry-specific factors are controlled for at the four-digit level. Substantial share of average employment decline can be explained by the intensified import competition. This paper also finds that the employment sensitivity increases with industry import share. These principal findings are evident especially in the years of recession with yen appreciation after 1993.

The remainder of the paper is structured as follows. Section II explains the data concordance and documents the inter-industry variation at the four-digit level. Section III formalizes our econometric specifications. Section IV reports the empirical results. Finally, Section V concludes.

II. MATCHING IMPORT AND EMPLOYMENT DATA AT 4-DIGIT LEVEL

Whenever a researcher becomes interested in the impact of import on employment and wages, the matching of import data to labor data has always been a substantial problem because two statistics adopt different classification systems in many countries, including Japan and the U.S. Even if we trace import data back to nine-digit levels in the Harmonized System (HS) classification which identifies more than eight

---

function.

[5] The data before 1988 is not available because the import classification system was substantially changed in that year due to the adoption of the international harmonized system of tariff classification. The data for 1995 is the most recent one at the time of data concordance research.

thousand products, some products cannot be mapped to one particular domestic industry.[6]

The availability of matched data, however, sharply varies depending on the countries under investigation. For the U.S. case, a comprehensive data concordance has already been established at NBER by Feenstra (1996) and been extensively used by many researchers.[7] To evaluate the impact of import competition on Japanese employment or wages, on the other hand, each researcher must establish own concordance table from scratch. Hampered partly by the lack of import data concorded to a domestic industry classification, previous studies of Japanese data have been limited at two-digit sectors (Higuchi (1989), Brunello (1990), Burgess and Knetter (1998), Deckle (1998), Tachibanaki et al. (1998), Rebick (1999)), while U.S. industries have already been often explored at four-digit level (Revenga (1992), for example). As will be explained later, the two-digit level classification is too broad for studying the impact of import on employment since the degree of import penetration substantially varies among four-digit industries even within the same two-digit sector. Unless we trace back at least to four-digit level and control for industry-specific factors, we cannot exclude the possibility that the aggregation effects could contaminate the results previously obtained at two-digit Japanese data.

This paper employs the import and employment data matched by Tomiura and Uchida (2001), which is the most comprehensive data concordance to date for Japanese industries available at the four-digit level.[8] Since we believe the relation of

[6] For example, many industries are classified in domestic industry classification by their production/processing method, which is unknown for imports produced/processed outside of the country.
[7] The data set constructed by Feenstra (1996) contains U.S. import data with many classifications such as SIC, SITC, and HS.
[8] For detailed information on this data set, see Tomiura and Uchida (2001), where the

employment with international competition is a current serious concern, this paper is intended to be an early contribution to the investigation of Japanese employment and import, by using this recently available data. The number of industries of which the data are available in this data set, 390, is by far the larger than those examined previously, i.e. from eight to twenty-four. The data set is also informative in that it includes, instead of a sub-sample of, all manufacturing industries, excluding only non-tradables, although it covers only the import-side of the Japan's foreign trade.[9] Since the sample period of concorded data is from 1988 to 1995, we have a longitudinal data of 3120 observations (390 industries for 8 years). The use of this detailed data set must contribute immensely to an understanding of Japanese response of employment to import competition.

Before discussing formal models and estimations, brief overview of basic statistics will be useful. Table I summarizes the import share data classified by two-digit sectors. The import share kept rising in many sectors. What is most striking in Table I, however, is the tremendous heterogeneity across four-digit industries within each two-digit sector.[10] For example, in the electric machinery industry, the largest sector in Japan in terms of employment size, imported products reached in 1995 to occupy nearly eight percent of the domestic market. The variation within the sector, however, is substantial since there simultaneously exist an industry with import share exceeding twenty percent

---

import data classified according to the domestic industry classification and the complete listing of SIC codes of industries are available.

[9] Out of 562, all four-digit domestic industries, 72 industries are excluded as nontradables. The SIC codes for these industries are listed in Tomiura and Uchida (2001). Other 490 industries are aggregated into 390 industries, of which each of 334 industries has one-to-one direct correspondence in import statistics. Although necessary to complete the analysis of impact of international competition, we leave the study of export to future work since no data concordance tables are currently available at a comparably disaggregated level and we believe import effect can be examined separately from export effect.

[10] We also calculated the import share in terms of deflated real values, but the ratio barely differs from the nominal ratio.

(radio and television sets) and an industry with that less than one-tenth percent (traffic signal control equipment).[11] Besides, while the highest import share observed at the two-digit level is at most around thirty percent, the same table also shows that imports actually dominate some industries with import share exceeding ninety percent when we disaggregate industries into the four-digit level.

Figure 1 visualizes the impressive variability in import penetration across four-digit industries. The import shares of industries are distributed with a thin long tail. While the median is 4.6%, the unweighted mean of the import shares of these 390 industries in the middle year of our sample, 1991, is 10.7%. Since the impact of import competition on labor demand in each industry is likely to vary depending on the industry's exposure to imports, we cannot neglect thus considerable inter-industry variation.

Table II documents the basic descriptive statistics of related variables, including employment and wages. The employment expanded in the first sub-period (1988–92) by around one percent and declined by slightly less than three percent during the latter sub-period (1993–95) if we measure the changes as the unweighted average of employment growth rates in 390 industries. The observation of such a mild employment fluctuation, however, should be viewed rather as an artifact of aggregation. The employment in industries with their growth rates one standard deviation above mean increased by more than 26 percent during 1988–92, while industries whose employment change rates lied one standard deviation below average experienced employment shrinkage of nearly twenty percent during 1992–95. We must also note here that these drastic employment changes at four-digit industries are not necessarily transfers within the same two-digit sector, as employment shares of four-digit industries within two-digit

[11] The names and SIC codes of the four-digit industries with maximal and minimal

sector are quite stable in our sample period.[12]

Such a large variation in employment growth is a good illustration of substantial inter-industry heterogeneity in many variables. In sum, as the figures in the table do demonstrate such wide variability across industries during the same period, we must control for various industry-specific factors in investigating labor demand in industries. Since the difference between two-digit and four-digit should be viewed as a matter of degree, we do not intend to claim that the four-digit is the best aggregation level for our analytical purpose. All this paper aims to accomplish is to take account of industry-specific factors at as disaggregated level as possible.

III. MODEL AND SPECIFICATION

This section sets out a simple theoretical framework and discusses the methods for estimation. First, the supply-side of the industry i (i=1, 2, …, N) at time t (t=1, 2, …, T) can be summarized by the following standard cost function:

$$C_{it} = \phi_{it} w_{it}^{\gamma_1+1} c_{it}^{\gamma_2} Q_{it} \qquad (1)$$

,where *w, c,* and *Q* denote wage, non-labor input costs, and output quantity,

import penetration ratio are available upon request.

12 As changes in employment shares of four-digit industries within each two-digit sector are mostly less than one percent in our sample period, it is not necessarily true that labor adjustment across four-digit industries within the same two-digit sector is distinctly easier than adjustment across two-digit sectors at least in this case. Besides, transfers across industries are reported to be not rare even at two-digit level for some plants, while some plants keep their four-digit product mix for a long period of time. On the other hand, since plants are classified to a specific industry in statistics based on the product with highest share in their product mix, transfers across industries are more difficult to be traced in the case of multi-product plants. These issues, however, are worth independent future research, as they require plant-level micro data.

respectively.[13] The factor markets are assumed to be perfectly competitive. Other cost shifters are captured by ϕ. We naturally assume $0 < \gamma_1 + 1 < 1,\ 0 < \gamma_2 < 1$. By Shephard's lemma, the labor demand is derived, suppressing the subscripts, as following;

$$L = \frac{\partial C}{\partial w} = \phi(\gamma_1 + 1) w^{\gamma_1} c^{\gamma_2} Q . \tag{2}$$

Next, consider the demand-side of the industry by introducing the following standard demand function for the output:

$$Q_i = A\left(\frac{p_i}{ep_i^*}\right)^{-\theta} y^{\gamma_3} \tag{3}$$

,with p_i, p_i^*, y denoting the price of the i-th product which is supplied by the domestic industry, the price of imported i-th product, and domestic income, respectively.[14] All the variables except for the import price *p** are denominated in terms of home-country's currency (yen, in the case of Japan), while *p** is expressed in source-country's currency ($, say). The nominal exchange rate (¥/$, say) is referred to as *e*, while the relative price term in the bracket in (3) as a whole corresponds to the real exchange rate. We assume that the product produced in the home country is an

---

13 The possibility for firms to change their product is assumed away, following all the previous studies cited in this paper. Since the discussion in the previous section suggests that difference between two-digit and four-digit classifications is not a matter of kind, this assumption will not especially affect our principal results.

14 Although we omit formalizing the mechanism for import price determination, the import price is not assumed exogenous. This issue will be discussed at the end of this section.

imperfect substitute for the imported product.[15] Other factors shifting demand are expressed by the term *A*. Both θ and γ_3 are naturally assumed positive.

By plugging (3) into (2) and by replacing the endogenous own output price, we can derive the following labor demand function in the first-differenced logarithm form:

$$d \ln L = \delta_0 + \delta_1 d \ln w + \delta_2 d \ln c + \delta_3 d \ln y + \theta d \ln ep^* + \varepsilon \tag{4}$$

,where ε denotes the error term with usual properties. The coefficient on wage, δ_1, should be negative in the labor demand function. We expect the positive sign for the coefficient on the import price, θ, since the import price fall intensifies competition and thus reduces demand for labor in domestic industries. The estimate of the employment elasticity with respect to the import price, θ, is the main target of this paper. In addition to (4), this paper considers the case where the elasticity θ varies across industries positively with the industry's import share, *MS*, as follows:

$$\theta_i = \theta_0 + \theta_1 MS_i \, . \tag{5}$$

Naturally, we expect θ_1 as well as θ_0 be positive.

In estimating the above model, we will assign instrumental variables (IV) to the wage, to the import price and to the import share because these variables are often supposed to be endogenous. Unless wages are preset, for example, by labor union or by

[15] In evaluating the impact of imports on employment, this paper concentrates on the direct competition between final products which are substitutes. It is true that import penetration also affects employment through imported inputs into production. Analyzing these two effects within the same model, however, is empirically difficult because both are often highly correlated and difficult to distinguish without extensive dependence on input-output tables. Campa and Goldberg (2001) limited themselves to

government, wage and employment are generally determined simultaneously in the labor market. The import price, too, may not sometimes be exogenously given.[16] Although the import price is predetermined for a "small country," domestic demand shifts in a country with large home market may affect prices in the world market by altering the world demand for the product. The import price may also be influenced by domestic demand factors in the case of differentiated products specially designed to the importer country. As we analyze relatively large Japan's import at diversifying four-digit industries, these factors cannot be ignored. The import share should also be assumed endogenous because it is defined as the share of imports in domestic demand, both of which are supposed to be simultaneously determined. We will compare IV estimates with OLS estimates in the next section and discuss the appropriateness of the use of IV for these variables.

IV. EMPIRICAL RESULTS

The specification derived in the previous section is adapted to the following empirical counterpart, taking account of the availability of data and the fitness of the model:

$$\begin{aligned} d\ln L_{it} &= \alpha_i + \theta_0 d\ln P_{it}^m + \theta_1 MS_{it} d\ln P_{it}^m + \beta_0 d\ln w_{it} \\ &\quad + \beta_1 d\ln c_{it} + \beta_2 d\ln c_{i,t-1} + \lambda d\ln L_{i,t-1} + \varepsilon_{it} \end{aligned} \tag{6}$$

,where P^m denotes the import price in terms of domestic currency, yen. As in Revenga

---

the latter channel, although they distinguish two routes in their theoretical model.

16 The following two cases for treating the import price endogenous are adapted from Revenga (1992, p.260). We will, however, again in the next section, discuss the appropriateness of assigning IV to these variables.

(1992), the import price data employed here are actual transaction prices of importers derived from WPI statistics, instead of the unit value indices, which are vulnerable to composition changes, reported in custom clearance statistics.[17] In calculating the import share, *MS*, of every industry, this paper utilizes the data concordance by Tomiura and Uchida (2001). All other data are consistently drawn from *Annual Survey of Manufacturers*.[18] Price series are deflated.[19] Similarly in Dekle (1998), the lagged employment is introduced to capture the effect of employment adjustment costs. Also as in Dekle (1998), the income variable, *y*, is omitted since real GDP or time-specific dummy appears an incorrect proxy for business cycles in this context. As they are more disaggregated, industries are more widely diversified and the common factor shared by all industries is likely to be less important compared with industry-specific factors.[20] The industry-specific dummy variables are denoted by α_i. All the variables included in the regression (6) are industry-specific. To check the robustness of the results, this paper also estimates the alternative specification which includes import share terms interacted not only with import price but also with wage and non-labor input costs.[21] Let us turn

[17] The most closely corresponding category in WPI is assigned to each SIC industry. No imputation was used. The concordance table is available upon request by the author.

[18] The wage is defined as the real average wage calculated as the deflated total wage payment divided by the number of employees. The employment in this paper is measured in terms of the number of employees, not the total man-hours of work. Although it is due to the data limitation in *Annual Survey of Manufacturers*, this choice does not seems to affect the main conclusion of this paper since Rebick (1999) found that these two measures result in virtually the same estimates in his model of the trade impact on Japanese wage differentials. The material and energy expenses are used as the non-labor costs.

[19] The import price is deflated by aggregate domestic WPI, while the wage is deflated by aggregate CPI.

[20] While Dekle (1998) adds year-specific dummies to the similar specification at two-digit industries, even income factors may differ across industries if we examine them at disaggregate level. For example, future anticipated income streams, not current GDP, must significantly affect current demand for durables such as automobiles, but not for non-durables. Besides, we found that year-specific dummies turned out to be insignificant in our case.

[21] The import share is interacted with wage and non-labor costs, too, because the

next to the empirical results.

Table III presents the estimation results from (6).[22] In all six specifications reported here, the fixed-effect model (FE) is chosen as the Hausman specification test shows that the null hypothesis of the random effect orthogonal to the explanatory variables is rejected at any conventional confidence levels. The test statistics are reported in the table in the row headed by χ^2.

The sign of wage coefficient β_0 is estimated to be negative, as is appropriate in labor demand function, in all specifications using the instrumental variables (IV), (1) to (4) and (6). The OLS estimation treating wage as exogenous, reported in the column (5), on the other hand, yields a quite different, wrong result, which shows that the wage is positively related to labor demand. This finding of importance of instrumenting the wage variable confirms the previous result by Dekle (1998). The non-labor input cost factors are significant in all specifications. The lagged employment is also strongly significant, suggesting that labor adjustment costs in Japanese manufacturing are substantial. This observation of sluggish labor adjustment appears consistent with existing evidence on Japanese employment. All the coefficient estimates of these variables are relatively robust to specification changes across (1) to (4).

---

coefficients of these two variables in the original reduced form (4) are composites of structural parameters including θ. While it is indirect through relative price changes caused by domestic pricing responses, we should not neglect this route of import share effect. I appreciate the comment by a referee in pointing out this issue. Dekle (1998) includes these additional interactive terms in the similar model, but finds that they are insignificant. See Appendix Table for estimation results.

[22] The instruments for the wage variable are own one-period lag, current and one-period lagged non-labor cost, and current and one-period lagged alternative wages. We choose wages in service sector and in construction sector as the alternative wages. The data for these alternative wages are from Ministry of Labor Statistics. The instrumental variables assigned to the import price are own one-period lag, current and one-period lagged real effective exchange rate of the yen (Bank of Japan). The instruments for the import share interacted with the import price are own one-period lag, one-period lagged non-labor cost, and current and one-period lagged real GDP.

The coefficient on the import price, θ_0, is significantly positive in all cases except (6), where instruments are assigned only to wage and import share. The finding of the significant employment sensitivity to imports contrasts with the results from some previous studies (Brunello (1990), for example), but confirms that from Dekle (1998).[23] The comparison of IV columns, (1) to (4), with (5), where all the explanatory variables are treated as exogenous, indicates that this result is robust irrespective of the treatment of the import price variable.[24]

The import price interacted with the industry exposure to import, θ_1, is statistically significant in no IV specifications except for the column (6). On the other hand, as is reported in Appendix Table, in the alternative specification where we allow interaction of import share with wage and non-labor input costs as well as import price, the import share terms are significant.[25] We will discuss this significance problem later in this section.

All the regressions using IV to import share, (1) to (4) and (6), yield estimates with the correct positive sign for coefficient on import share, but the OLS regression (5)

---

[23] Burgess and Knetter (1998) conclude that Japanese employment is less responsive to the exchange rate changes in the cross-country comparison context. Tachibanaki et al. (1998) found that the total import impact on employment is small. Higuchi (1989) found that the yen appreciation exerts a restraining impact on Japanese wages only for senior/middle-aged workers. Rebick (1999) detected small effect of import share on employment and wage differentials in Japan.

[24] In all the IV columns (1) to (4) and in the OLS column (5), the estimated coefficients for import price are significant and virtually the same in magnitude. Even in the column (6), the industry-specific elasticity of employment to import price, inclusive of interactive terms, is not substantially altered. Consequently, although Hausman specification test does not significantly identify a strong simultaneity, to emphasize the consistency with discussions in the previous section, this paper chooses to report the results from regressions assigning IV to import price as well as wage and import share in what follows.

[25] The industry-specific coefficients on wage and on non-labor input costs, inclusive of interactive terms, are also estimated with the correct sign. The industry-specific elasticity of employment with respect to import price is estimated larger than those reported in Table III. Therefore, this alternative specification rather strengthens our conclusion.

ends up with the wrong negative sign. Hence, as in the case of wage, the use of IV seems appropriate for import share. The results from the Hausman specification test also statistically confirm a significant simultaneity.[26]

This paper further provides richer information by splitting the whole sample period based on the phase of business cycle. The impact of imports on employment may differ depending on the period, since our sample period of 1988-95 can be divided into the following two sub-periods: the earlier years of boom with the real estate and stock bubble during the relatively stable exchange rate and the later years of recession after the burst of the bubble and yen appreciation. The sharp contrast between these two sub-periods is obvious, for example, from the figures depicted in Table II. To control this difference within our sample period, we introduce the period dummy, *D*, which takes the value one until 1992 and zero after 1993, defined based on the sign of average employment change. The dummy is interacted with the import price as follows.

$$\begin{aligned} & d\ln L_{it} \\ & = \alpha_i + (\theta_0 + \eta_0 D) d\ln P_{it}^m + (\theta_1 + \eta_1 D) MS_{it}\, d\ln P_{it}^m \\ & \qquad + \beta_0 d\ln w_{it} + \beta_1 d\ln c_{it} + \beta_2 d\ln c_{i,t-1} + \lambda d\ln L_{i,t-1} + \varepsilon_{it} \end{aligned} \tag{7}$$

The estimation results with thus defined period dummy are reported in Table IV.[27] As were in the regressions without the dummy, instrumental variables are assigned and

---

26 The test is performed in the Hausman-Wu form (adding the fitted value to the original explanatory variables). The test statistics are available upon request. For the import price, see the discussion in the footnote 24.

27 The specification (7) focuses on the interaction with import price. Even if dummy is added into the constant term, however, the same results can be confirmed. See the column (11) of Table IV. Besides, we also estimated alternative specifications allowing the period dummy to interact with wage and non-labor costs as well as import price. The estimation of these alternative cases does not either substantially alter the principal results from the above specification (7).

FE model is used for estimating the panel data. The estimates of coefficients of explanatory variables not linked with the dummy appear basically robust to this modification.

All the coefficients, especially for the latter sub-period, are precisely estimated. What should be emphasized most in Table IV is the impressive contrast in the employment response across different sub-periods. First, as the coefficients with the period dummy and those without it are almost canceled out, both the import price and the interactive term with import share have virtually no impact on employment in the earlier sub-period, while they are significant for the latter sub-period in all cases reported in the table. Second, the introduction of the period dummy makes the interaction term with import share, which was insignificant in the previous estimation, now significant for the latter sub-period.

Since the sensitivity of employment to imports increases with the degree of exposure to imports in the industry, these estimates enable us to calculate the industry-specific employment elasticity. Evaluated at the average import share of 11.4%, the implied employment elasticity with respect to import price is around 0.71 for the latter sub-period, based on the estimate reported in the column (7). The same estimates also indicate that employment elasticity in an industry with a 27% import penetration ratio (one standard deviation above the mean) is larger than one, i.e. around 1.25. Consequently, by comparing the estimates shown in the two tables, we can interpret that the relatively low elasticity estimate without the period dummy, 0.1–0.2, is a composite of substantially higher elasticity in recent years and nearly zero response in earlier years.

The estimates of employment elasticity with respect to import price obtained in this paper are in a comparable range with previous results, for example, 0.4–1.7 by Dekle (1998) from a similar model at the Japanese two-digit level.[28] Yet none of the differences in estimated values should be exaggerated. Considering differences in data employed in each research, we should emphasize that the principal conclusion revealing significant impact of imports on employment is shared.[29] In other words, this paper has confirmed that, in spite of substantial heterogeneity across four-digit industries within each two-digit sector, previous estimate from two-digit data is robust even if industries are disaggregated into four-digit level as long as we control for industry-specific factors.

As for the import share, we find that the employment elasticity increases significantly with the industry import share during the latter sub-period, but the existing evidence on the relation with import share has been mixed. For example, Campa and Goldberg (2001) and Dekle (1998) reported no significant effect of import share on employment sensitivity for the U.S. and for Japan, respectively.[30] On the other hand, Revenga (1992) found that the responsiveness of U.S. employment to import price changes varies positively with the degree of import penetration in the industry. Although far from the decisive argument, the level of aggregation seems to affect these

---

[28] Branson and Love (1988) reported employment elasticity for each 2-digit U.S. industry from nearly zero to about 0.65. Campa and Goldberg (2001) concluded that a ten percent permanent dollar appreciation reduces overtime employment by around 0.3 percent, based on 2-digit U.S. data. Revenga (1992) found the U.S. elasticity estimate of 0.1–0.4 for the pooled 38 four-digit industries.

[29] If there exist active employment transfers across four-digit industries within two-digit sector, we expect lower estimate of employment elasticity at more aggregate levels. The higher estimate by Dekle (1998) at two-digit level seems at odd with this prediction, but, as was already reported, the employment share of four-digit industries within each two-digit sector is actually stable in our sample period. Thus, the interpretation attributing the difference in estimates to the difference in aggregation levels does not work here. Alternatively, one might possibly explain the gap by different data used for real import price series. Dekle (1998) constructed it from weighted-average of foreign prices, while we derived it from WPI.

[30] Rebick (1999) also reported that import share changes have no significant effect on

results because Campa and Goldberg (2001) and Dekle (1998) depend on two-digit data while Revenga (1992) and this paper utilize four-digit data.[31] This linkage is plausible since inter-industry heterogeneity among four-digit industries within each two-digit sector is substantial in terms of import share, as was reported in Table I. In other words, the use of disaggregated import share data in this paper must have helped us uncover the relation between employment sensitivity and the industry import share, often obscured in two-digit data, where widely diversified import shares of different industries are aggregated. Although this interpretation seems convincing, on the other hand, we should not view it as conclusive because, even in our estimation, the import share term was insignificant without the introduction of the period dummy. The strongly positive relationship of employment response with the import share in each industry at least confirms, in our context, that the simultaneous observation of employment decrease and falling import prices during the same period is not a mere superficial coincidence.

The estimated magnitude of employment elasticity cannot be neglected also in comparison with average employment fluctuation in whole manufacturing in Japan. The estimates in Table IV indicate that import price fall of around three percent, observed during 1992-95, must have reduced labor demand by more than two percent, evaluated at the mean and held other factors constant. Since the actual employment decrease is less than three percent in terms of the average of 390 industries, substantial share of average employment decline can be accounted for by the intensified import competition

employment changes in Japan, but his conclusion is based on a different approach.

[31] Dekle (1998) refers to Japanese regulation and long-term employment practices as the causes isolating the employment adjustment from industry's exposure to imports. We tried the regressions directly including the dummy for regulated industry, but they perform poorly.

during the latter sub-period.

Thus, this paper reveals the substantial impact of competitive pressure from imports on Japanese employment, especially amid the yen-appreciating recession years after the burst of the bubble. Should we interpret it as implying that Japanese employment is more responsive to declining import prices during recessions compared with to import price hikes during booms? If so, our result may contradict with optimization under sunk costs of firing because employment must be less responsive to negative shocks. The observed asymmetry, however, could be reasonable, for example, if import price falls in the latter sub-period are perceived as more permanent compared with transitory import price rises in the earlier sub-period. Interpreting import price rises during those yen-depreciated years as temporary seems plausible because the yen exchange rate generally follows the appreciating trend. Since it requires us to explicitly formalize the dynamics of labor demand, however, the exploration of exact causes of this asymmetry is beyond the scope of this paper and should be left for future research.

V. CONCLUDING REMARKS

The impact of imports on labor demand in Japan has been investigated. A brief overview of basic statistics clearly indicates the needs to take account of the considerable variability among industries when we evaluate the employment response to imports.

Consequently, we have exploited the recently available data of 390 manufacturing industries. This paper has confirmed that previous results from two-digit data are basically robust even if we control for industry-specific factors at the four-digit level. Besides, the use of disaggregated data has helped us detect that the employment sensitivity varies positively depending on the industry exposure to import.

REFERENCES

Branson, William H. and Love, James P. (1988), U.S. manufacturing and the real exchange rate, *in* “Misalignment of Exchange Rates: Effects on Trade and Industry” (R.C. Marston, Ed.), pp.241-275.

Brunello, Giorgio (1990), Real exchange rate variability and Japanese industrial employment, *J. Japan. Int. Econ.* **4**, 121-138.

Burgess, Simon M. and Knetter, Michael (1998), An international comparison of employment adjustment to exchange rate fluctuations, *Rev. Int. Econ.* **6**(1), 151-163.

Campa, Jose Manuel and Goldberg, Linda S. (2001), Employment versus wage adjustment and the U.S. dollar, *Rev. Econ. Statist.* **83**, 477-489.

Dekle, Robert (1998), The yen and Japanese manufacturing employment, *J. Int. Money Finance* **17**, 785-801.

Feenstra, Robert C. (1996), “U.S. imports, 1972-1994: Data and concordances,” NBER Working Paper 5515.

Higuchi, Yoshio (1989), Japan’s changing wage structure: The impact of internal factors and international competition, *J. Japan. Int. Econ.* **3**, 480-499.

Rebick, Marcus E. (1999), Trade and the wage structure in the presence of price differentials in the product market: The Japanese labor market 1965-1990, *J. Japan. Int. Econ.* **13**, 22-43.

Revenga, Ana L. (1992), Exporting jobs? The impact of import competition on employment and wages in U.S. manufacturing, *Quart. J. Econ.* **107**, 255-284.

Tachibanaki, Toshiaki, Morikawa, Masayuki, and Nishimura, Taro (1998), Economic development in Asian countries, and the effect of trade in Asia on employment and wages in Japan, *Asian Econ. J.* **12**(2), 123-151.

Tomiura, Eiichi and Uchida, Yukio (2001), "The impact of import competition on gross job creation and destruction: A study based on Japanese import-industry data concordance," Discussion Paper #01-DOF-36, Research Institute of Economy, Trade and Industry.

TABLE I

IMPORT SHARE AND VARIABILITY WITHIN 2-DIGIT SECTOR

INDUSTRY	MS 1988	1991	1995	Within -sector St.Dev	MAX	MIN
ELECTRIC MACHINERY (30)	3.17	4.27	7.78	5.29	22.09	0.09
GENERAL MACHINERY (29)	2.57	2.95	3.44	3.02	13.62	0.09
FOOD MANUFACTURING (12)	9.07	11.12	11.56	11.60	36.58	0.08
TRANSPORT EQUIPMENT (31)	2.40	3.08	3.50	11.80	34.87	0.28
METAL PRODUCTS (28)	1.00	1.30	1.66	6.16	26.29	0.39
PRINTING & PUBLISHING (19)	0.51	0.57	0.65	1.08	2.06	0.01
PLASTIC PRODUCTS (22)	1.16	1.31	1.88	1.89	6.19	0.24
TEXTILE MILL PRODUCT (15)	12.01	15.01	24.70	20.07	78.63	6.61
CHEMICAL PRODUCTS (20)	7.88	8.17	8.42	16.31	91.58	0.82
APPAREL & OTHER FABRICS (14)	10.84	11.62	17.15	20.46	95.42	0.50
CERAMIC, STONE & CLAY (25)	2.29	2.82	2.88	11.04	57.56	0.10
PULP & PAPER (18)	5.13	4.35	5.45	22.81	83.24	0.01
IRON & STEEL (26)	3.95	3.97	3.92	10.78	31.99	0.04
LUMBER & WOOD PRODUCT (16)	12.19	15.32	18.93	22.60	72.08	0.05
MISCELLANEOUS MANUFACT. (34)	13.60	14.62	16.84	17.17	51.97	0.41
PRECISION INSTRUMENT (32)	7.19	9.25	14.60	20.28	97.90	0.21
FURNITURE & FIXTURES (17)	3.63	4.84	6.70	8.62	24.69	0.70
NONFERROUS METALS (27)	24.75	21.32	20.95	19.83	56.50	0.10
RUBBER PRODUCTS (23)	5.21	6.32	8.12	12.01	40.17	0.14
BEVERAGE & TABACCO (13)	3.01	4.72	4.68	19.00	60.40	0.04
LEATHR & FUR PRODUCT (24)	14.87	20.52	30.46	22.77	84.43	14.69
COAL & OIL PRODUCTS (21)	14.87	13.75	10.15	12.55	32.26	0.21
ORDNANCE (33)	14.00	9.58	7.34	-----	-----	-----

(NOTE) The import share (MS) is measured in percentage. The standard deviation, maximum and minimum are defined for import share across four-digit industries within each two-digit sector at 1995. The ordnance industry (33) is composed of only one four-digit industry (3311). The number in parentheses following the abbreviated industry name is the two-digit SIC code for corresponding industry. The industries are arrayed in descending order of the number of employees at 1995.

TABLE II

SUMMARY STATISTICS

	1988-92	1993-95
EMPLOYMENT AVERAGE	1.3442	–2.8125
St. DEV	24.7359	15.3695
MAX	397.0686	181.6488
MIN	–46.2277	–70.4602
REAL WAGE AVERAGE	2.1198	0.9444
St. DEV	4.7316	4.9321
MAX	31.1196	42.4596
MIN	–21.4884	–26.5324
NON-LABOR COSTS AVERAGE	–0.2058	–0.6383
St. DEV	6.1131	6.0000
MAX	37.3988	37.2249
MIN	–33.2886	–35.9442
REAL IMPORT PRICE AVERAGE	–0.8005	–3.2354
St. DEV	7.0867	6.8590
MAX	26.2283	29.8366
MIN	–25.3685	–21.9187
IMPORT SHARE AVERAGE	10.3987	11.4020
St. DEV	15.1508	15.4568
MAX	97.3937	96.2997
MIN	0.0013	0.0057

(NOTE) The import share is in absolute level (%), while all the other figures are percent change rates from the previous year. Each figure is expressed in terms of average, over the years during the period, of the cross-section unweighted average (standard deviation, maximum, or minimum) of 390 industries in each year.

TABLE III

ESTIMATION RESULTS (WHOLE PERIOD)

RHS variables/ Statistics	(1) IV	(2) IV	(3) IV	(4) IV	(5) OLS	(6)
$d\ln L_{t-1}$	–0.307 (0.022)	–0.316 (0.022)	–0.307 (0.022)	-----	–0.312 (0.021)	–0.308 (0.022)
$d\ln w_t$	–0.292 (0.173)	–0.238 (0.175)	–0.304 (0.173)	–0.090 (0.180)	0.402 (0.055)	–0.239 (0.169)
$d\ln P_t^m$	0.114 (0.083)	0.202 (0.082)	0.175 (0.065)	0.129 (0.086)	0.093 (0.041)	0.009 (0.035)
$MS_t d\ln P_t^m$	1.418 (1.198)	0.517 (1.166)	-----	0.841 (1.248)	–0.520 (0.177)	2.357 (0.990)
$d\ln c_t$	0.244 (0.043)	-----	0.250 (0.043)	0.322 (0.045)	0.243 (0.042)	0.242 (0.043)
$d\ln c_{t-1}$	0.311 (0.045)	-----	0.300 (0.044)	0.295 (0.047)	0.290 (0.044)	0.322 (0.045)
R^2	0.186	0.163	0.185	0.116	0.205	0.185
χ^2	36.981	37.105	36.771	4.0531	39.091	37.692

(NOTES)

1. The dependent variable is the first-differenced employment in the logarithm form ($d\ln L_t$) in all cases. The columns from (1) to (4) are the results from the regressions assigning IV to wage, import price and import share. The column (5) treats all explanatory variables as exogenous, while (6) assigns IV only to wage and import share. The figures in parentheses are the standard errors.
2. All the regressions use the fixed-effect (FE) model for the longitudinal data. χ^2 is the test statistics for the Hausman test of fixed-effect vs. random-effect models.

TABLE IV

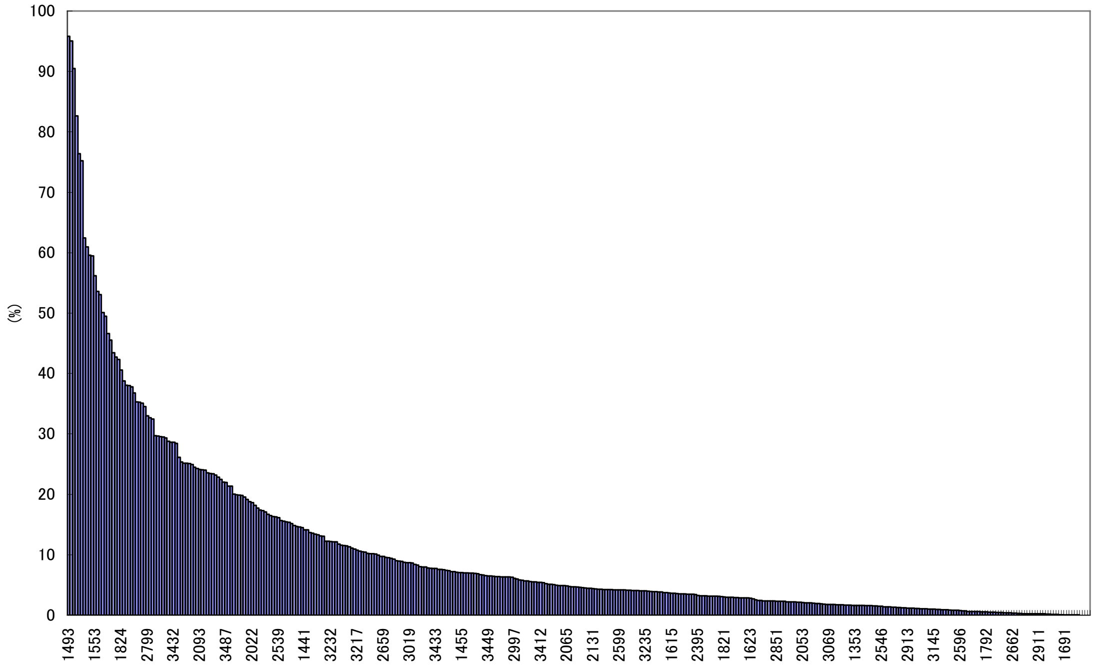
ESTIMATION RESULTS (WITH PERIOD DUMMY)

RHS variables/ Statistics	(7)	(8)	(9)	(10)	(11)
$d \ln L_{t-1}$	–0.319 (0.022)	–0.328 (0.022)	–0.314 (0.022)	–0.319 (0.022)	–0.323 (0.022)
$d \ln w_t$	–0.522 (0.179)	–0.512 (0.181)	–0.528 (0.179)	–0.400 (0.171)	–0.446 (0.182)
$d \ln P_t^m$	0.309 (0.134)	0.498 (0.132)	0.518 (0.099)	-----	0.709 (0.213)
$D_t * d \ln P_t^m$	–0.307 (0.134)	–0.446 (0.134)	–0.499 (0.109)	-----	–0.669 (0.201)
$MS_t d \ln P_t^m$	3.476 (1.603)	1.964 (1.566)	-----	5.766 (1.178)	2.746 (1.630)
$D_t * MS_t d \ln P_t^m$	–2.812 (1.169)	–2.113 (1.179)	-----	–4.447 (0.952)	–2.136 (1.201)
$d \ln c_t$	0.239 (0.043)	-----	0.240 (0.043)	0.242 (0.043)	0.235 (0.043)
$d \ln c_{t-1}$	0.296 (0.046)	-----	0.278 (0.044)	0.319 (0.044)	0.293 (0.045)
R^2	0.195	0.174	0.193	0.193	0.197
χ^2	37.818	37.909	37.288	39.742	41.085

(Note) The period dummy, *D*, takes one until 1992 and zero from 1993. The dummy is added into the constant term in the column (11). Each regression assigns IV to wage, import price and import share. The notes to Table III apply to this table.

FIGURE 1

IMPORT SHARE OF 4-DIGIT INDUSTRIES



(NOTE) Graphed is the import share measured in percentage in 1991. Industries are arrayed in descending order of import share. The numbers on horizontal axis are the SIC codes for several four-digit industries.

APPENDIX TABLE

RHS variables/ Statistics	(12)	(1)
$d \ln L_{t-1}$	−0.312 (0.021)	−0.307 (0.022)
$d \ln w_t$	0.202 (0.225)	−0.292 (0.173)
$MS_t d \ln w_t$	−4.233 (0.941)	-----
$d \ln P_t^m$	0.133 (0.090)	0.114 (0.083)
$MS_t d \ln P_t^m$	2.806 (1.446)	1.418 (1.198)
$d \ln c_t$	−0.812 (0.625)	0.244 (0.043)
$MS_t d \ln c_t$	4.203 (2.225)	-----
$d \ln c_{t-1}$	−0.001 (0.057)	0.311 (0.045)
$MS_t d \ln c_{t-1}$	2.072 (0.544)	-----
R^2	0.217	0.186
χ^2	50.044	36.981

(Note) The column (1) is reproduced from Table III for comparison. Each regression assigns IV to wage, import price and import share. The notes to Table III apply to this table.